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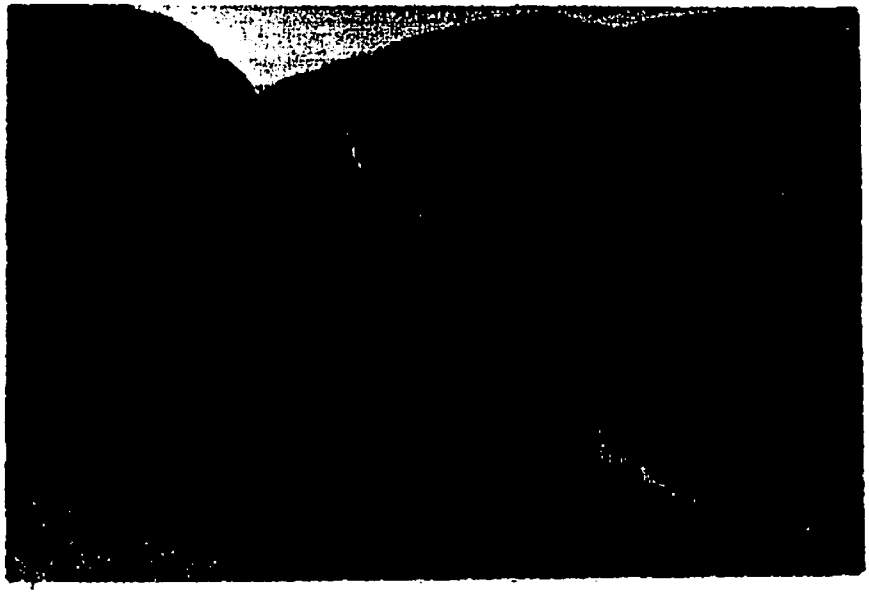
UNITED STATES DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE

ENVIRONMENTAL ASSESSMENT

TUOLUMNE RIVER FLOW SCHEDULE REVISION

(CANYON POWER PROJECT)



UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

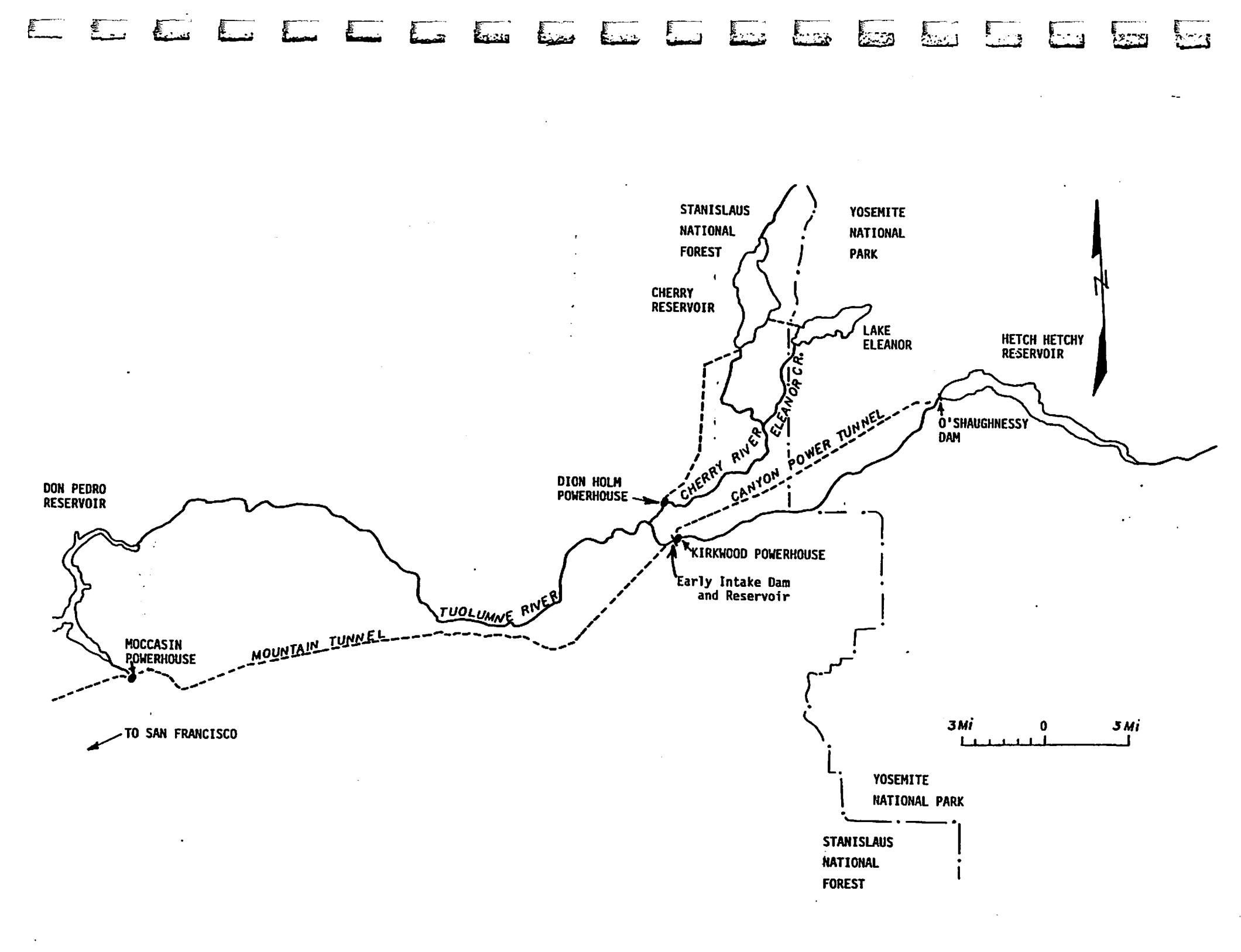
REGION I
PORTLAND, OREGON

TUOLUMNE RIVER
FLOW SCHEDULE REVISION
(CANYON POWER PROJECT)
CALIFORNIA

A Report By The U.S. Fish And Wildlife Service On The Proposed Modification Of Minimum Flow Requirements Below O'Shaughnessy Dam, Yosemite National Park, California, With Assistance From The National Park Service, The U.S. Forest Service, The U.S. Geological Survey, The Water and Power Resources Service And The California Department of Fish And Game

Approved: February 6, 1981

By: [signature]
FOR R. Kahler Martinson
Regional Director


STANISLAUS
NATIONAL
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RESERVOIR
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ELEANOR
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RESERVOIR
ELEANOR CR.
CHERRY RIVER
CANYON POWER TUNNEL
O'SHAUGHNESSY
DAM
DON PEDRO
RESERVOIR
DION HOLM
POWERHOUSE
KIRKWOOD POWERHOUSE
Early Intake Dam
and Reservoir
TUOLUMNE RIVER
MOCCASIN
POWERHOUSE
MOUNTAIN TUNNEL
TO SAN FRANCISCO
3Mi
0
3Mi
YOSEMITE
NATIONAL PARK
STANISLAUS
NATIONAL
FOREST

Summary

Conclusions Drawn from the Assessment Include:

(1) Implementation of the 75-200 cfs flow requirements as described in the Tuolumne River Flow Study Report (1976) and as proposed under the "recommended plan" (Alternative 1) of this assessment will not result in significant adverse impacts to the natural or human environments.

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Purpose and Need for the Action

On December 19, 1913, President Woodrow Wilson signed into law the Raker Act which granted to the City and County of San Francisco (hereinafter referred to as the Grantee or the City) certain rights to develop lands in Yosemite National Park and the Stanislaus National Forest for the purposes of water supply and power generation. During the ensuing 47 years, the Grantee constructed: (1) several water storage reservoirs (Hetch Hetchy on the Tuolumne River, Cherry Reservoir on Cherry River and Lake Eleanor on Eleanor Creek), (2) a water conveyance system extending from Hetch Hetchy Reservoir to the San Francisco Bay Area, (3) two major hydroelectric generation facilities (Moccasin Powerhouse which utilizes water from the Tuolumne River diverted at Early Intake and Dion Holm Powerhouse which derives its water from Cherry Reservoir and Eleanor Lake), and (4) other appurtenant facilities including access roads, transmission lines, and caretaker residences. This complex network of water and power facilities, known as the Hetch Hetchy Water and Power System, is operated by the San Francisco Public Utilities Commission.

By letter dated February 26, 1958, the Grantees applied for a change in location of their aqueduct right-of-way as described in Sacramento Serials No. 07187 (June 9, 1914) and No. 07259 (July 29, 1914) as provided

for under Section 2 of the Raker Act. Controversy immediately developed around the following two issues: (1) instream flow reservations for fish, wildlife, recreation and aesthetics, and (2) compliance with Section 5 of the Raker Act "...That the construction of the aforesaid works shall be prosecuted diligently, and no cessation of such construction shall continue for a period of three consecutive years...." In the event the Secretary of the Interior determines ..."that there has not been diligent prosecution of the work or some integral and essential part thereof, or that there has been a cessation of such construction for a period of three consecutive years, then he may declare forfeited all rights of the Grantee herein as to that part of the works not constructed...."

The Grantee, responded to the two issues by letter dated August 6, 1959 to the Director of the Bureau of Land Management. They argued that approval for construction of the Canyon Power Plant and connecting tunnel had already been granted and that it did not contain any stipulations requiring the release of water down the river channel. They therefore claimed that they should not be required to do so for a change in right-of-way (Appendix A). The City and County also maintained that, by virtue of their attempts to pass a bond issue on eight separate occasions between 1927 and 1941, they had proceeded diligently and that failure of the bond issue to pass should have been considered circumstances beyond

their control. The Grantees appealed to the Director, Bureau of Land Management, the decision made by the Land Office at Sacramento, California, which required them to execute certain stipulations as a condition of their right-of-way amendment. The Secretary of the Interior assumed direct jurisdiction over this appeal and, by April 27, 1961 letter, decided that the sport fishery and recreational interest could be protected and therefore the City and County's application should be granted, subject to certain conditions, including an interim flow requirement (Stipulation No. 6). The conditions also included the undertaking of a two-year fishery and recreation study to ascertain whether the interim flow schedule was adequate and if it were not, to determine necessary minimum flows (Appendices B and C). The question of diligence was raised by the Secretary but deferred because an acceptable compromise seemed possible. On May 3, 1961, the City and County of San Francisco agreed to the stipulations imposed for the relocation and amendment of their tunnel right-of-way (Appendix C).

Construction of the Canyon Power Project commenced and the project was completed in 1967. The Fish and Wildlife Service, U.S. Forest Service, National Park Service, and the California Department of Fish and Game conducted the interagency fishery and recreation study in 1968 and 1970, as provided for under Stipulation 6. The interagency group concluded from the study that the interim flow schedule was inadequate to protect the fishery and recreational interests and recommended a revised schedule

for minimum flows and several related measures. The conclusions and recommendations are presented in the Fish and Wildlife Service's Report, "Tuolumne River Flow Study-Canyon Power Project" (Appendix D). The Grantee formally objected to the recommendations set forth in the report and requested that a hearing be held, claiming that the flow study recommendations were "excessive and unjustifiable" and if implemented would cause undue hardship upon the City's domestic water supply and power generation potential (Appendix E). The Grantee also stated in the above letter that the components of the Canyon and Moccasin Power Projects were sized based on the water volume specified in the interim water release schedule. In an October 6, 1976 letter to Mr. O.L. Moore (General Manager, Hetch-Hetchy Water and Power), the Assistant Secretary for Fish and Wildlife and Parks granted the City's request for a hearing (Appendix F).

The counsel for the Turlock and Modesto Irrigation Districts indicated he will request a delay in the hearing until an Environmental Impact Statement is prepared. The reason the District is involved is that they purchase surplus power from the Hetch Hetchy System at rates below that charged by other suppliers. The Grantee has indicated that it wishes to be a party to the request (See Appendix G for details). However, the Supreme Court on May 27, 1980, ruled that the San Francisco Public Utilities Commission is within its legal rights to sell their surplus power at comparable rates charged by commercial suppliers, with the

exception of power for agricultural purposes. Because of the dual rates, it is unknown whether TID and MID would still wish to be included as a party of the request.

Alternatives Including the Proposed Action

Alternative 1 (Recommended Flow Schedule)

The flow regime under this alternative was formulated based on conclusions drawn from the fishery studies (Appendices D, H, I) and from the recreation recommendations provided by the U.S. Forest Service and the National Park Service.

Period	Flow in cfs
January 1 - April 30	75
May 1 - June 30	200
July 1 - September 30	150
October 1 - December 31	75

Alternative 2

The flow regime under this alternative calls for the return to the streamflow conditions that followed the construction of O'Shaughnessy Dam and Hetch Hetchy Reservoir (1923) but preceded the completion of the Canyon Power Project (1967).

During the 44-year period (1923-1967), the river channel was used to convey water between Hetch Hetchy Reservoir and the Mountain Diversion Tunnel which resulted in a relatively high, stabilized flow. Under this alternative, the river channel would again be used and the flow regime woud be expected to be similar to that of the 1923 to 1967 period. The mean monthly and 25th percentile flows are presented in Table 1.

Alternative 3 (Interim Flow Schedule)

The "interim" flow schedule called for by the 1961 Agreement has been in effect since 1967 and would be adopted as the Canyon Power Project's minimum flow requirements. The release of water for the

TABLE 1.

	Mean Monthly (cfs)	25th Percentile* (cfs)
January	707	511
February	639	449
March	681	486
April	722	601
May	1,050	711
June	2,811	1,031
July	1,131	782
August	734	628
September	727	612
October	728	642
November	726	597
December	703	594

*Flow equal to or exceeded 75% of the time.

maintenance of fisheries, recreation, and esthetics would be according to the schedule below:

Period	Flow in cfs
January 1 - April 30	35
May 1 - September 15	75
September 16 - December 31	35

Alternative 4

A minimum flow of 211 cubic feet per second would be released from O'Shaughnessy Dam under this alternative. Although this quantity is presumed to be less than the optimal flow for fishery, recreation and aesthetic values, it is the highest flow at which fishery habitat measurements were taken.

Alternative 5

Streamflow releases under this alternative would be determined by the availability of precipitation and runoff. During "normal" periods (about a 60% occurrence) the minimum flows would be identical to that of the recommended plan. Streamflow releases would be reduced to schedules B and C in "moderate" (20%) and critical (20%) periods.

This alternative was developed to accommodate San Francisco's water (ultimate diversion) and power needs during "below normal" water years. Alternative 5 is similar to San Francisco's suggested plan (Alternative 7) except that the minimum flow releases made would be greater and that the precipitation-runoff criteria is not as heavily weighted toward deficient periods.

Decisions would be made on a monthly basis using the following criteria and criteria presented in Table 2:

Definition: Cumulative precipitation = Total precipitation measured at O'Shaughnessy Dam during the period Oct. 1 to the first of each month.

Cumulative runoff = Total inflow measured at Hetch Hetchy Reservoir during the period Oct. 1 to the first of each month. For the months, Oct., Nov. and Dec., the period commences on Oct. 1 of the previous water year.

Decision criteria for the period, January 1 to June 30:

1. If cumulative precip. < column C precip., use col. C flow schedule
2. If col. B precip. ≤ cum. precip. < col. A precip., use col. B flow schedu
3. If cumulative precip. ≥ col. A precip., use col. A flow schedule

Decision criteria for the period, July 1 to December 31:

1. If cumulative inflow < column C inflow, use col. C flow schedule
2. If col. B inflow ≤ cum. inflow < col. A inflow, use col. B flow schedul
3. If cumulative inflow ≥ col. A inflow, use col. A flow schedule

Table 2

PERIOD	CUMULATIVE PRECIPITATION-RUNOFF (inches & 1000 AF)			FLOW SCHEDULE (cu. ft. per sec)		
	A	B	C	A	B	C
JANUARY 1-31	7.5	6.3	<6.3	75	50	40
FEBRUARY 1-28	11.7	10.1	<10.1	75	50	40
MARCH 1-31	17.8	14.7	<14.7	75	60	45
APRIL 1-15	20.3	18.8	<18.8	75	75	45
APRIL 16-30	20.3	18.8	<18.8	75	75	45
MAY 1-15	24.8	22.2	<22.2	200	90	75
MAY 16-31	24.8	22.2	<22.2	200	110	75
JUNE 1-30	25.6	23.1	<23.1	200	125	110
JULY 1-31	560	471	<471	150	125	110
AUGUST 1-31	635	485	<485	150	125	110
SEPTEMBER 1-15	635	485	<485	150	110	100
SEPTEMBER 16-31	635	485	<485	150	75	75
OCTOBER 1-31	635	485	<485	75	50	50
NOVEMBER 1-30	635	485	<485	75	50	40
DECEMBER 1-31	635	485	<485	75	50	40
FREQUENCY	60%	20%	20%			

Alternative 6

The Streamflow releases below O'Shaughnessy Dam under this alternative would be dependent on the availability of precipitation and runoff and would be nearly identical to those made under Alternative 5. Under certain "dry period" conditions, a varying quantity of the above release would be available for diversion to San Francisco at Early Intake Reservoir. However, Stipulation 3 of the 1965 Amendment of Rights-of-Way (Appendix J) prohibits the recapture of the fishery maintenance flow and would have to be amended. In return for the opportunity to recapture river water at Early Intake, the Grantee would be required to: (1) mix the Canyon Tunnel flow (55° F) with the warmer water of the river at Early Intake Reservoir, (2) if necessary, treat their water supply by filtration or by chemical means in lieu of prohibiting public usage of the Tuolumne River above Early Intake, and (3) provide a base flow release of 90 cfs from Holm Powerhouse to the Cherry River to stabilize and improve stream conditions in the Tuolumne and Cherry Rivers for fishery and recreational use.

Streamflow release decisions would be made on a monthly basis and in accordance with the following criteria (see Alternative 5 for definitions of cumulative precipitation and cumulative runoff):

Decision criteria for the period, January 1 to June 30:

1. If cumulative precip. < column C precip., use col. C flow schedule
2. If col. B precip. ≤ cum. precip. < col. A precip., use col. B flow schedule
3. If cumulative precip. ≥ col. A precip., use col. A flow schedule

Decision criteria for the period, July 1 to December 31:

1. If cumulative inflow < column C inflow, use col. C flow schedule
2. If col. B inflow ≤ cum. inflow < col. A inflow, use col. B flow schedule
3. If cumulative inflow ≥ col. A inflow, use col. A flow schedule

Table 3

PERIOD	CUMULATIVE PRECIPITATION-RUNOFF (inches & 1000 AF)			O'SHAUGHNESSY FLOW SCHEDULE (cu. ft. per sec)			EARLY INTAKE FLOW SCHEDULE (cu. ft. per sec)		
	A	B	C	A	B	C	A	B	C
JANUARY 1-31	7.5	6.3	<6.3	75	50	40	75	35	20
FEBRUARY 1-28	11.7	10.1	<10.1	75	50	40	75	35	20
MARCH 1-31	17.8	14.7	<14.7	75	60	45	75	35	20
APRIL 1-30	20.3	18.8	<18.8	75	75	45	75	35	20
MAY 1-31	24.8	22.2	<22.2	200	100	75	200	75	40
JUNE 1-30	25.6	23.1	<23.1	200	125	110	200	75	40
JULY 1-31	560	471	<471	150	125	110	150	75	40
AUGUST 1-31	635	485	<485	150	125	110	150	75	40
SEPTEMBER 1-31	635	485	<485	150	90	75	150	75	40
OCTOBER 1-31	635	485	<485	75	50	50	75	35	20
NOVEMBER 1-30	635	485	<485	75	50	42	75	35	20
DECEMBER 1-31	635	485	<485	75	50	40	75	35	20
FREQUENCY	60%	20%	20%						

Alternative 7

This alternative was developed by the City and County of San Francisco (transmitted with their January 23, 1973 letter - Appendix K) and incorporates alternative streamflow release schedules that are dependent on cumulative runoff and precipitation. The frequency of occurrence within a particular schedule also varies with time of year. The first part of the calendar year is weighted more heavily toward flow reductions, e.g., "normal" year releases (schedule A) would be made only 30% of the time in January but would increase to 44% in July. Frequency of occurrence for the other schedules during the same periods, respectively, are: 24% and 19%, schedule B; 30% and 22%, schedule C; 15% for both months, schedule D. The latter part of the year is weighted more heavily toward normal year releases. Streamflow release decisions would be made on a monthly basis using the following criteria (see Alternative 5 for definitions on cumulative precipitation and cumulative runoff):

Decision criteria for the period, January 1 to June 30:

1. If cumulative precip. < column D precip., use col. D flow schedule.
2. If col. D precip. ≤ cum. precip. < col. B precip., use col. C flow sche
3. If col. B precip. ≤ cum. precip. < col. A precip., use col. B flow schedu
4. If cumulative precip. ≥ col. A precip., use col. A flow schedule

Decision criteria for the period, July 1 to December 31:

1. If cumulative inflow < column D inflow, use col. D flow schedule
2. If col. D inflow ≤ cum. inflow < col. B inflow, use col. C flow schedul
3. If col. C inflow ≤ cum. inflow < col. A inflow, use col. B flow schedule
4. If cumulative inflow ≥ col. A inflow, use col. A flow schedule

Table 4

PERIOD	CUMULATIVE PRECIPITATION-RUNOFF (inches & 1000 AF)				FLOW SCHEDULE (cu. ft. per sec)			
	A	B	C	D	A	B	C	D
JANUARY 1-31	14.5	10.0	6.0	<6.0	75	50	35	25
FEBRUARY 1-28	19.0	15.0	10.0	<10.0	75	50	35	25
MARCH 1-31	25.5	18.7	14.2	<14.2	75	60	50	25
APRIL 1-15	29.5	23.0	18.5	<18.5	75	60	50	25
APRIL 16-30	29.5	23.0	18.5	<18.5	110	100	50	25
MAY 1-15	31.0	26.0	21.0	<21.0	150	125	75	50
MAY 16-31	31.0	26.0	21.0	<21.0	200	125	100	75
JUNE 1-30	32.3	27.0	21.7	<21.7	200	125	100	75
JULY 1-31	680	545	415	<415	150	125	100	75
AUGUST 1-31	720	580	440	<415	150	125	100	75
SEPTEMBER 1-15	720	580	440	<415	150	125	100	75
SEPTEMBER 16-31	720	580	440	<415	110	100	75	50
OCTOBER 1-31	720	580	440	<415	75	60	50	35
NOVEMBER 1-30	720	580	440	<415	75	50	35	25
DECEMBER 1-31	720	580	440	<415	75	50	35	25

Affected Environments

The natural environment most affected by implementation of the selected alternative (recommended schedule) is the 37-mile reach of the Tuolumne River from O'Shaughnessy Dam to Don Pedro Reservoir. Human environments within the service areas of Modesto and Turlock Irrigation Districts and the City and County of San Francisco would be directly affected by altered electrical energy supplies.

Natural Environment

The Tuolumne River from its source at the top of 13,000 foot high Mt. Lyell flows westward for 158 miles to join the San Joaquin River near sea level. This assessment is primarily concerned with a 37-mile long river stretch which, for the sake of clarity, is broken into two reaches. Reach 1 starts at the base of O'Shaughnessy Dam (Hetch Hetchy Reservoir) and continues downstream for 12 miles ending at Early Intake Dam and Reservoir. The upper 6 miles of this reach is located within Yosemite National Park; the lower portion is within the Stanislaus National Forest administered by the U.S. Forest Service. Reach 2 covers the 25 mile long stretch beginning at Early Intake Dam and ending at the upper end of Don Pedro Reservoir.

Reach 2 is almost entirely within the Stanislaus National Forest. The two river reaches differ greatly in flow regimes. Reach 1 is totally dependent on releases or spills from Hetch Hetchy Reservoir, having only insignificant flow augmentation from tributary and groundwater inflow. Reach 2, however, in addition to the flow from Reach 1, receives significant inflow from 5 tributary streams and major contributions from Dion Holm and Kirkwood Powerhouses.

The Tuolumne River (Reaches 1 and 2) flows along the bottom of a deep canyon which rises more than 1500 feet above the channel below. The topography of the canyon is highly variable, from the near vertical walls of the 2.5 mile long Tuolumne Gorge to the wide and flatter terrain of Poopenaut Valley. The river itself is a series of large pools separated by short riffles, cascades and falls. The gradient is high, with the river falling over 90 and 60 feet per mile in Reaches 1 and 2, respectively. The quickly changing river character, together with its rugged canyon setting, offers outstanding scenic qualities. In recognition of its outstanding natural values, the Tuolumne River between Hetch Hetchy and Don Pedro Reservoir was designated in 1970 (pursuant to Section 5(d) of the Wild and Scenic Rivers Act - P.L. 90-542) as a potential addition to the National Wild and Scenic Rivers System. The Act was amended in 1975 to include the Tuolumne River from Don Pedro Reservoir to its headwaters on the active study list (Section

5(a) (52) PL 93-621). The study was initiated in August, 1975 and a recommendation for wild and scenic status was submitted to Congress during October 1979. No action has yet been taken.

The fishery resources of the Tuolumne River in the 37 mile reach are significant. Rainbow and brown trout are the primary sport fish sought with western sucker, California roach and riffle sculpin as the major nongame species. The availability of both road and foot trail access provides opportunities for both the "casual" and the "wilderness" type fisherman. Angler success is considered to be better than average when compared with other California rivers.

Under the interim schedule, the fishery resource of Reach 1 has declined from pre-project levels. Several problem conditions, which presently restrict the trout population, could be eliminated or reduced. The flow regime in Reach 2 has not been significantly altered by the operation of the Canyon Power Project.

The major recreational uses of the Tuolumne River include fishing, camping, hiking and rafting (including kayaking). During the April-November periods of 1977, recreational use information was collected at the 5 main trailheads leading into Reach 1. About 2400 visitor days of use was recorded. Recreational use data was collected by the U.S. Forest Service during 1978 covering Reach 2 and is summarized as follows (in visitor days): (1) fishing 3,900, (2) camping 12,894, and (3) rafting and kayaking 10,390. Reach 2 is more heavily

used than Reach 1, in part due to its greater length, better vehicular access, suitability for rafting, and the much higher streamflow.

Human Environments

City and County of San Francisco

The City and County of San Francisco own and operate the Hetch Hetchy System which supplies a portion of the South Bay Area's water requirements. Power generation is used to satisfy energy requirements at municipal facilities, with surplus electricity sold principally to the Modesto and Turlock Irrigation Districts. Between 1971 and 1978, water deliveries from the Hetch Hetchy System ranged between 161,000 and 263,000 acre-feet (annual average 220,000 acre-feet). The maximum anticipated diversion of water from the Hetch Hetchy System to San Francisco is estimated at 448,000 acre-feet (440 mgd).

Power generation from Kirkwood Powerhouse varied from 243 thousand to 640 thousand megawatt-hours (MW-Hrs) with an annual average of 532 MW-Hrs; power generation from the entire Hetch Hetchy System ranged from 708 to 2,054 thousand MW-Hrs (annual average 1,700 thousand MW-Hrs).

Power generation would be most affected at Kirkwood Powerhouse (Canyon Power Project) by implementation of the proposed action. Water to be used for power generation at Kirkwood Powerhouse is stored in Hetch Hetchy Reservoir and delivered via Canyon Tunnel along the north side

of the Tuolumne River Channel. After passing through the Kirkwood Powerhouse generators, the water enters Mountain Tunnel via a river bypass conduit for delivery to Moccasin Powerhouse. Water for domestic and municipal use is conveyed from Moccasin Powerhouse to San Francisco through a series of tunnels and pipelines.

Power is also generated at Dion Holm Powerhouse which utilizes water from Lake Eleanor on Eleanor Creek and Cherry Reservoir on Cherry River. This facility is located on Cherry River about 1/2 mile above the confluence with the Tuolumne River. The Cherry River enters the Tuolumne about 14 miles downstream from Hetch Hetchy Reservoir. Water passing from Holm Powerhouse enters the Cherry River and thence the Tuolumne River where it flows uninterrupted until it reaches Don Pedro Reservoir.

Turlock and Modesto Irrigation Districts

The Turlock and Modesto Irrigation Districts are both located in Stanislaus County, and have been included in the "affected environment" section because they are the major purchasers of surplus power from the Hetch Hetchy System. Because of the provisions of the Raker Act pertaining to the sale of surplus power, the District's receive special rates. A reduction in surplus power would require them to purchase more power at less favorable rates from commercial suppliers.

Environmental Consequences

The major areas of concern that have been identified with regard to the alternatives under consideration are: (1) fishery resources, (2) recreational values, including aesthetics, (3) reduction of power generation and (4) impairment to the Grantee's ability to supply water to meet its domestic and municipal needs.

Consequence of the Alternatives on Fishery Resources

Following the "completion" of Hetch Hetchy Reservoir in 1923 and prior to the construction of the Canyon Power Project in 1967, the flow in the Tuolumne River (Reach 1) seldom dropped below 200 cubic feet per second. The lowest monthly flow for the 44 year period was about 640 cfs (February). However, once operation of the Canyon Power Project began, river flow was reduced to 35 cfs from fall to early spring and to 75 cfs from late spring through the summer. No studies were conducted prior to 1967 to use to compare the pre-project fishery with that which exists today. The loss of habitat and the resultant reduction in the fishery resource was undoubtably great.

TROUT HABITAT

35 CFS

75 CFS

150 CFS

TROUT HABITAT

35 CFS

75 CFS

150 CFS

In 1968 and 1970, stream transect measurements were taken at flows ranging between 35 and 211 cfs to determine the available habitat at each of the study flows. The Instream Flow Group's (Office of Biological Services) habitat model was used to analyze the transect data (velocity, depth and substrate measurements). The effect of flow on the availability of habitat for both rainbow and brown trout was analyzed for spawning, fry, juvenile and adult requirements (Figures 1 and 2). During 1968, 1970 and 1971, water temperature data were collected at each of the study flows to determine whether the water temperature at the interim minimum flows was satisfactory, and if not, the flows necessary to provide suitable temperatures. The results of the above studies indicate that: (1) within the 35-211 cfs range, available habitat generally increased as streamflow increased, (2) water temperatures in excess of the upper limits considered suitable for trout (68° F) occurred at the interim minimum flow (75 cfs, summer) and (3) a flow release of at least 125 cfs is necessary to provide suitable water temperatures (Appendix D).

A comparative study was undertaken in 1977 to determine what "long term" changes, if any, had occurred since 1970. The study showed declines of 24 percent and 14 percent in the numbers of "catchable size" (greater than 6.5" fork length) and "sub-catchable size" trout, respectively, during the period (Appendices H and I). It should be noted that the fishery resource, when assessed in 1970, had most likely already undergone a significant reduction (the river flow by this time had

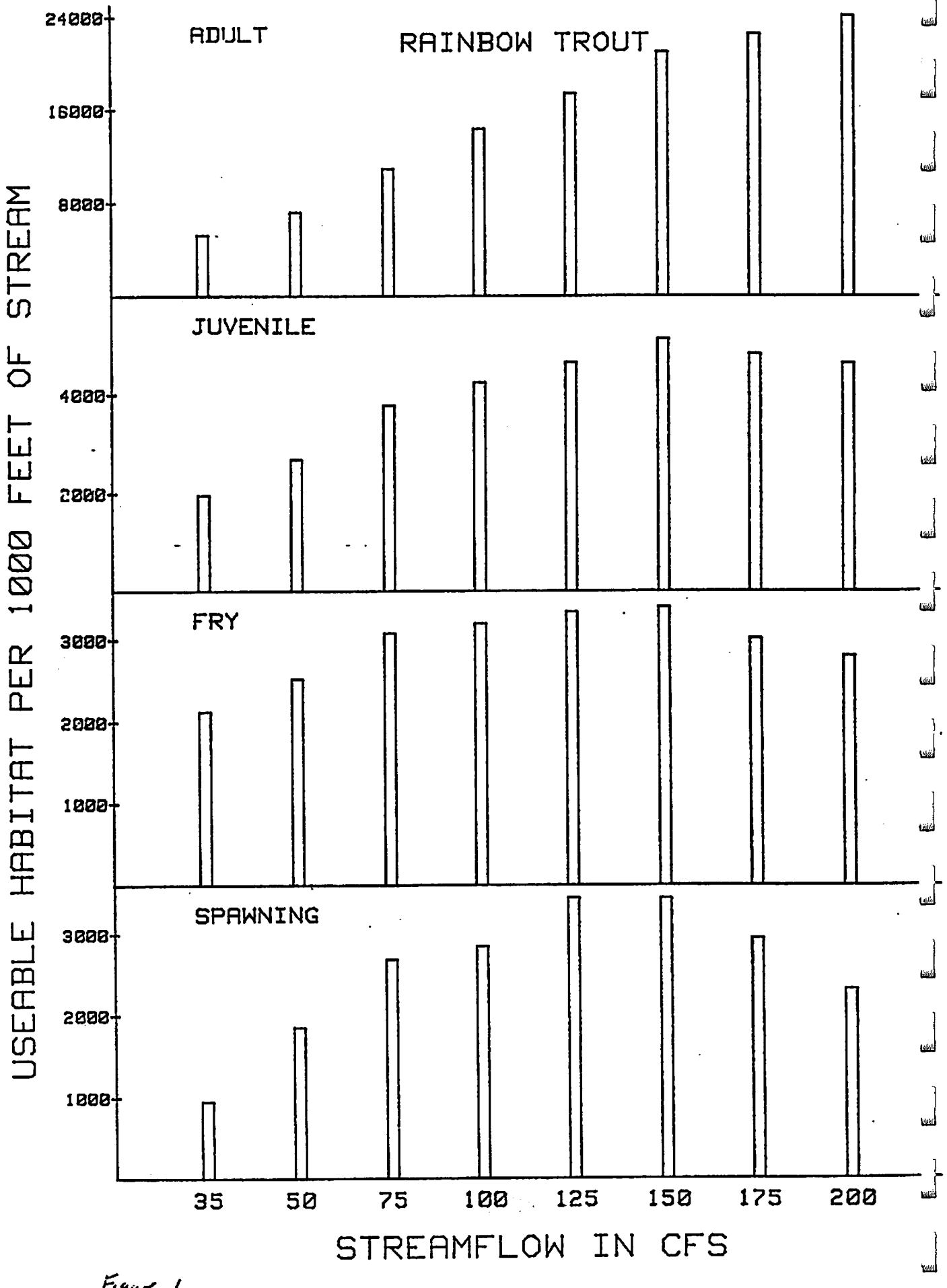

RAINBOW TROUT
ADULT
JUVENILE
FRY
SPAWNING
24000
16000
8000
4000
2000
3000
2000
1000
3000
2000
1000
USEABLE HABITAT PER 1000 FEET OF STREAM
35
50
75
100
125
150
175
200
STREAMFLOW IN CFS

Figure 1

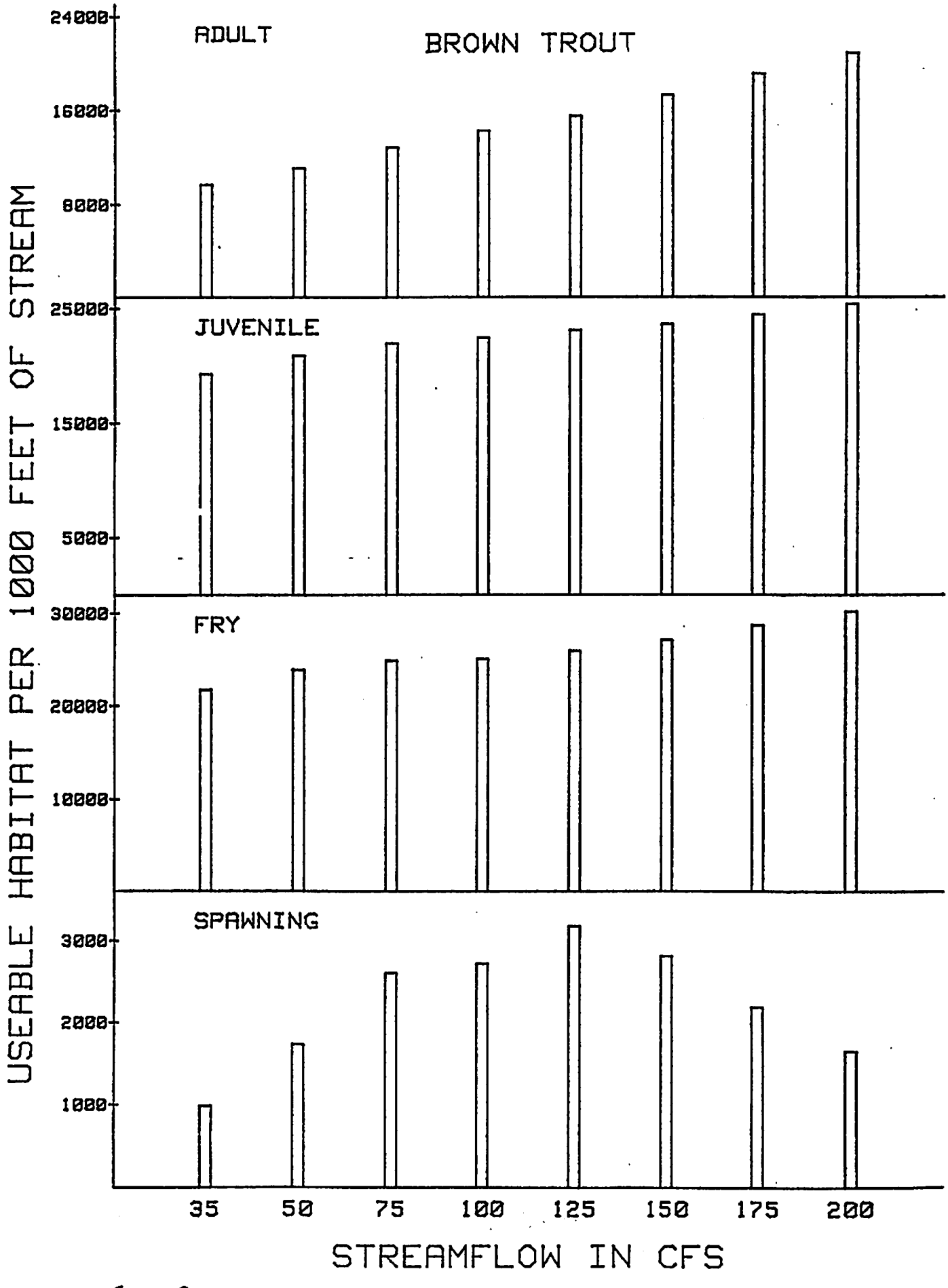

BROWN TROUT
ADULT
JUVENILE
FRY
SPAWNING
24000
16000
8000
25000
15000
5000
30000
20000
10000
3000
2000
1000
USEABLE HABITAT PER 1000 FEET OF STREAM
35
50
75
100
125
150
175
200
STREAMFLOW IN CFS

Figure 2

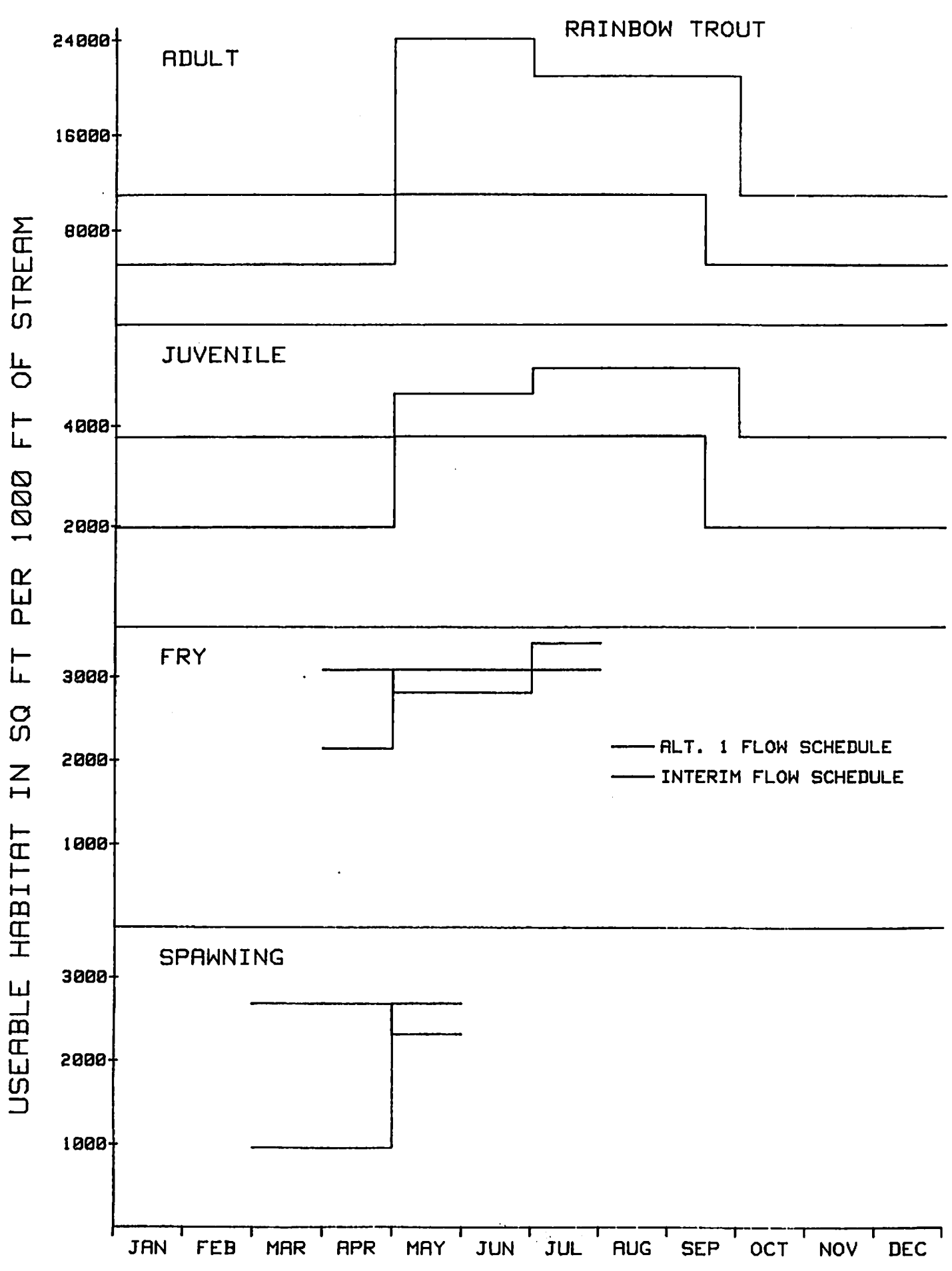
been reduced by over 90% for a period of about two years). The declines in numbers of trout were generally most severe at the lower three sampling stations where the higher water temperatures occur.

Alternative 1 (Recommended Flow Schedule)

Significant improvements to the fishery resource (when compared to the resource level that presently exists under the interim flow schedule) would result if the flow regime under this alternative is implemented. The amount of habitat that would be provided under this alternative and that which presently exists under the interim flow schedule is depicted in Figures 3 and 4. The analysis was based on water depth, water velocity and substrate, without consideration to water temperature.

The results from the temperature study indicated that streamflow of at least 125 cfs was necesary to provide suitable water temperatures (less than 68° F) for trout in Reach 1 (Appendix D). The recommended flow schedule would achieve this goal. The population studies conducted in 1970 and 1977 also support the above finding (Appendices H and I).

Refer to the Tuolumne River Flow Study report for greater detail on the study conclusions and subsequent recommendations (Appendix D).


RAINBOW TROUT
ADULT
JUVENILE
FRY
SPAWNING
24000
16000
8000
4000
2000
3000
2000
1000
3000
2000
1000
USEABLE HABITAT IN SQ FT PER 1000 FT OF STREAM
ALT. 1 FLOW SCHEDULE
INTERIM FLOW SCHEDULE
JAN
FEB
MAR
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JUN
JUL
AUG
SEP
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NOV
DEC

Figure 3

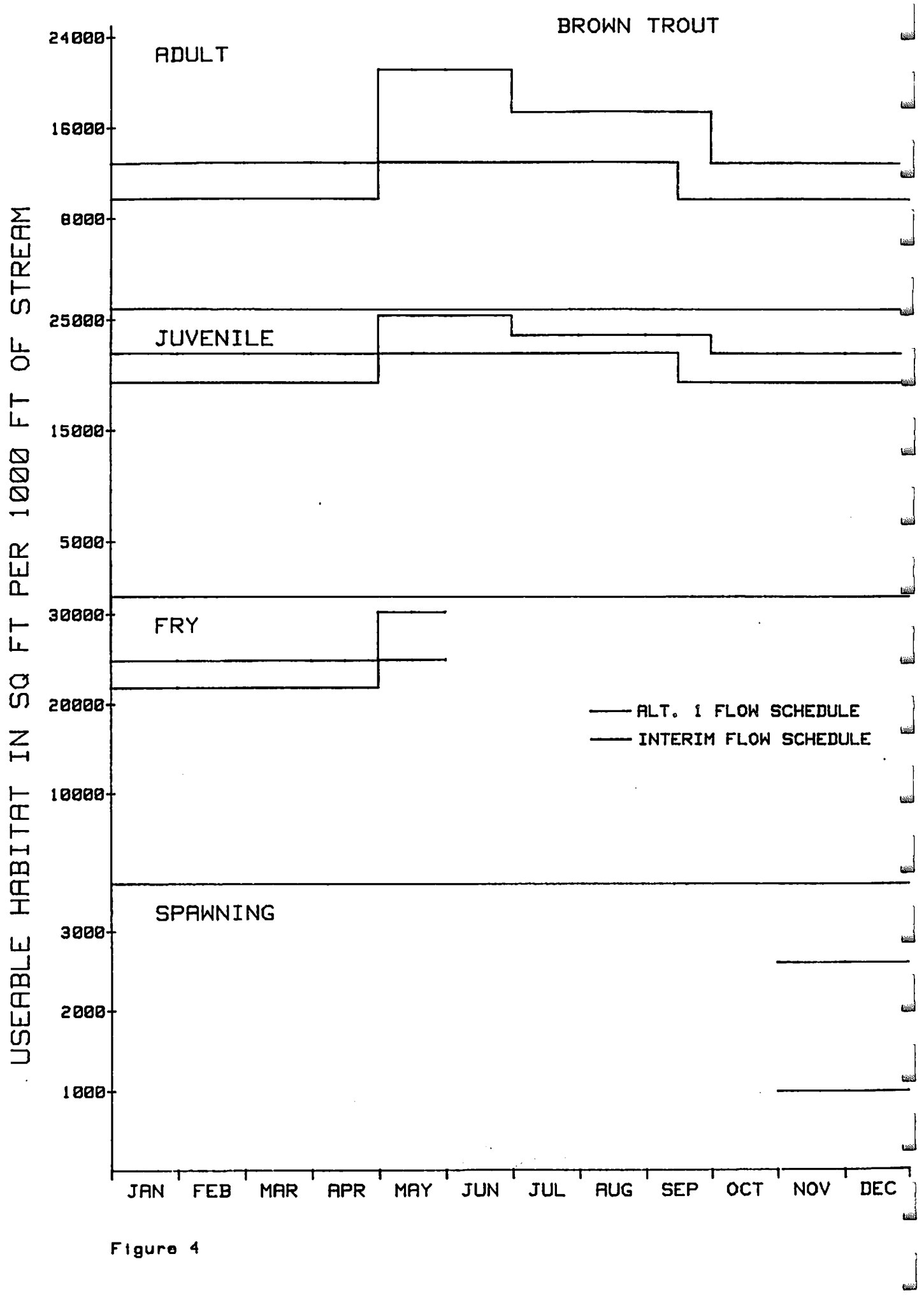

BROWN TROUT
ADULT
JUVENILE
FRY
SPAWNING
USEABLE HABITAT IN SQ FT PER 1000 FT OF STREAM
24000
16000
8000
25000
15000
5000
30000
20000
10000
3000
2000
1000
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
ALT. 1 FLOW SCHEDULE
INTERIM FLOW SCHEDULE

Figure 4

Alternative 2 (Canyon Power Project)

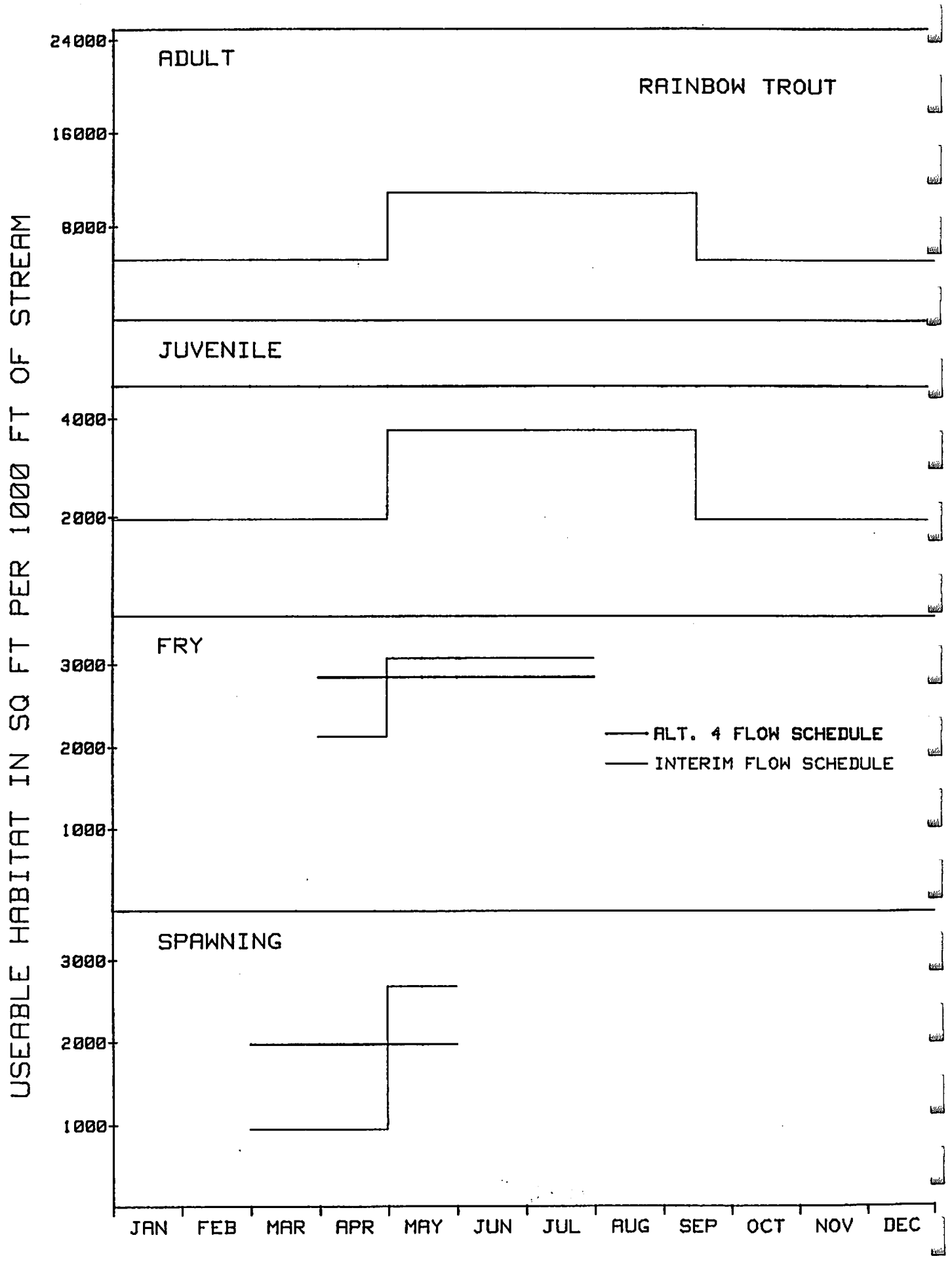
Under this alternative, the river channel (Reach 1) would again be used to convey water to Early Intake Reservoir and from there to Mountain Tunnel. The fishery resource would return to the level made possible by the high controlled flows (mean monthly flow ranging between 639 cfs in February to 2,811 cfs in June). Of the alternatives considered, the fishery resource would be the greatest under this plan.

Alternative 3 (Interim Flow Schedule)

Under this alternative, the fishery resource losses that resulted from the construction of the Canyon Power Project would continue to occur, and the resource would be expected to remain at about the reduced level measured by the 1977 population study. High water temperature and restricted habitat would continue to be a problem.

Alternative 4

The higher river flow (211 cfs) called for under this alternative would provide suitable water temperatures for trout and the greatest amount of adult habitat within the range of flows measured (35-211 cfs, Figures 5 and 6).


ADULT
RAINBOW TROUT
JUVENILE
FRY
SPAWNING
24000
16000
8000
4000
2000
3000
2000
1000
3000
2000
1000
ALT. 4 FLOW SCHEDULE
INTERIM FLOW SCHEDULE
JAN
FEB
MAR
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JUL
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OCT
NOV
DEC
USEABLE HABITAT IN SQ FT PER 1000 FT OF STREAM

Figure 5

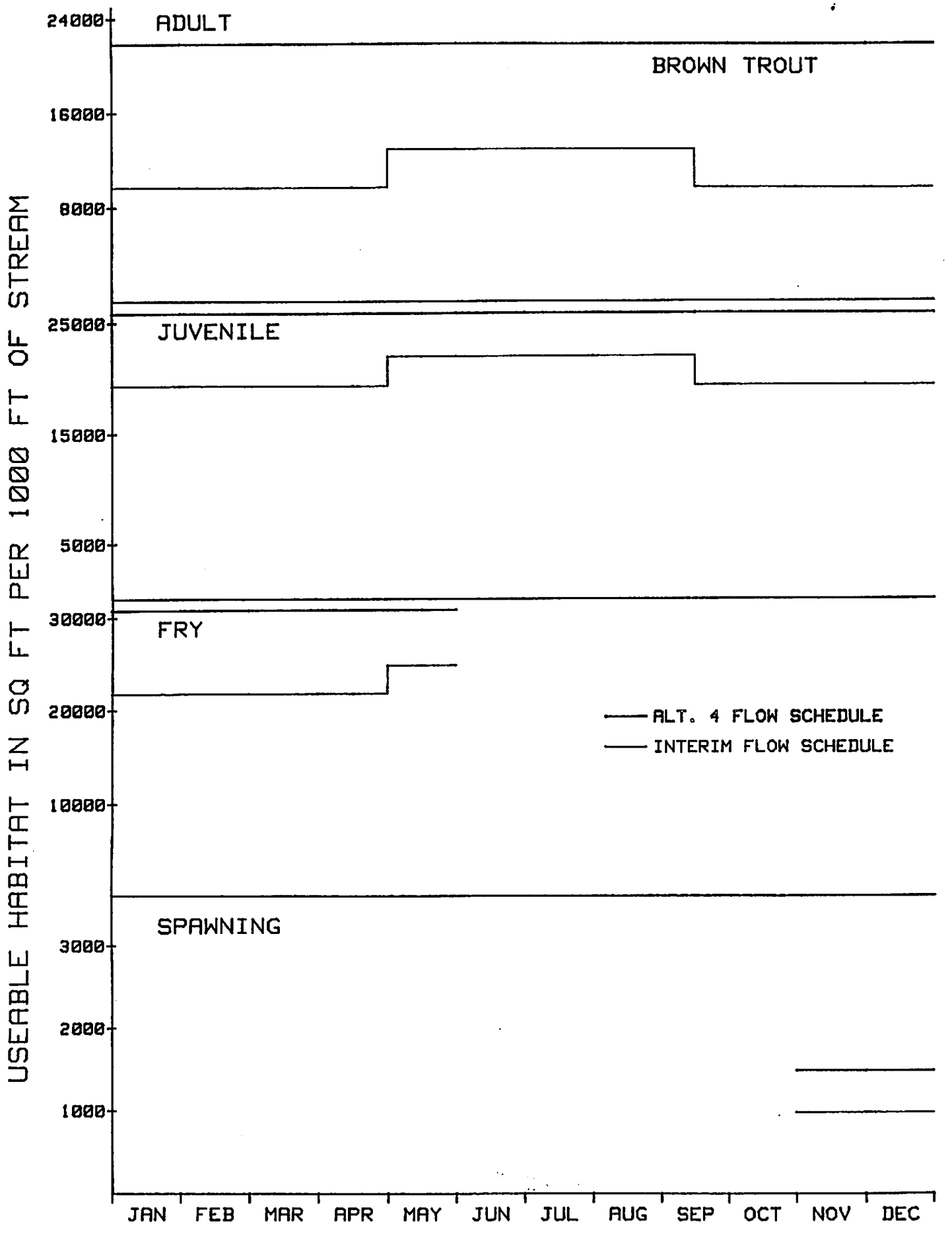
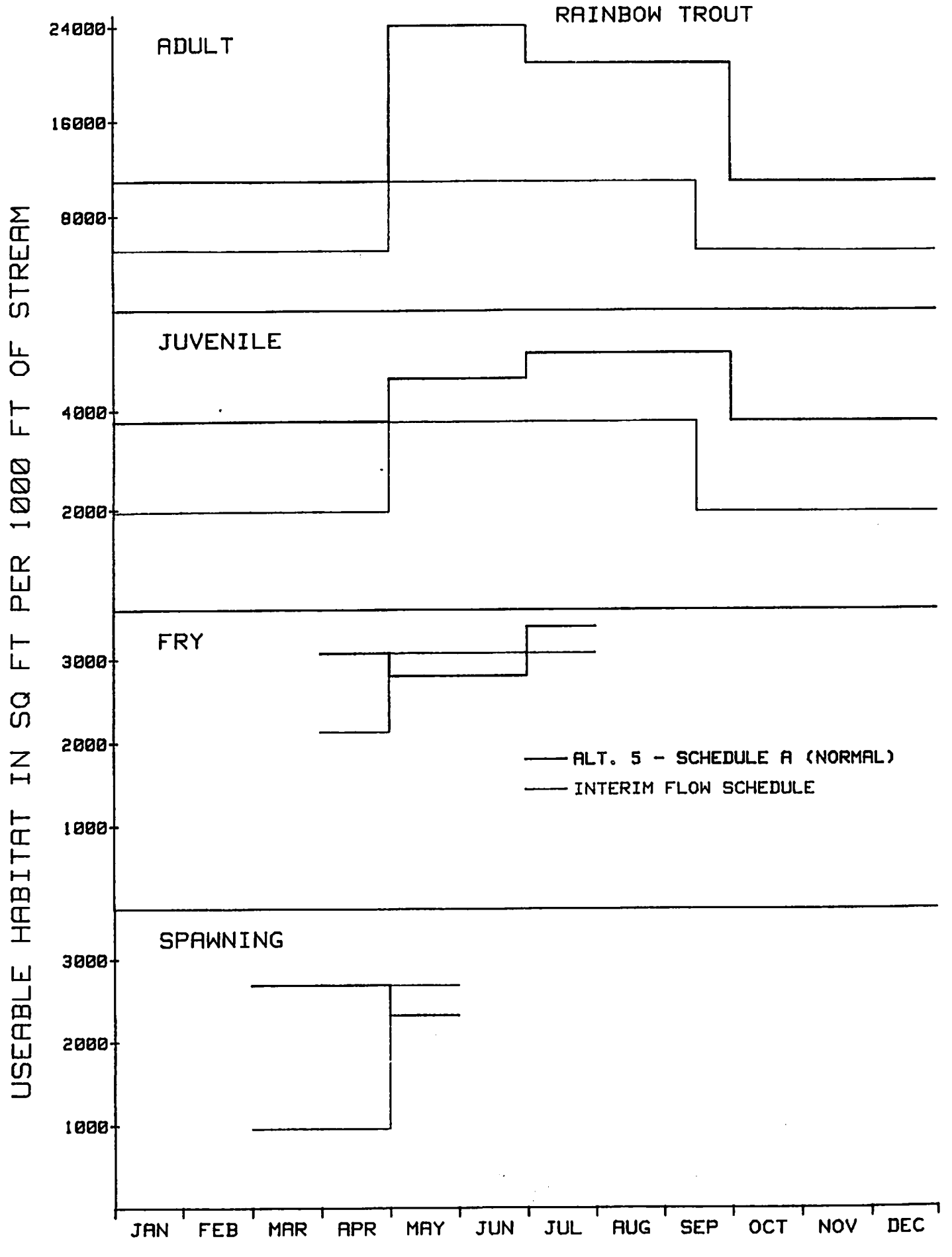

ADULT
BROWN TROUT
JUVENILE
FRY
SPAWNING
24000
16000
8000
25000
15000
5000
30000
20000
10000
3000
2000
1000
USEABLE HABITAT IN SQ FT PER 1000 FT OF STREAM
ALT. 4 FLOW SCHEDULE
INTERIM FLOW SCHEDULE
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

Figure 6

Alternative 5

The fishery resource that would occur under this alternative is expected to be substantially greater than that which presently exists. However, the resource level would be less than that provided under the recommended alternative because of the lower streamflow releases called for during "moderate periods" (schedule B, 20% of the time) and "dry period" (schedule C, 20%). During "normal" conditions, the flow release (schedule A) made under this alternative would be identical to that made under the recommended plan. See Figures 7, 8, 9 (rainbow trout) and Figures 10, 11, 12 (brown trout).


RAINBOW TROUT
ADULT
JUVENILE
FRY
SPAWNING
USEABLE HABITAT IN SQ FT PER 1000 FT OF STREAM
24000
16000
8000
4000
2000
3000
2000
1000
3000
2000
1000
ALT. 5 - SCHEDULE A (NORMAL)
INTERIM FLOW SCHEDULE
JAN
FEB
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JUL
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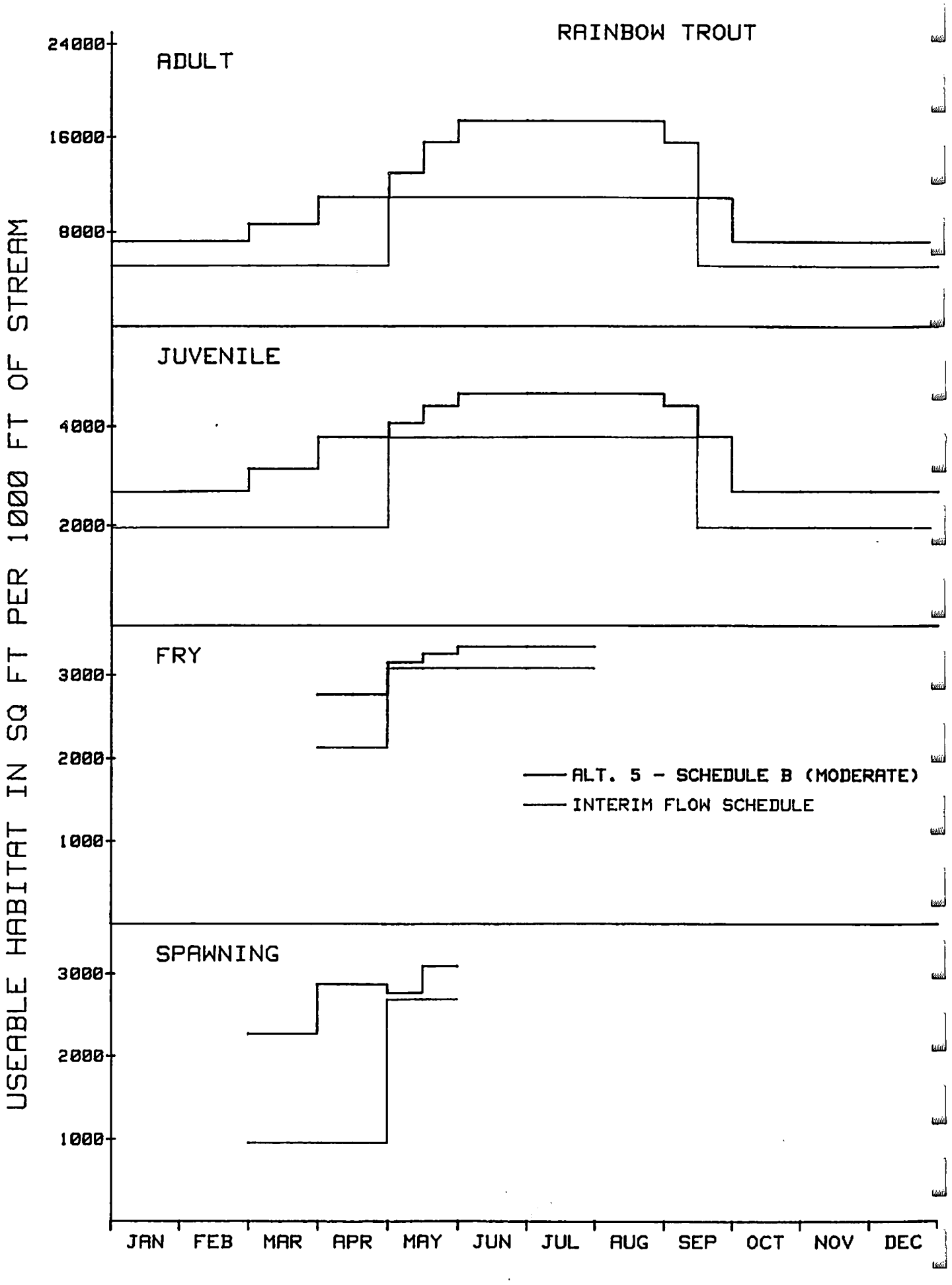
SEP
OCT
NOV
DEC

Figure 7


RAINBOW TROUT
ADULT
JUVENILE
FRY
SPAWNING
24000
16000
8000
4000
2000
3000
2000
1000
3000
2000
1000
USEABLE HABITAT IN SQ FT PER 1000 FT OF STREAM
ALT. 5 - SCHEDULE B (MODERATE)
INTERIM FLOW SCHEDULE
JAN
FEB
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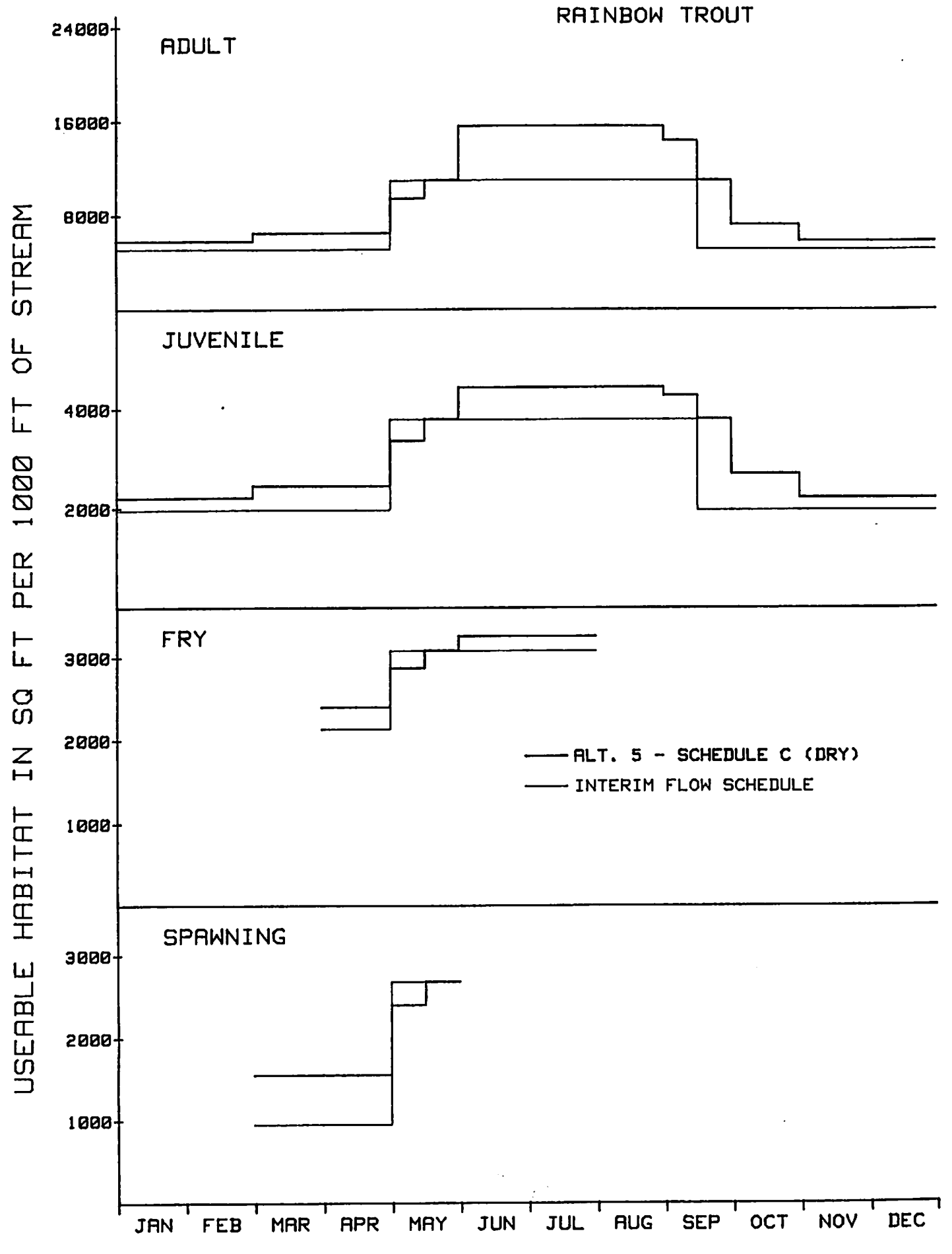
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

Figure 8


RAINBOW TROUT
ADULT
JUVENILE
FRY
SPAWNING
24000
16000
8000
4000
2000
3000
2000
1000
3000
2000
1000
USEABLE HABITAT IN SQ FT PER 1000 FT OF STREAM
ALT. 5 - SCHEDULE C (DRY)
INTERIM FLOW SCHEDULE
JAN
FEB
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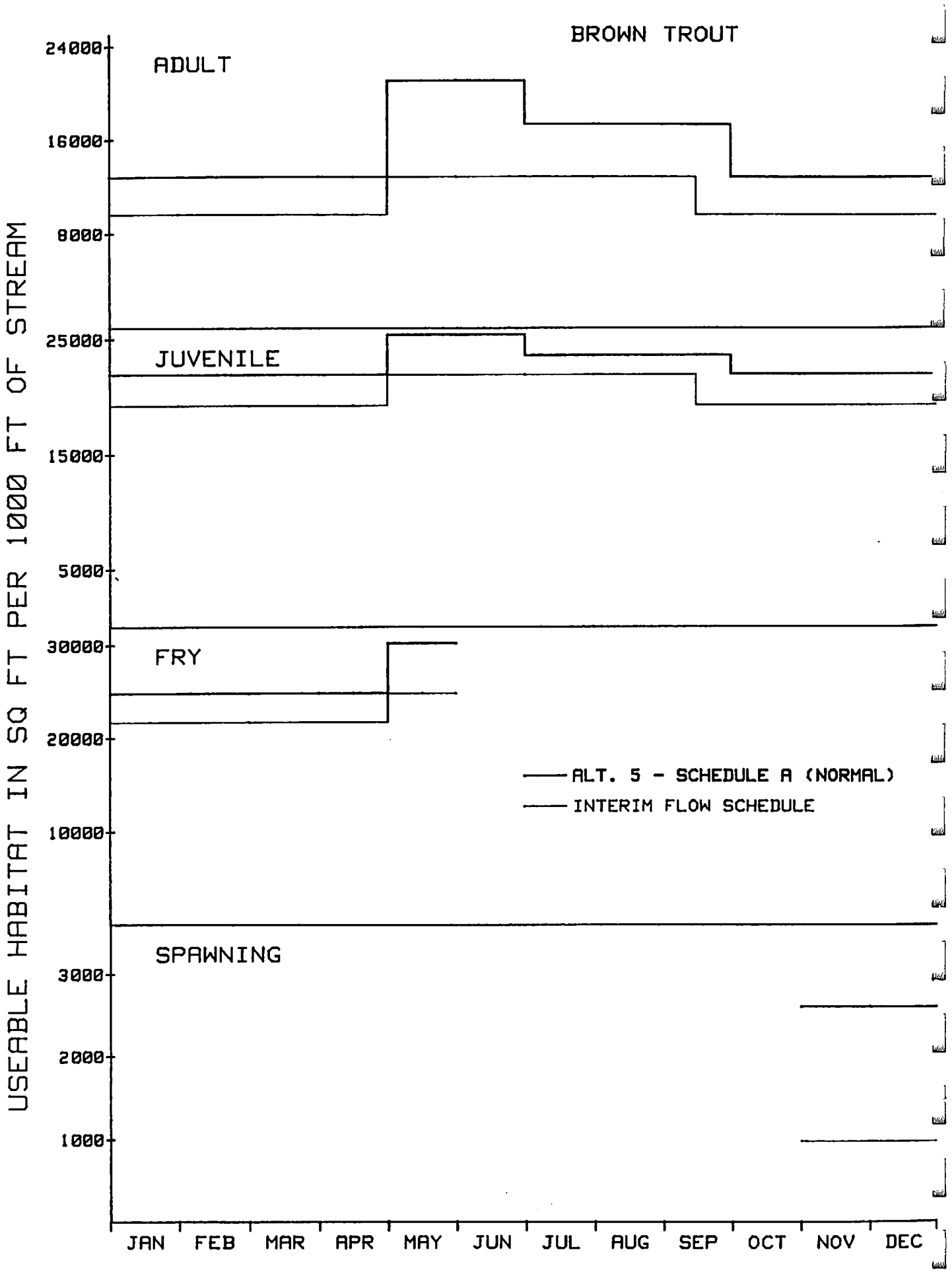
JUN
JUL
AUG
SEP
OCT
NOV
DEC

Figure 9


BROWN TROUT
ADULT
JUVENILE
FRY
SPAWNING
USEABLE HABITAT IN SQ FT PER 1000 FT OF STREAM
24000
16000
8000
25000
15000
5000
30000
20000
10000
3000
2000
1000
JAN
FEB
MAR
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AUG
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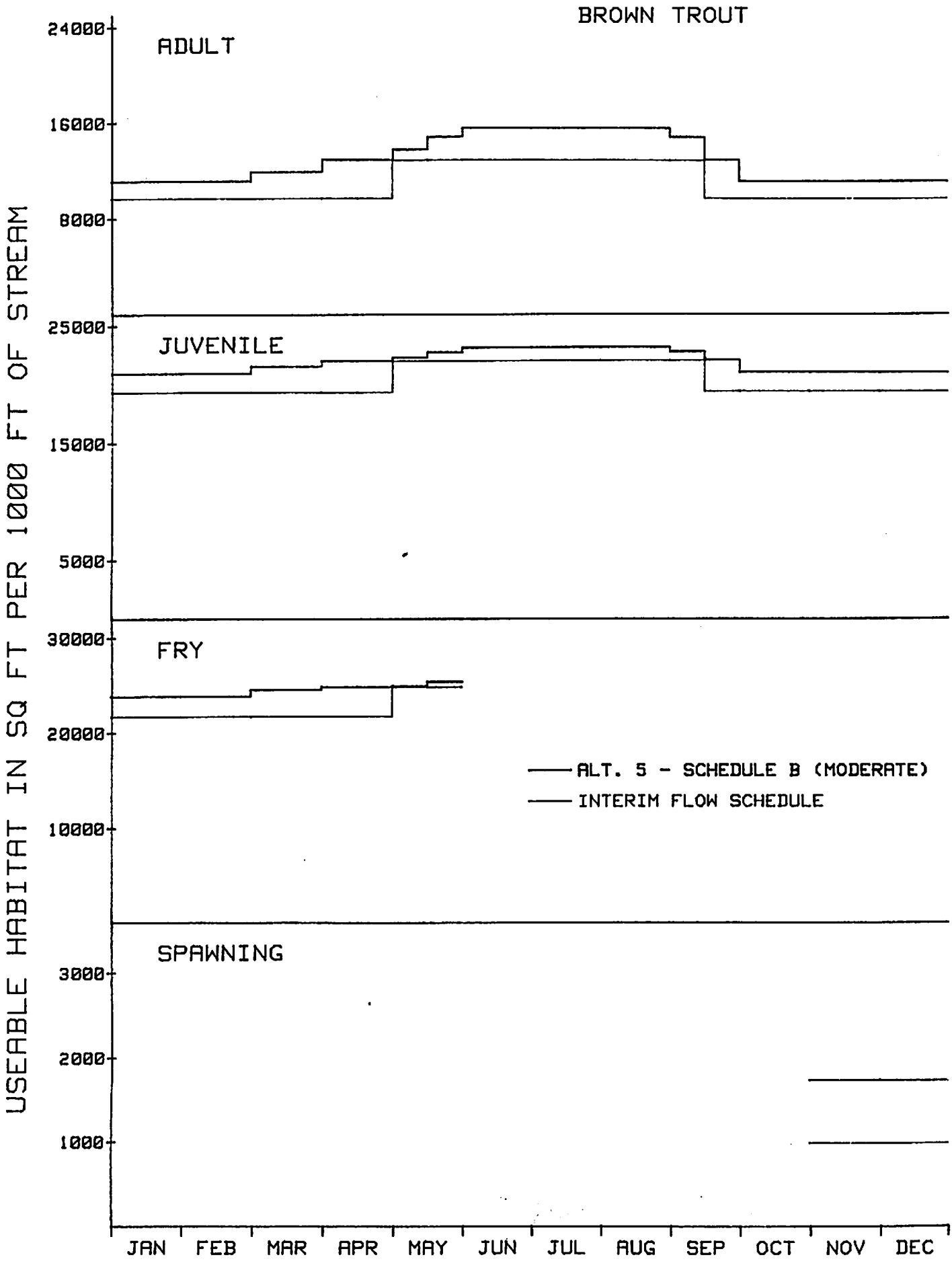
OCT
NOV
DEC
ALT. 5 - SCHEDULE A (NORMAL)
INTERIM FLOW SCHEDULE

Figure 10


BROWN TROUT
ADULT
JUVENILE
FRY
SPAWNING
USEABLE HABITAT IN SQ FT PER 1000 FT OF STREAM
24000
16000
8000
25000
15000
5000
30000
20000
10000
3000
2000
1000
ALT. 5 - SCHEDULE B (MODERATE)
INTERIM FLOW SCHEDULE
JAN
FEB
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JUN
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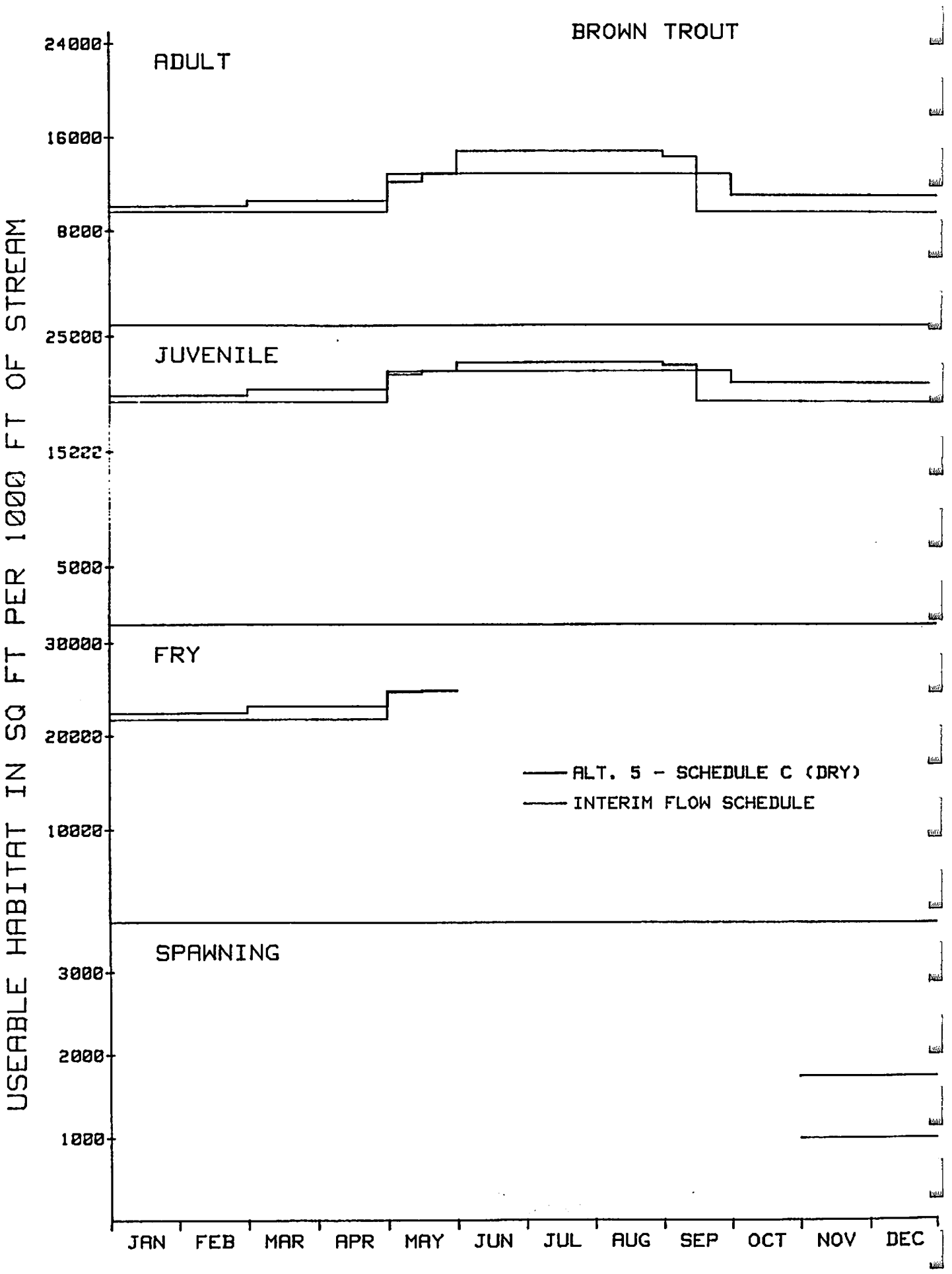
SEP
OCT
NOV
DEC

Figure 11


BROWN TROUT
ADULT
JUVENILE
FRY
SPAWNING
24000
16000
8000
25000
15222
5000
30000
20000
10000
3000
2000
1000
USEABLE HABITAT IN SQ FT PER 1000 FT OF STREAM
ALT. 5 - SCHEDULE C (DRY)
INTERIM FLOW SCHEDULE
JAN
FEB
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MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

Figure 12

Alternative 6

The required flow releases from Hetch Hetchy Reservoir would be nearly identical to the regime proposed under Alterntive 5. Refer to the discussion under alternative 5 for details pertaining to Reach 1. High water temperature in the 1.5 mile stretch between Early Intake Reservoir and the confluence with Cherry River is presently a problem. The mixing of the warm river water with the much colder water from Kirkwood Powerhouse in Early Intake Reservoir would provide suitable water (temperature) for release below Early Intake Reservoir. In return for the opportunity to recapture river flow at Early Intake Reservoir for use at Moccasin Powerhouse and for diversion to the Bay Area, the Grantee would provide a minimum flow of 90 cfs from Holm Powerhouse. Streamflow in Reach 2, under the present operation of Holm Powerhouse, occasionally fluctuates drastically during the late summer. Holm Powerhouse is operated on a peaking load basis and, with the reduced demand for power on weekends, stream flow is reduced from over 800 cfs to less than 65 cfs. A 90 cfs minimum flow from Holm Powerhouse would reduce the magnitude of the fluctuations and maintain the fishery resource of Reach 2 at a higher level.

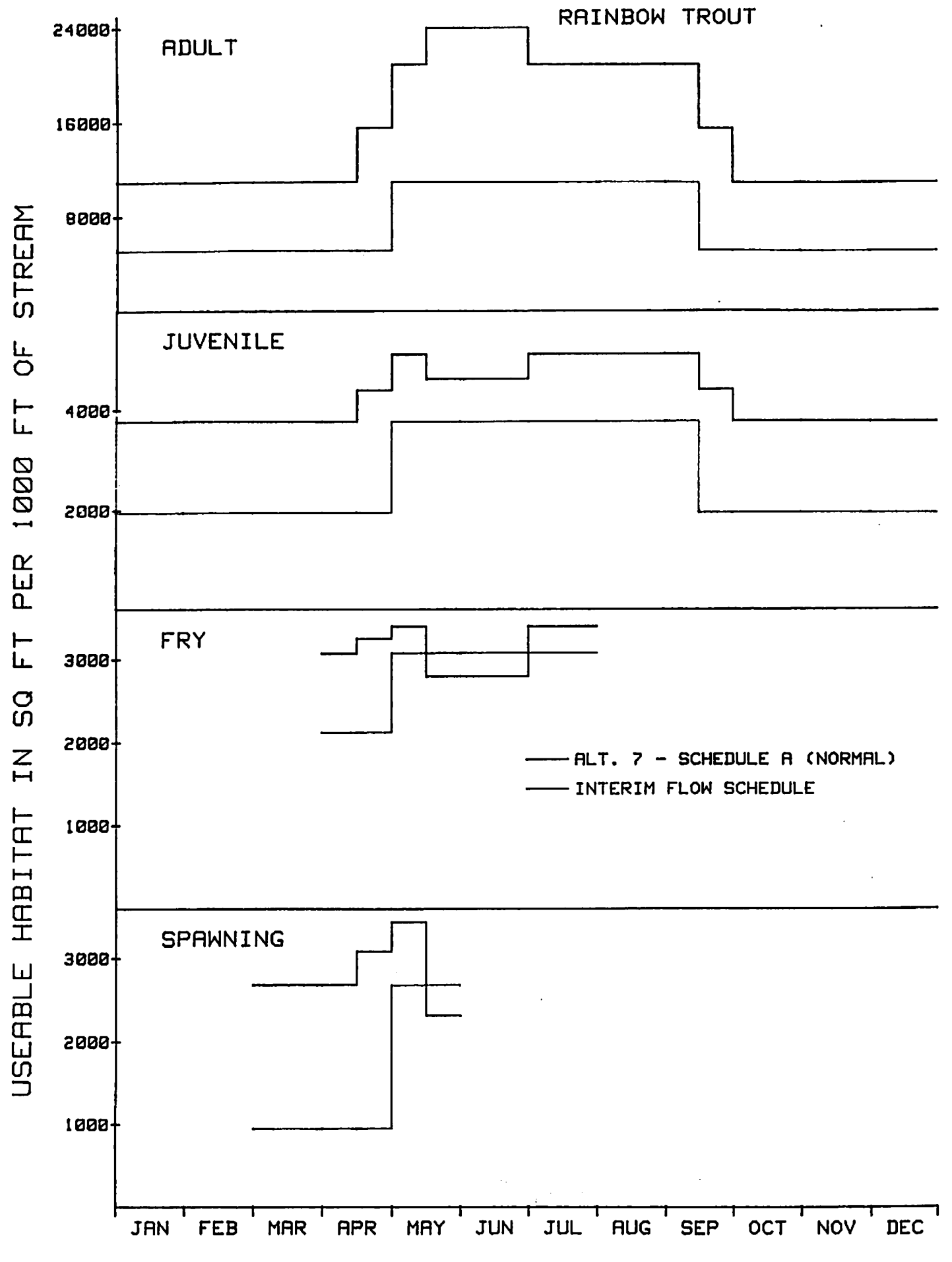
Alternative 7

This alternative includes multiple streamflow release schedules which are determined by precipitation and runoff. Consequently, the fishery resource level would vary according to the schedule in effect. Even when streamflow releases are at a maximum (schedule A under this alternative), a period of time is necessary before fish and invertebrate populations can respond to

the increase in habitat availability if low flow conditions (schedules B, C, D) had occurred earlier. For example, the carrying capacity for adult trout under schedule A might never be reached if low flow conditions occur within 2-3 year intervals.

The fishery resource under this atlernative would increase above the level which presently exists, but not to the level that would occur under the recommended alternative. Based on precipitation data (1918-1978) and runoff data (1911-1978), scheudle A would be in effect 30% (January) of the time to 44% (July) of the time; schedule B, 24% to 19%; schedule C, 30% to 22%; schedule D, 15%. The criteria within a particular schedule varies with time of year, hence the range in frequency.

Habitat availability for each release schedule under this alternative is depicted in Figure 13 to 16 for rainbow trout and Figures 17 to 20 for brown trout.


RAINBOW TROUT
ADULT
JUVENILE
FRY
SPAWNING
24000
16000
8000
4000
2000
3000
2000
1000
3000
2000
1000
USEABLE HABITAT IN SQ FT PER 1000 FT OF STREAM
ALT. 7 - SCHEDULE A (NORMAL)
INTERIM FLOW SCHEDULE
JAN
FEB
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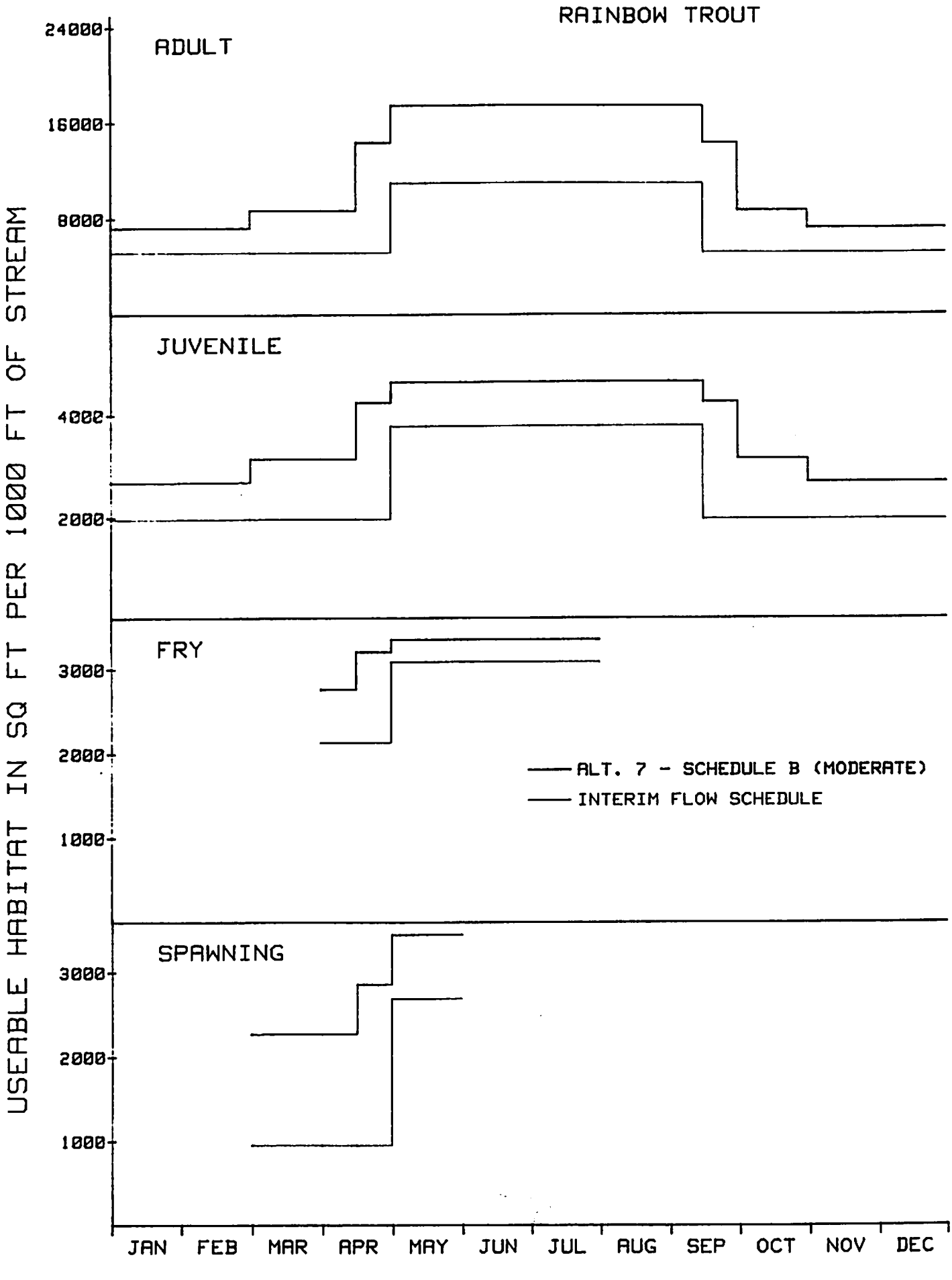
JUN
JUL
AUG
SEP
OCT
NOV
DEC

Figure 13


RAINBOW TROUT
ADULT
JUVENILE
FRY
SPAWNING
USEABLE HABITAT IN SQ FT PER 1000 FT OF STREAM
24000
16000
8000
4000
2000
3000
2000
1000
3000
2000
1000
ALT. 7 - SCHEDULE B (MODERATE)
INTERIM FLOW SCHEDULE
JAN
FEB
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JUN
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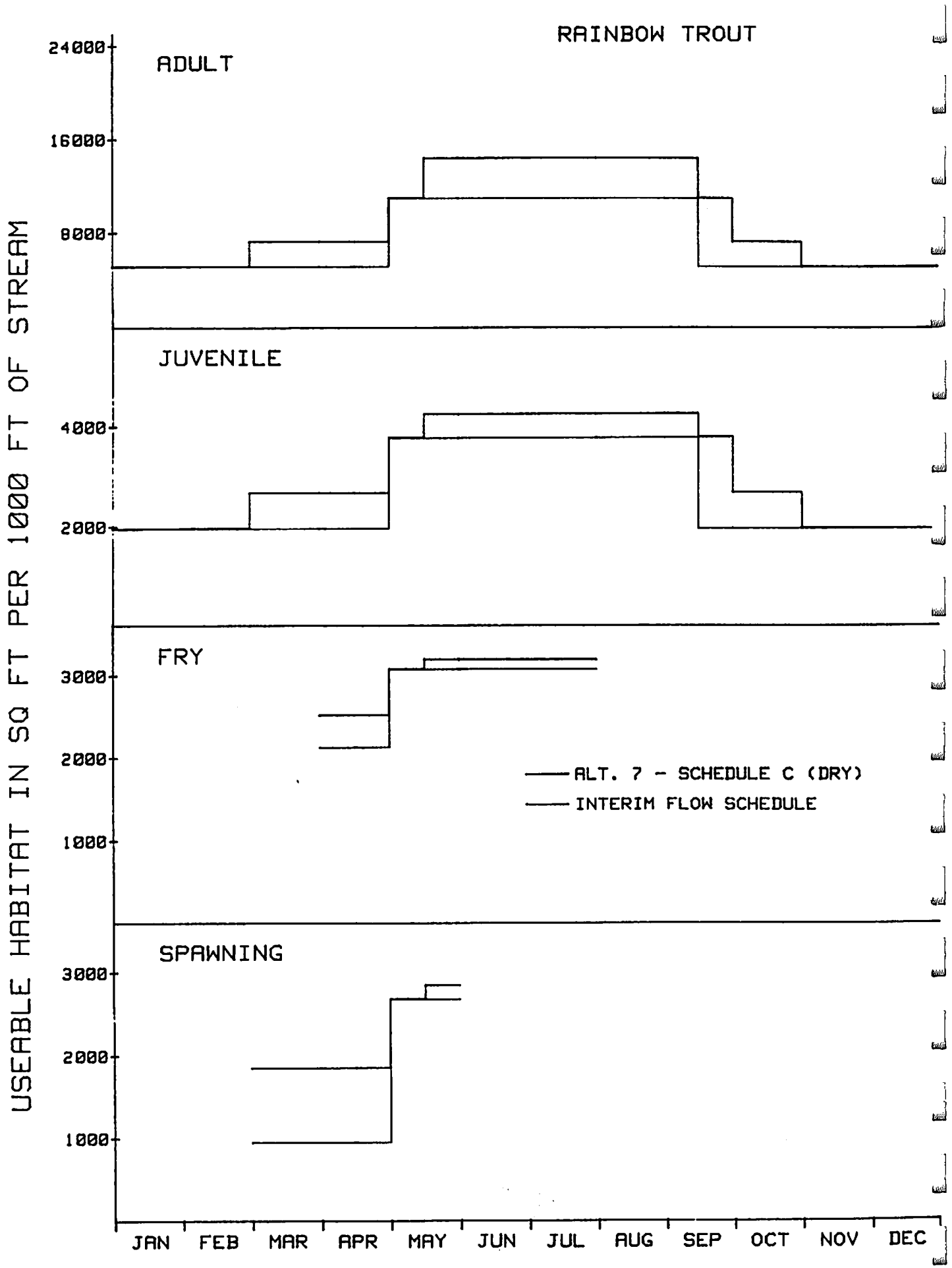
AUG
SEP
OCT
NOV
DEC

Figure 14


RAINBOW TROUT
ADULT
JUVENILE
FRY
SPAWNING
USEABLE HABITAT IN SQ FT PER 1000 FT OF STREAM
24000
16000
8000
4000
2000
3000
2000
1000
3000
2000
1000
ALT. 7 - SCHEDULE C (DRY)
INTERIM FLOW SCHEDULE
JAN
FEB
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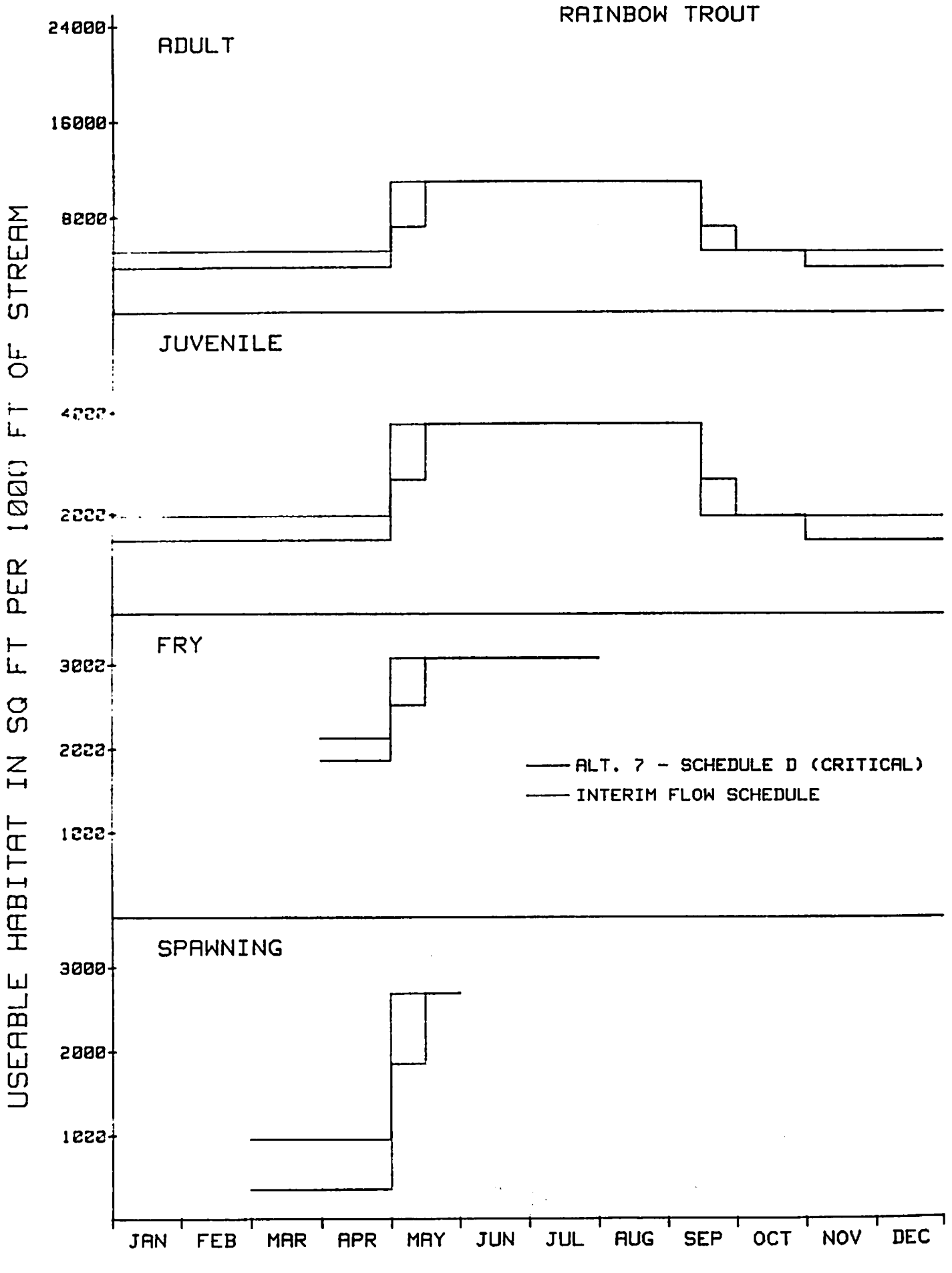
SEP
OCT
NOV
DEC

Figure 15


RAINBOW TROUT
ADULT
24000
16000
8000
JUVENILE
4000
2000
FRY
3000
2000
1000
SPAWNING
3000
2000
1000
USEABLE HABITAT IN SQ FT PER 1000 FT OF STREAM
ALT. 7 - SCHEDULE D (CRITICAL)
INTERIM FLOW SCHEDULE
JAN
FEB
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MAY
JUN
JUL
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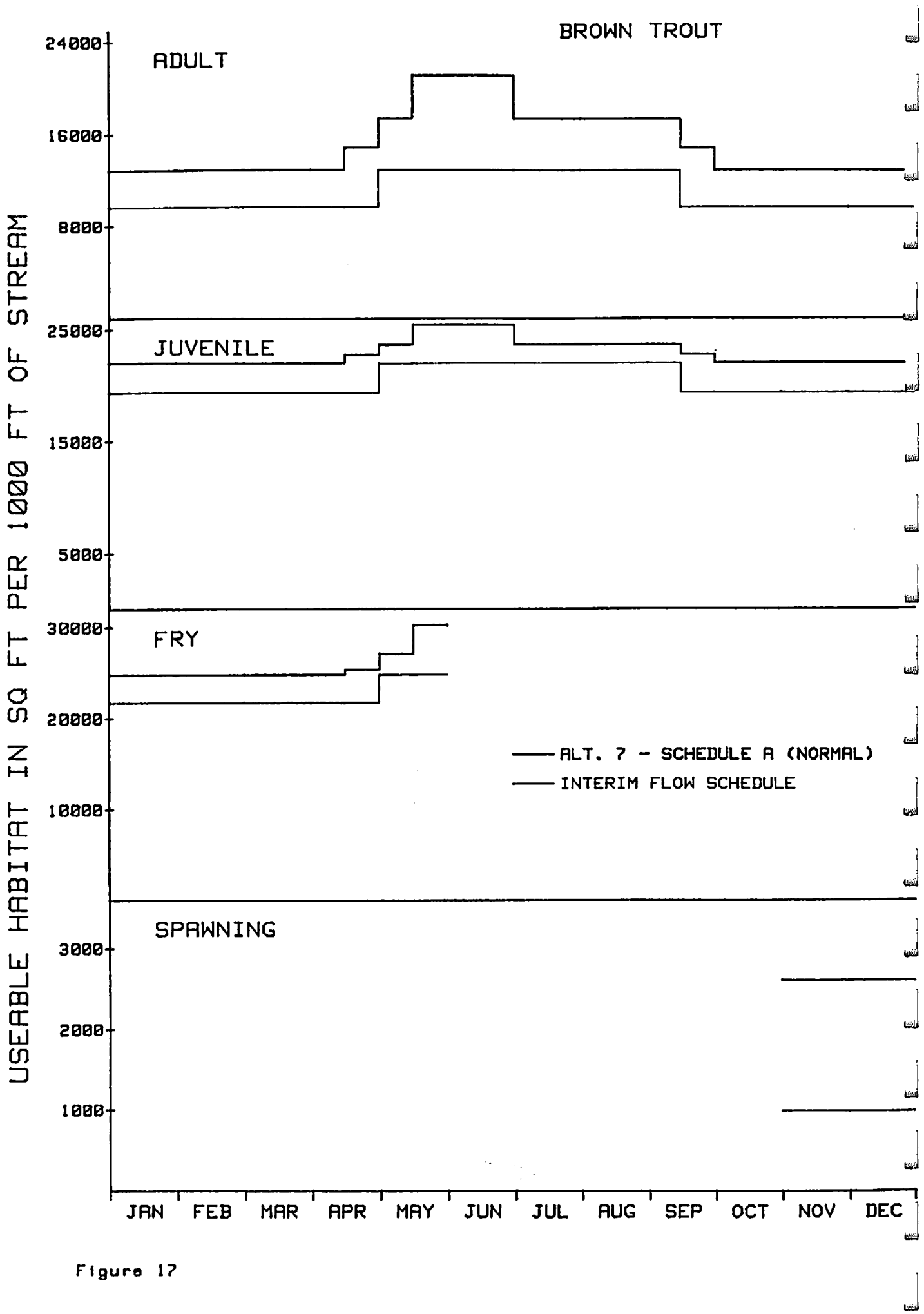
SEP
OCT
NOV
DEC

Figure 16


BROWN TROUT
ADULT
JUVENILE
FRY
SPAWNING
USEABLE HABITAT IN SQ FT PER 1000 FT OF STREAM
24000
16000
8000
25000
15000
5000
30000
20000
10000
3000
2000
1000
ALT. 7 - SCHEDULE A (NORMAL)
INTERIM FLOW SCHEDULE
JAN
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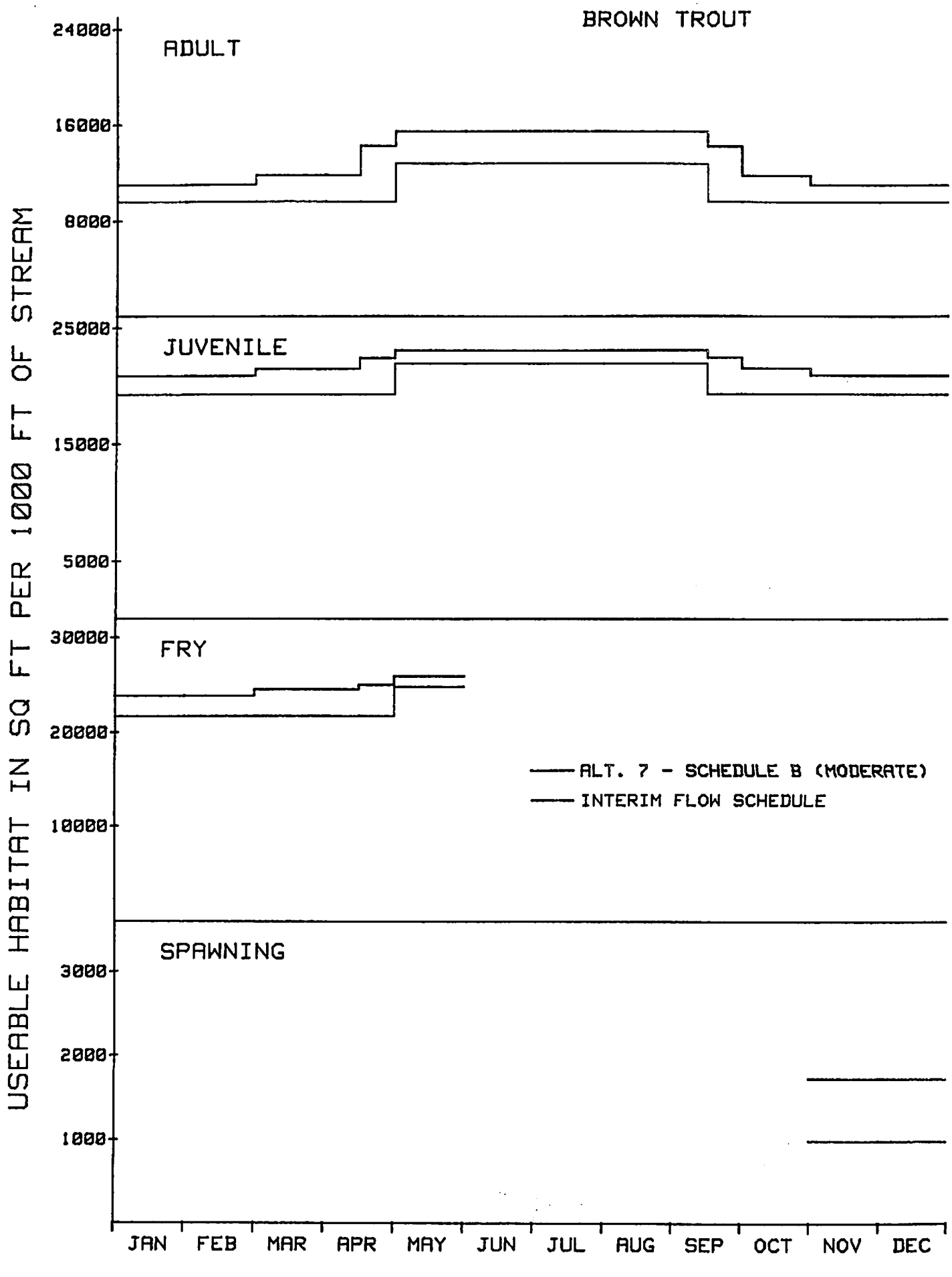
NOV
DEC

Figure 17


BROWN TROUT
ADULT
JUVENILE
FRY
SPAWNING
USEABLE HABITAT IN SQ FT PER 1000 FT OF STREAM
24000
16000
8000
25000
15000
5000
30000
20000
10000
3000
2000
1000
ALT. 7 - SCHEDULE B (MODERATE)
INTERIM FLOW SCHEDULE
JAN
FEB
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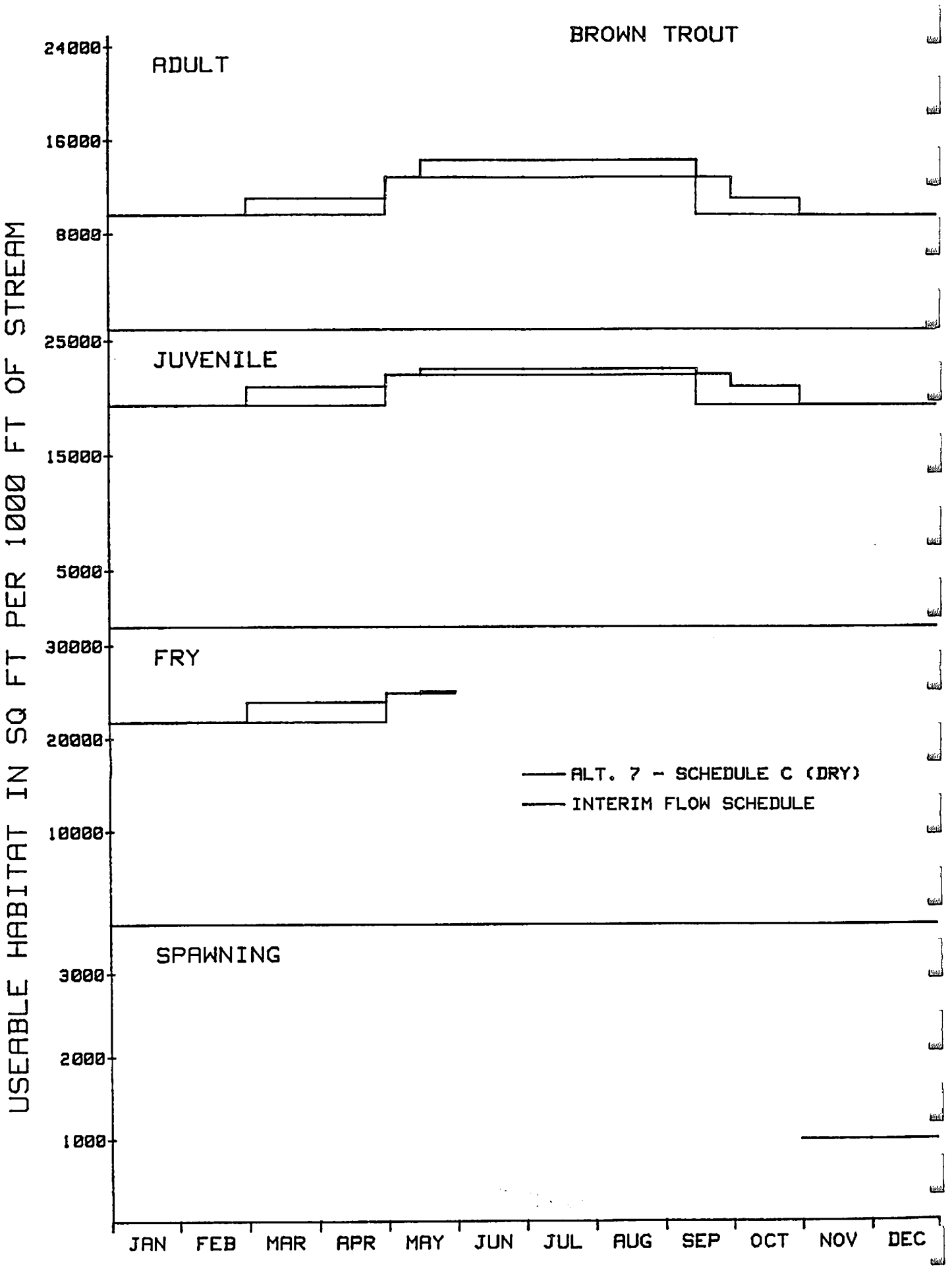
NOV
DEC

Figure 18


BROWN TROUT
ADULT
JUVENILE
FRY
SPAWNING
USEABLE HABITAT IN SQ FT PER 1000 FT OF STREAM
24000
16000
8000
25000
15000
5000
30000
20000
10000
3000
2000
1000
JAN
FEB
MAR
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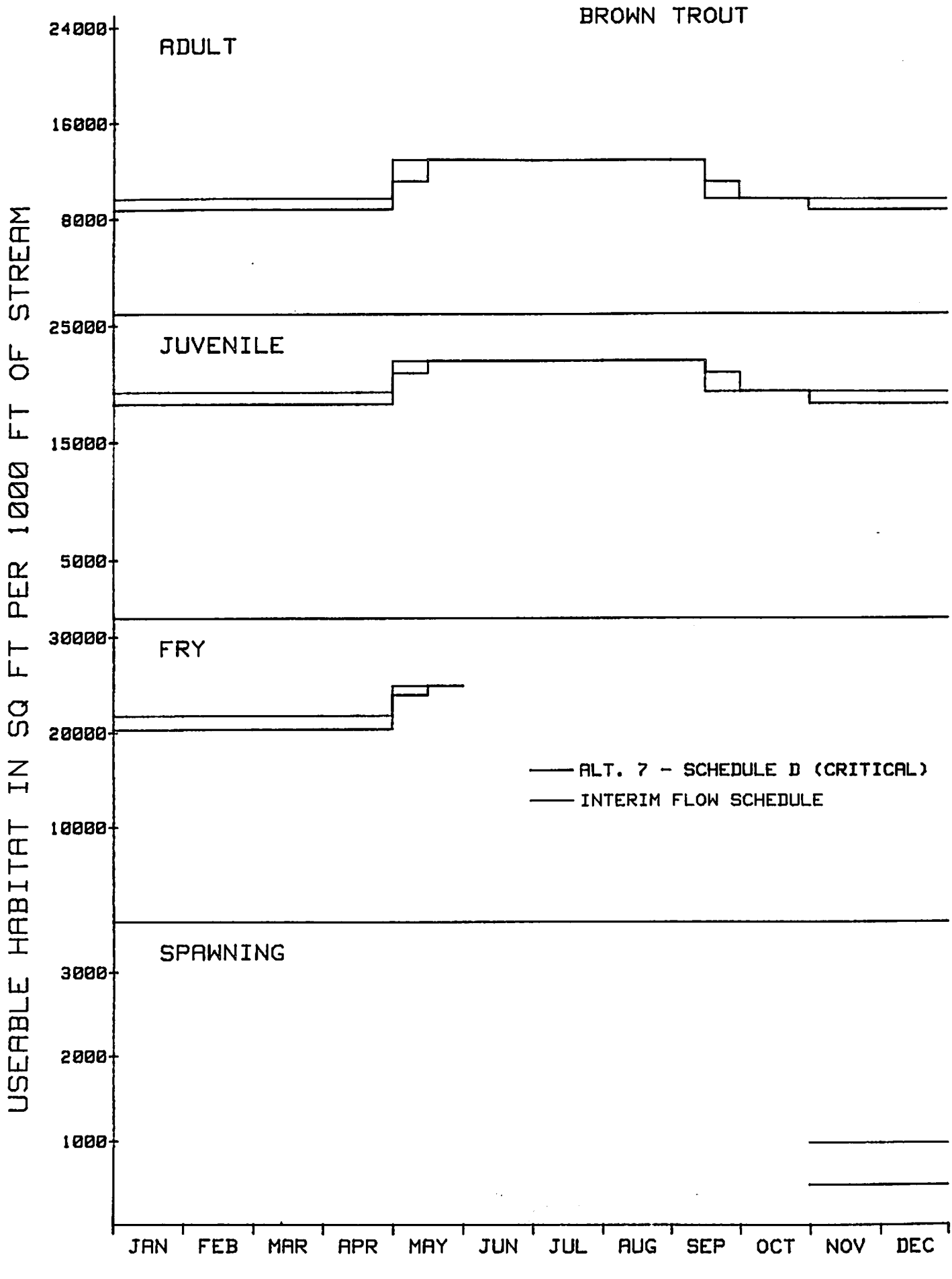
NOV
DEC
ALT. 7 - SCHEDULE C (DRY)
INTERIM FLOW SCHEDULE

Figure 19


BROWN TROUT
ADULT
JUVENILE
FRY
SPAWNING
USEABLE HABITAT IN SQ FT PER 1000 FT OF STREAM
24000
16000
8000
25000
15000
5000
30000
20000
10000
3000
2000
1000
ALT. 7 - SCHEDULE D (CRITICAL)
INTERIM FLOW SCHEDULE
JAN
FEB
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DEC

Figure 20

Consequence of the Alternatives on Recreation and Aesthetics

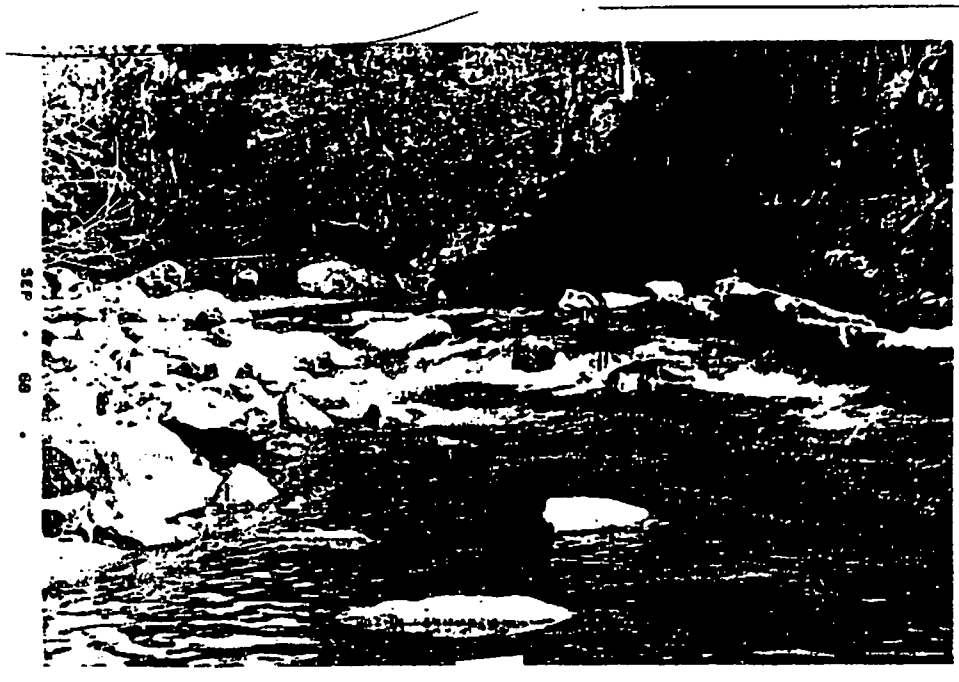
Recreation studies have been conducted separately by the U.S. Forest Service, the National Park Service and the City and County of San Francisco. Only the Forest Service study makes a reasonable attempt at relating scenic values with river flow (Tuolumne River Flow Study, 1968-72, Groveland Ranger District, Stanislaus National Forest). According to the findings presented in the USFS study, the outstanding scenic and recreational values are impaired when river flow is reduced to less than 150 cfs. For this reason, the Forest Service has recommended that the minimum river flow during the recreation season (May 15 to September 15) be at least 150 cfs.

The National Park Service is in agreement with conclusion drawn by the Forest Service with exception of the May and June minimum flows. During this period the National Park Service has recommended a minimum flow of at least 200 cfs to simulate the period of high runoff.

The City and County of San Francisco have conducted recreational use surveys during selected periods in 1978 and 1979. Their study reports are included in Appendices L and M.

RECREATION-
AESTHETICS

35 CFS

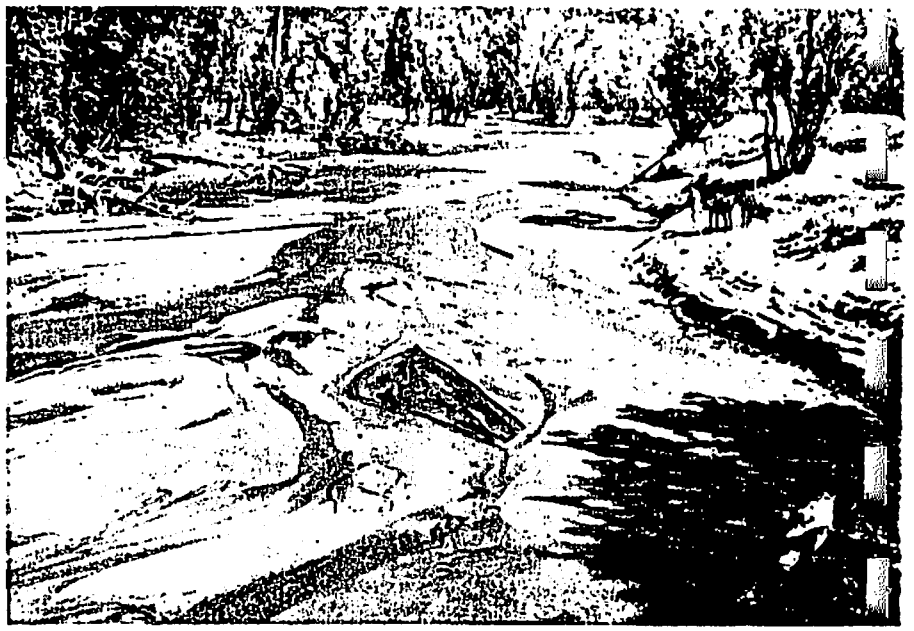


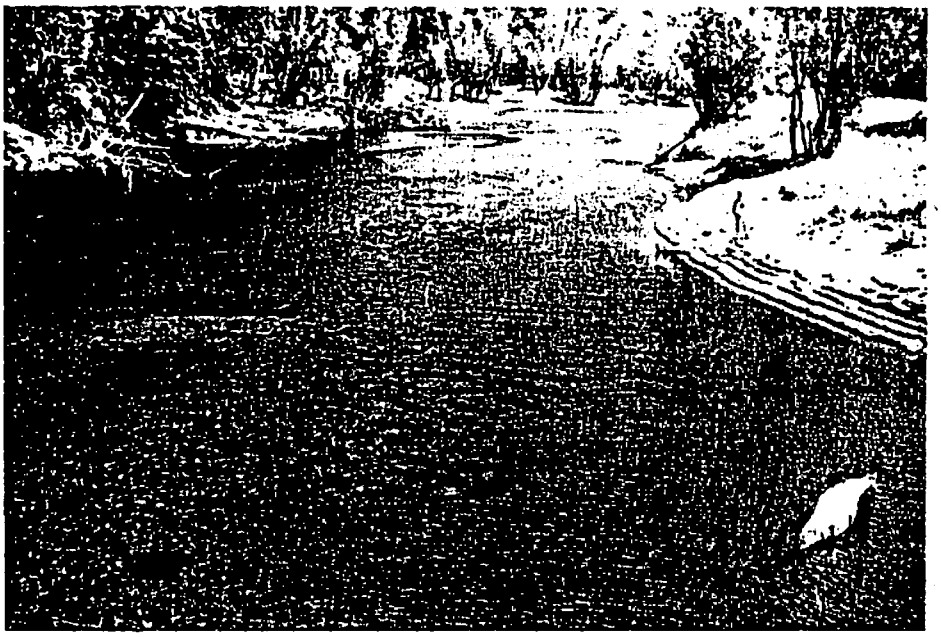
75 CFS

150 CFS

RECREATION-
AESTHETICS

35 CFS





75 CFS

150 CFS

Alternative 1 (Recommended Flow Schedule)

Under this alternative, the recreational and aesthetic values would exceed the values provided by the interim flow regime but would be less than that which occurred prior to the Canyon Power Project within Reach 1. Fishermen use should increase over that which occurs with the interim flow schedule because of the more suitable water temperatures and greater habitat for fish. Fishing and other recreational uses should also increase downstream from Early Intake Dam because of the improved flows.

Based on recommendations from the U.S. Forest Service (November 7, 1972 letter - Appendix N) and the National Park Service (March 10, 1972 letter - Appendix O), flows ranging between 150 cfs and 200 cfs are considered necessary to provide acceptable levels of recreational opportunities and scenic qualities. The interest and concern of those agencies is due to the fact that: the Tuolumne River (Reaches 1 and 2) flows almost exclusively through lands administered by the National Park Service or by the U.S. Forest Service, and (2) the Tuolumne River is presently

under consideration for inclusion into the National Wild and Scenic Rivers System.

Alternative 2 (Pre-Canyon Power Project)

The aesthetic values of the Tuolumne River environment would be greatest under this alternative (within the scope of the alternatives considered). Recreational values would be high, though water contact activities may decline due to the lower water temperatures and the increase in water velocity.

Alternative 3 (Interim Flow Schedule)

Recreational use and aesthetic values are adversely impacted by the low flows provided under this alternative and would continue to be impaired if the interim flow schedule is adopted as the permanent schedule. The river qualities (e.g., vigor, fullness, sound, clarity, etc.) are subdued with the river losing much of its attractiveness and appeal. Under this flow schedule, the Tuolumne River has the appearance of a slow moving stream instead of an outstanding Sierra river.

Alternative 4

Under this alternative, the aesthetic values of the Tuolumne River would be significantly greater than those which presently occur. The river would again exhibit qualities of vigor and fullness which were lacking under the interim schedule. Recreational usage, however, would change. Water

contact activities such as swimming and tubing would be expected to decline by reason of the higher flow velocity and colder water temperature. Activities associated with visual qualities (e.g., photography, hiking and camping) are expected to increase, as is fishing by reason of the better fishing conditions. The establishment of a trophy trout fishery would be expected if this alternative is complemented.

Alternative 5

The recreational opportunities and aesthetic values provided under this alternative would be an improvement over existing conditions but less than that provided by the recommended plan because of the flow reductions during "moderate periods" (schedule B) and "dry periods" (schedule C). Under schedule B and schedule C, the minimum flow releases would not be sufficient to maintain the outstanding scenic and recreational values of the Tuolumne River between O'Shaugnessy Dam and the Cherry River confluence. However, the river flow would be higher under this alternative than under the interim schedule. Therefore, the number of fishermen and users primarily concerned with scenic qualities should increase. Water contact use, however may decline because of higher water velocities and colder water temperatures.

Alternative 6

The effect of this alternative on aesthetics and recreation in Reach 1 would be identical to that described under alternative 5. The recreational and aesthetic values of Reach 2 downstream from the Cherry River confluence would be improved over existing conditions by reason of the higher minimum flow. In the 1.5 mile stretch between Early Intake Dam and the Cherry River confluence, recreation and aesthetic values would increase during "normal" (schedule A) years, remain at existing levels during "moderate" (schedule B) periods and decrease during "dry" (schedule C) periods.

Alternative 7

Under this alternative, the recreation and aesthetic values would increase with respect to interim conditions under schedules A, B and C but decrease under schedule D). The outstanding scenic and recreation values of the Tuolumne River would be maintained under schedule A but would be impaired under schedules B, C and D. However, even under schedule A, potential recreation usage may be reduced by the yearly variation in river flow, i.e., some potential users may avoid the area because of the uncertainity in river flow. The full potential of the fishery resource and its utilization under schedule A may never be reached because of the flow reductions that would occur approximately 65% of the time.

Consequence of the Alternatives on Power Generation

At the present time, water to be used at Kirkwood Powerhouse for power generation is transported from Hetch Hetchy Reservoir on the Tuolumne via Canyon Tunnel. Following use at Kirkwood, the water enters Mountain Tunnel by way of a river by-pass conduit for transport to Moccasin Powerhouse. From there it is either released to New Don Pedro Reservoir or is piped to the San Francisco area for municipal and industrial uses.

In the Cherry River watershed, runoff is stored at Cherry Reservoir and Lake Eleanor for power generation at Dion Holm Powerhouse, this water is released to the Cherry River, enters the Tuolumne River and flows into New Don Pedro Reservoir. However, during the 1976-1977 drought, the operation of the Cherry River system was modified to facilitate the diversion of water to San Francisco. Instead of releasing all of the water through Holm Powerhouse, up to 200 cfs was diverted to Early Intake Reservoir via the renovated Cherry Aqueduct. This water was then used for generation purposes at Moccasin Powerhouse before being diverted to San Francisco. Because the generation facilities at Holm Powerhouse are more efficient than those at Moccasin Powerhouse (greater head), the Cherry Aqueduct is not used except when it is necessary to convey additional water to San Francisco. It is expected that the Cherry Aqueduct would be utilized during periods similar to the 1976-1977 drought and in the future when San Francisco approaches their maximum diversion rate of 448,000 acre-feet per year.

Mountain Tunnel has a design capacity of about 620 cfs and a maximum capacity of 720 cfs. According to the survey reports filed with the Government Land Office on July 3, 1916 (Sacramento Serial No. 09719), Canyon Tunnel was described as having a capacity of 620 cfs. In 1958, the City and County of San Francisco applied for a change in location of the Canyon Tunnel right-of-way. By 30 December 1958 Public Utilities Commission's letter to the U.S. Forest Service, Manager and Chief Engineer Lloyd stated, "The City and County of San Francisco possess valid appropriative water rights to divert from the Tuolumne River at O'Shaughnessy Dam all of the water (700 second-feet) required for the operation of the proposed Canyon Power Project" (Appendix P).

In addition, City Attorney Holm by 6 August 1959 brief to the Bureau of Land Management stated "The application from which this appeal results seeks only to shift the tunnel right of way, penstock line and powerhouse site to locations ...." (Appendix A). Later in the City's Petitioner's Reply Brief dated 30 March 1960, City Attorney Holm stated, "...design capacity is not the same as maximum capacity, and had the aquaduct of the Canyon Power Project as presently approved (south side of Tuolumne River) been built with 620 cfs design capacity, its maximum capacity would have been approximately the same as the maximum capacity of the Early Intake-Moccasin Power House aqueduct due to the similarity of the tunnels" (Appendix Q). Although it may be argued that the Raker Act did not contain specific constraints whereby tunnel size could be limited, the understanding at the time of the 1961 Agreement was for a tunnel with a maximum capacity of about 700 cfs.

Canyon Tunnel, however, was constructed with a significantly greater capacity as evidenced by the diversion of more than 900 cfs in July of 1978 (Appendix R). This added capacity allows for the generation of additional power but contributes to the difficulty of meeting both stream maintenance releases and full power releases (720 cfs) during some periods.

Utilizing power generation curves, diversion rates precipitation data and other information provided by the Grantee and flow data from the U.S. Geological Survey, an operation study was developed by the Water and Power Resources Service to analyze the power generation that would have hypothetically occurred during the 1918 to 1978 period, assuming a water supply demand of 448,000 AF and the present level of development with the addition of the proposed O'Shaughnessy toe generator. Stream maintenance releases can be utilized for power generation by incorporating a toe generator at the base of O'Shaughnessy Dam. Such plans have already been considered by the Grantee and have been approved by the necessary regulatory agencies. The operation study assumptions and details are presented in Appendices S and T.

Power capacity of the Hetch Hetchy Project is measured by average annual generation (AAG) and system dependable capacity (SDC). Average annual generation for the Hetch Hetchy System is the amount of energy that could be generated on a yearly basis over the 1918 to 1978 period using historical hydrological data. System Dependable Capacity is the firm electrical capacity that could be provided by the system during a specified critical dry period (1976 through 1977 in the WPRS analysis).

Power generation impacts were analyzed under both the present and maximum level of water demand and were found to be nearly identical over the long term. Because of their similarity, the following analyses and discussion is based on a comparison of operation studies in which only the maximum water demand is assumed.

The Power generation features under each of the alterntives are summarized in Tables 5 and 6.

Alternative 1 (Recommended Flow Schedule)

If the alternative 1 flow schedule had been implemented as the "interim" schedule under the 1961 Agreement and if the Grantee's maximum water demand is assumed for the 1918 and 1978 period of analysis, on the average an additional 400 thousand MW-Hrs of power generation could have been provided above the pre-Canyon Power Project level (Table 5).

For discussion purposes, if it is assumed that the City and County of San Francisco had met the question of diligence and had constructed the Canyon Power Project along the original right-of-way with the original specifications, an annual average generation (AAG) of 598 thousand MW-Hrs could have theoretically been produced at Kirkwood Powerhouse. Under alternative 1 the Grantee would have been able to produce 543 thousand MW-Hrs, or 87% of the originally authorized project potential.

Table 5.

AVE. ANNUAL GENERATION IN 1000 MW-HRS (1918-1978)

ALT.	H.HETCHY SYSTEM						TUOL. SYSTEM	
	KIRKWOOD	MOCCASIN	HOLM	O'SHAUGH.	TOTAL	%	DON PEDRO	TOTAL	%
1	543	526	770	16	1855	96	500	2355	97
2	0	545	786	124	1455	75	494	1949	80
3	598	540	781	9	1928	100	498	2426	100
4	471	492	722	26	1711	89	513	2224	92
5	593	536	768	12	1909	99	502	2411	99
6	595	537	759	12	1903	99	501	2404	99
7	598	539	769	12	1918	99	498	2416	100

Table 6.

DEPENDABLE CAPACITY IN MEGAWATTS (1976-1977)

ALT.	H.HETCHY SYSTEM						TUOL. SYSTEM	
	KIRKWOOD	MOCCASIN	HOLM	O'SHAUGH.	TOTAL	%	DON PEDRO	TOTAL	%
1	61	102	80	0	243	85	90	333	90
2	0	106	100	0	206	72	85	291	78
3	80	106	100	0	286	100	85	371	100
4	37	80	74	0	191	67	94	285	77
5	62	100	85	0	247	86	89	336	91
6	62	98	86	0	246	86	90	336	91
7	62	97	89	0	248	87	89	337	91

Implementation of the recommended alternative with respect to the interim schedule would result in a 9% AAG reduction at Kirkwood Powerhouse and a 4% reduction to the Hetch Hetchy System. System Dependable Capacity (SDC), based on the 1976 through 1977 period, would be reduced from 286 MW to 243 MW, or by 15% (Table 6). The annual generation that would be provided under this alternative from the Hetch Hetchy System (1918 to 1978 period) is presented in Figure 21.

A small portion of the Hetch Hetchy power loss would be offset by Don Pedro generation, and if considered together would result in an AAG reduction of about 3% (71 thousand MW-Hrs) and a SDC reduction of 10%.

Alternative 2

In the analysis of this alternative, the impacts to power generation were estimated in a slightly different manner because of the elimination of the Canyon Power Project from the analysis, the inclusion of a significantly larger generator at O'Shaughnessy Dam and the absence of operating criteria comparable to that used in the analyses of the other alternatives. Therefore, it was necessary to use an average value (124 thousand MW-Hrs) for O'Shaughnessy Powerhouse generation and to use values for Moccasin Powerhouse generation that were still slightly influenced by the presence of Kirkwood Powerhouse. As a consequence, O'Shaughnessy Powerhouse values are expected to be overestimated during dry periods and underestimated during wet periods and Moccasin Powerhouse estimates are slightly low. These estimates are adequate for the purposes of this assessment.

Of the alternatives considered, power generation would be impacted to the greatest extent under this alternative, amounting to an AAG reduction of 598 thousand MW-Hrs from Kirkwood Powerhouse (Table 5). The reduction to the Hetch Hetchy system would be somewhat less (474 thousand MW-Hrs) because of the increase in generation at the Moccasin, Holm and O'Shaughnessy facilities. A comparison of AAG from the Hetch Hetchy System under alternative 2 and under interim conditions is presented in Figure 22. A slight increase in generation would also occur at the Don Pedro facilities. Implementation of this alternative would result in 25% and 20% reductions in power generation from the Hetch Hetchy Project and to the Tuolumne System, respectively. Dependable capacity would be reduced to 291 MW from the 371 MW provided under interim conditions, resulting in a 22% reduction (Table 6).

Alternative 3

Under this alternative, there would be no change in power generation. On the average, 598 thousand MW-Hrs of power would be generated at Kirkwood and 1928 thousand MW-Hrs from the Hetch Hetchy System. Annual generation from the Hetch Hetchy System is presented in Figure 23. Hetch Hetchy dependable capacity would remain at 286 MW.

Alternative 4

Implementation of this alternative relative to interim conditions would result in power reductions of 21%, 9%, and 8% from Kirkwood, Moccasin and Holm Powerhouses, respectively; and in a 11% reduction to the Hetch Hetchy System (Table 5). Power generation at Moccasin and Holm Powerhouse would be more severely impacted by this alternative than by any of the six other alternatives by reason of the higher stream maintenance releases which would be unavailable for power generation at Moccasin Powerhouse or diversion to San Francisco. Greater quantities of water from the Cherry River watershed would be required to meet the Grantee's water demand, thereby reducing Holm Powerhouse generation. The annual generation that would be produced by the Hetch Hetchy System under this alternative is presented in Figure 24. Dependable capacity would be reduced by 33% to 191 MW.

Alternative 5

The implementation of this alternative would result in less than a 1% average annual generation reduction to either Kirkwood Powerhouse or the Hetch Hetchy System (Table 5). Dependable capacity would be reduced by 14% to 247 MW (Table 6).

If Don Pedro generation is included, SDC would be reduced by 9% to 336 MW Annual generation from Hetch Hetchy System is presented in Figure 25.

Alternative 6

The implementation of this alternative would have about the same impact (1% reduction) on the average annual generation as that which would occur under alternative 5 (Table 5). Dependable capacity of the Hetch Hetchy System would be reduced by 14% to 246 MW (Table 6). Annual generation that would be provided from the Hetch Hetchy System under alternative 6 and interim schedule is presented in Figure 26.

Alternative 7

Implementation of this alternative would result in a 1% reduction in average annual generation and a reduction of 13% in dependable capacity to the Hetch Hetchy System (Tables 5 and 6). Annual generation totals that would be provided from the Hetch Hetchy System under this alternative and under the interim schedule are presented in Figure 27.

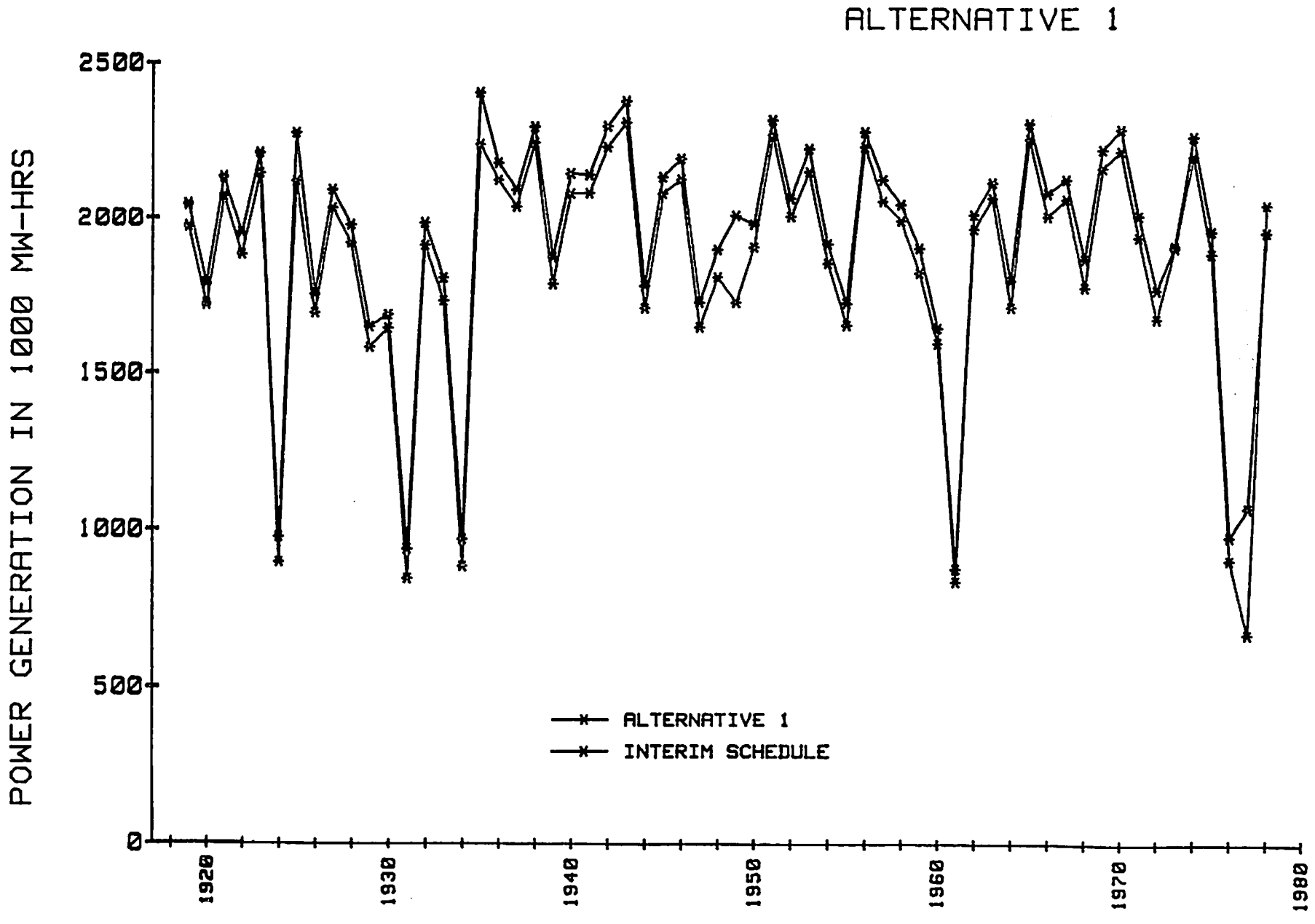
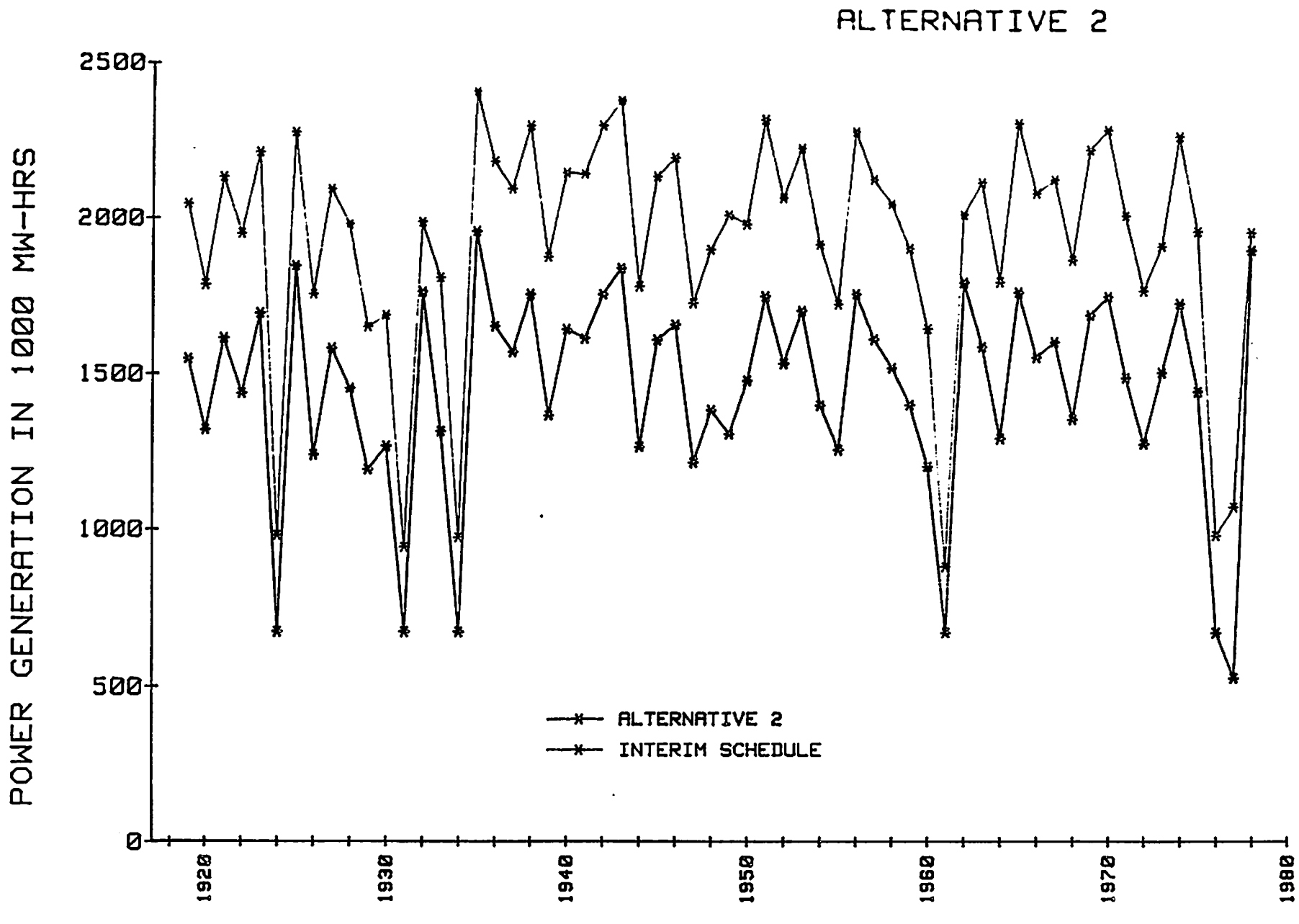

ALTERNATIVE 1
POWER GENERATION IN 1000 MW-HRS
2500
2000
1500
1000
500
0
1920
1930
1940
1950
1960
1970
1980
ALTERNATIVE 1
INTERIM SCHEDULE

Figure 21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POWER GENERATION IN 1000 MW-HRS
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2000
1500
1000
500
0
1920
1930
1940
1950
1960
1970
1980
ALTERNATIVE 2
INTERIM SCHEDULE

Figure 22

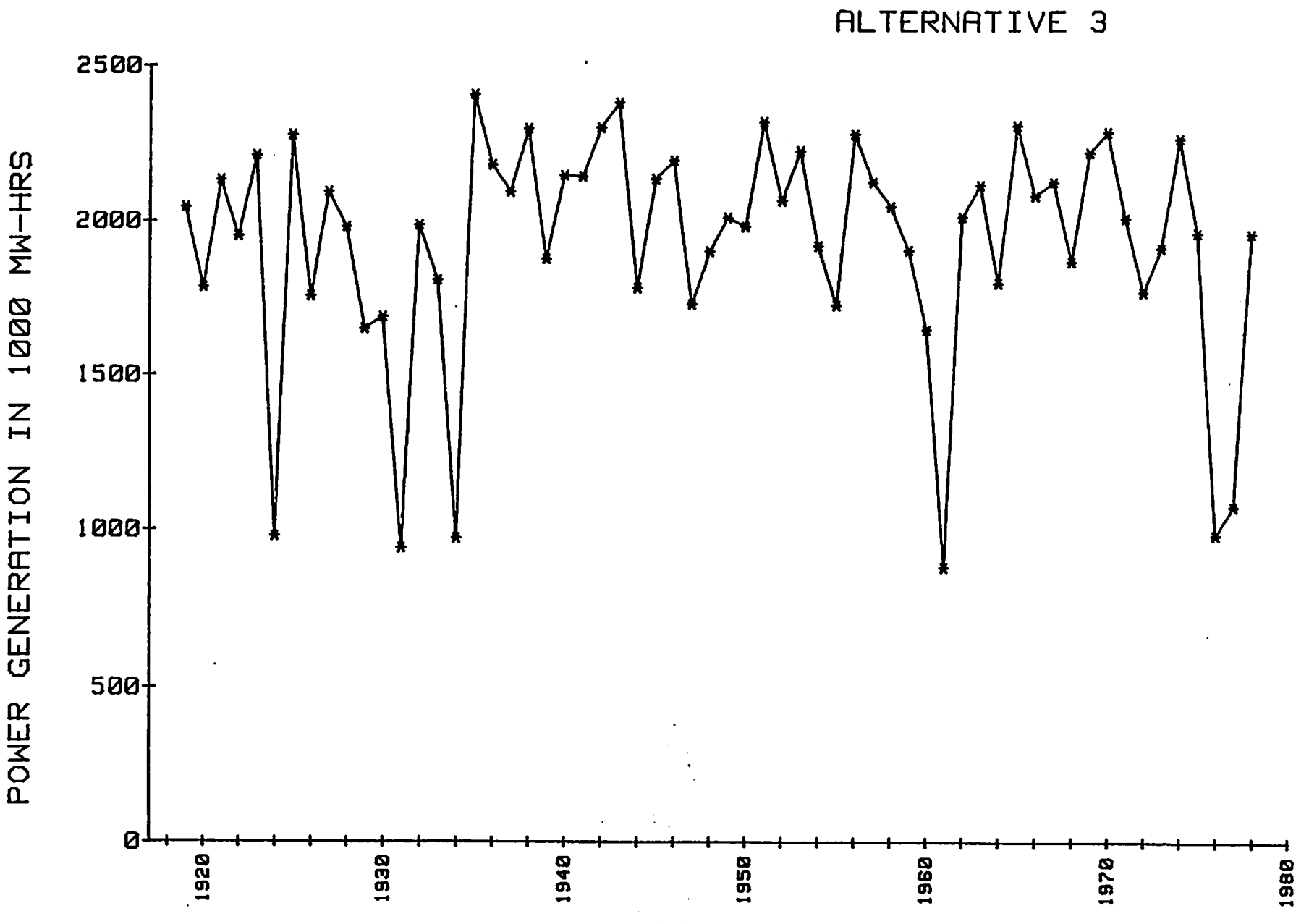
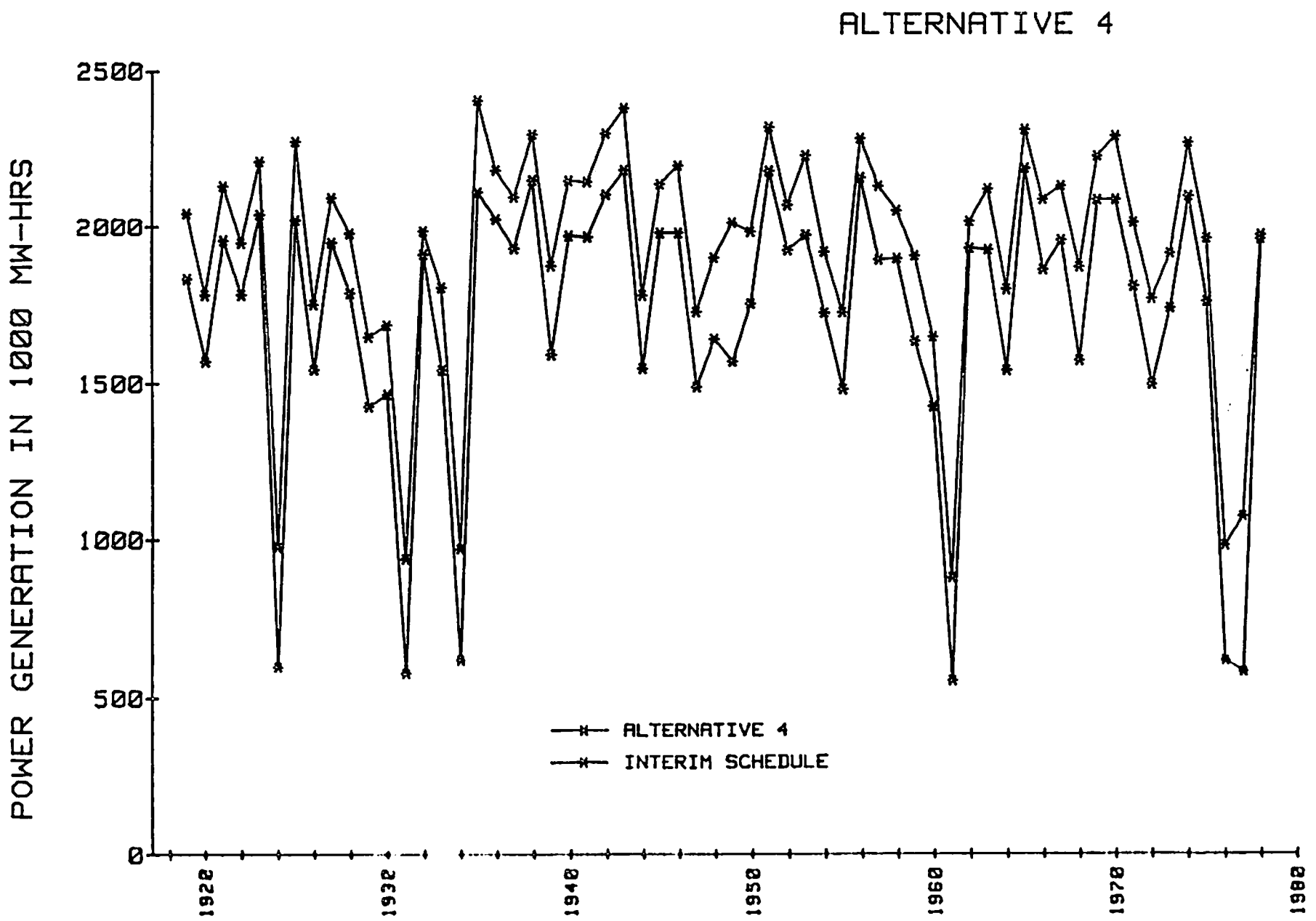

ALTERNATIVE 3
POWER GENERATION IN 1000 MW-HRS
2500
2000
1500
1000
500
0
1920
1930
1940
1950
1960
1970
1980

Figure 23


ALTERNATIVE 4
POWER GENERATION IN 1000 MW-HRS
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2000
1500
1000
500
0
1920
1930
1940
1950
1960
1970
1980
ALTERNATIVE 4
INTERIM SCHEDULE

Figure 24

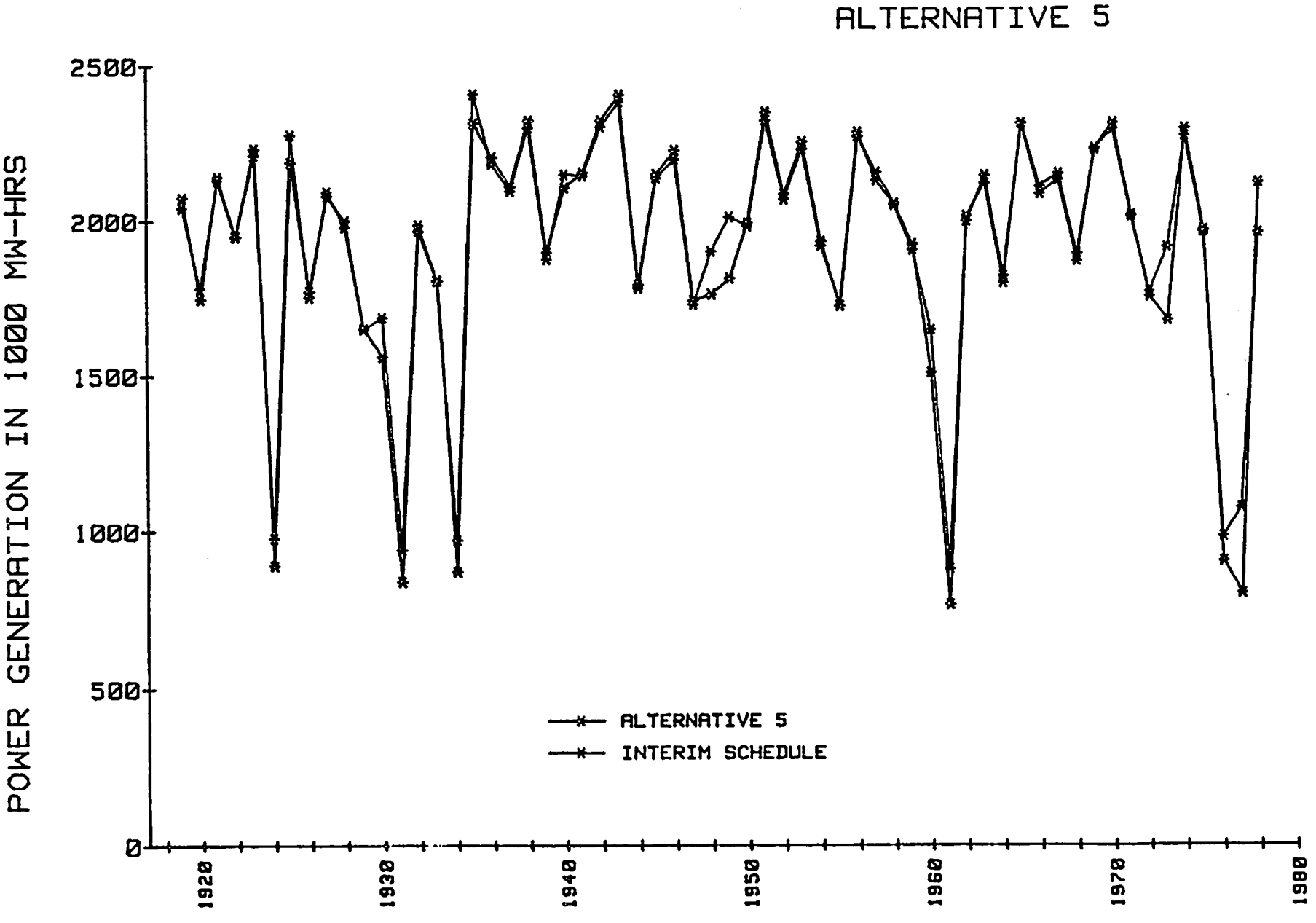
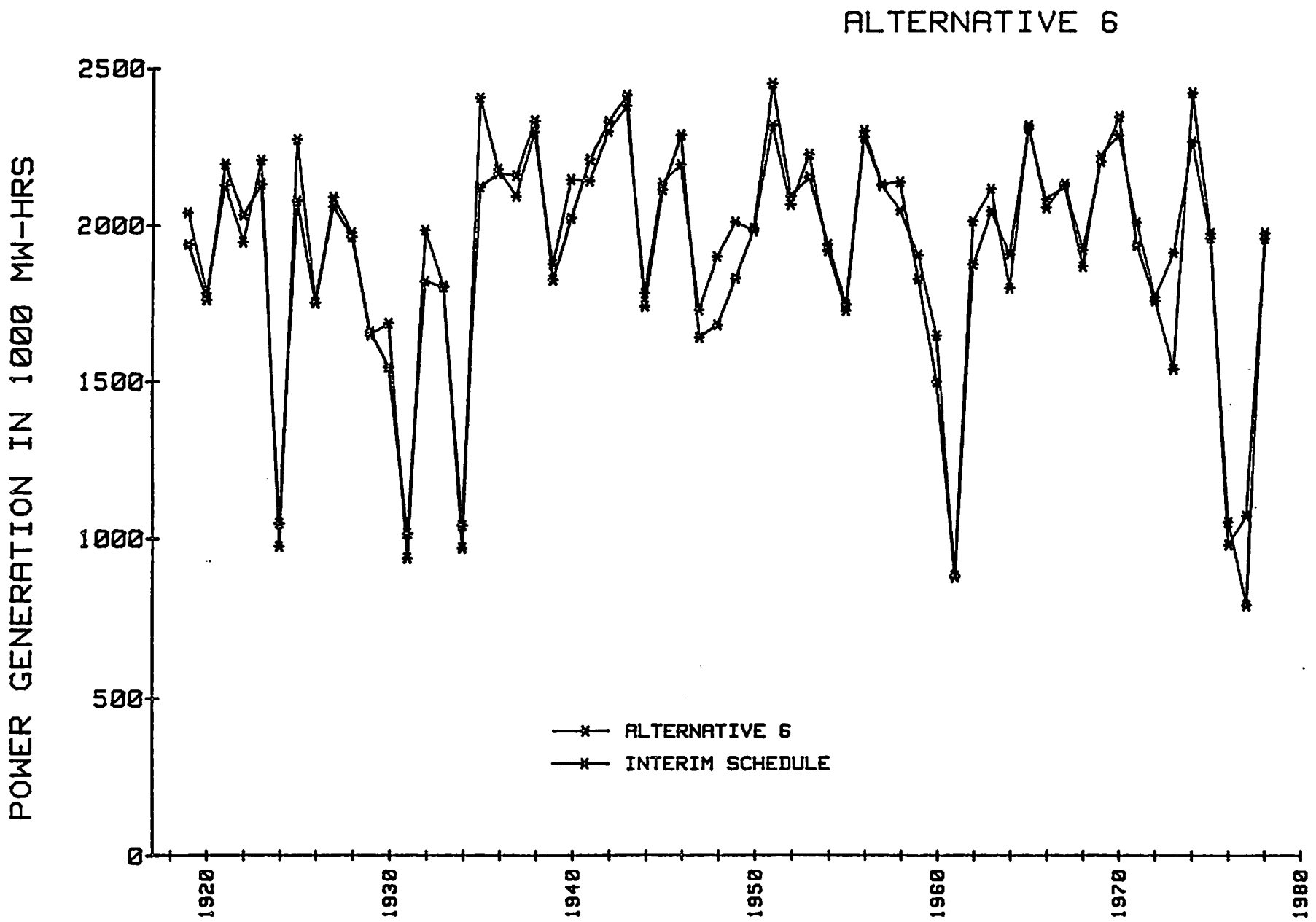

ALTERNATIVE 5
POWER GENERATION IN 1000 MW-HRS
2500
2000
1500
1000
500
0
1920
1930
1940
1950
1960
1970
1980
ALTERNATIVE 5
INTERIM SCHEDULE

Figure 25


ALTERNATIVE 6
POWER GENERATION IN 1000 MW-HRS
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2000
1500
1000
500
0
1920
1930
1940
1950
1960
1970
1980
ALTERNATIVE 6
INTERIM SCHEDULE

Figure 26

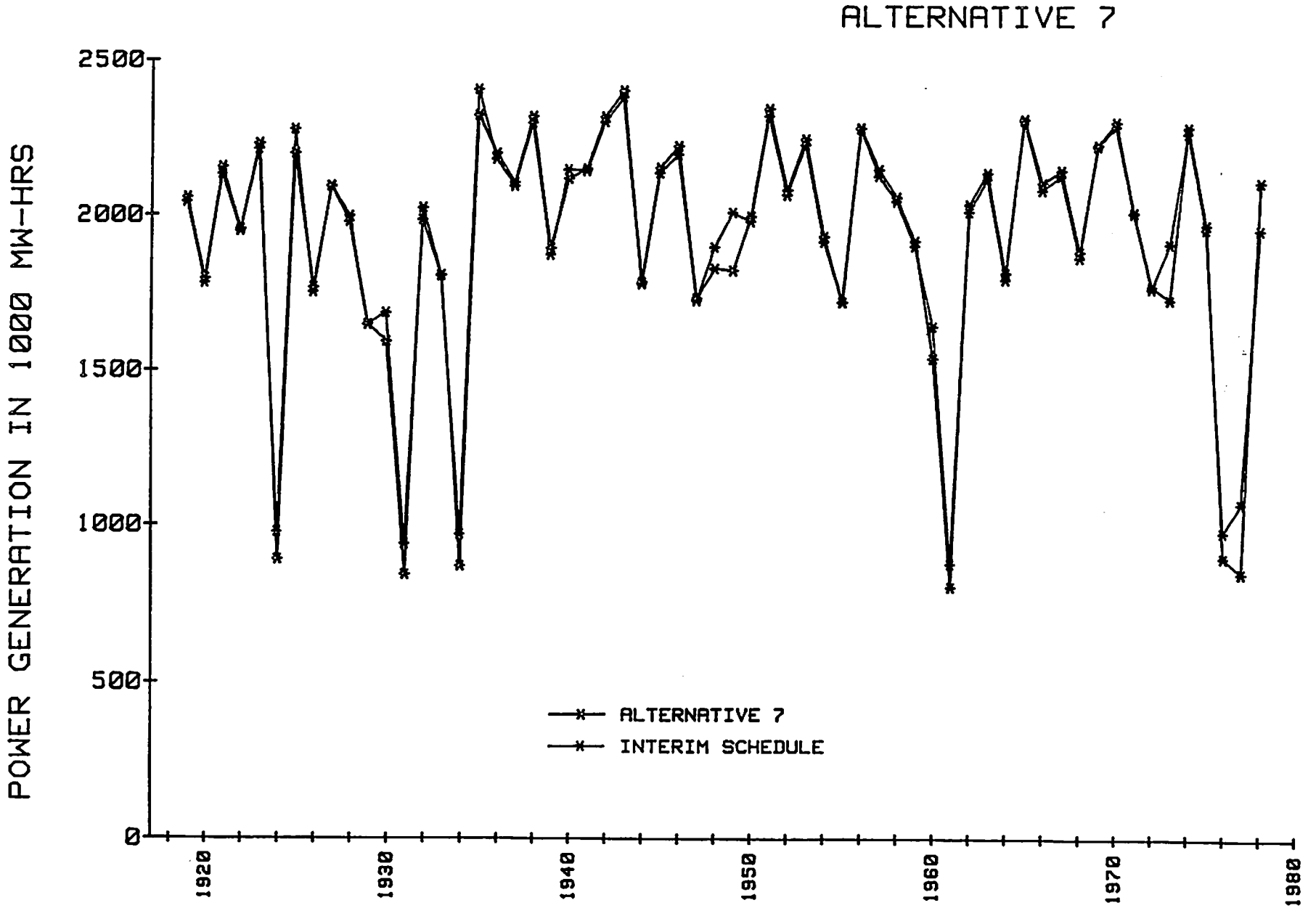
ALTERNATIVE 7
POWER GENERATION IN 1000 MW-HRS
2500
2000
1500
1000
500
0
1920
1930
1940
1950
1960
1970
1980
ALTERNATIVE 7
INTERIM SCHEDULE

Figure 27

Consequences of the Alternatives on Water Supply

Both the Hetch Hetchy System and the Don Pedro Project are included in the analysis of water supply impacts conducted by the Water and Power Resources Service. The study assumptions are presented in Appendix S. The City and County of San Francisco, by bearing a portion of the construction costs for Don Pedro Dam have obtained storage rights at that impoundment (although they have no power generation or water conveyance facilities associated with the project). Water credits (up to 570,000 AF) accumulate in Don Pedro reservoir and are used during dry years to meet the superior downstream water rights of the Turlock and Modesto Irrigation Districts. During "dry" periods, the Grantee's may be able to divert all of the runoff occurring above Early Intake Dam (with the exception of the fishery flows) to San Francisco and meet the downstream water rights by withdrawing credits from their account. Flow released from Hetch Hetchy to the river for fishery and recreational uses are added to the Grantee's account at New Don Pedro.

For the analysis, it was assumed that the Cherry Aqueduct would be used (as it was during the 1976-1977 drought) to convey water to Early Intake Reservoir for subsequent diversion to San Francisco. The frequency of use is expected to increase as San Francisco's diversion rate approaches their maximum entitlement.

Under the present maximum diversion rate (263,000 AF), full delivery would be possible for the entire period of analysis, 1918 to 1978, under each of the alternatives.

In the following disucssion of water supply impacts, the maximum anticipated diversion (448,000 AF) was assumed.

Alternative 1 (Recommended Plan)

During an extremely dry year such as 1977 (27% of normal) or during an extended dry period similar to the 1929 to 1935 interval, the fishery and recreational flows would reduce slightly the Grantee's ability to meet their maximum anticipated water demand.

Based on the operation study results, the Grantees would have been able to meet their maximum water demand in 52 of the 60 years analyzed (Figure 28). Water supply deficiencies would have hypothetically occurred in 1924, 1931, 1932, 1934, 1961, 1962, 1977 and 1978. The deficiency would have been least severe in 1924 (98.5% of maximum) and most severe in 1977 (82.5% of maximum). However, because of the superior downstream water rights of the Turlock and Modesto Irrigation Districts, only about 30,000 AF of the 78,000 AF deficiency (1977) is attributable to stream maintenance releases.

Even without provisions for minimum streamflow, water supply deficiencies would have occurred on 5 occasions (1925, 1933, 1962, 1977 and 1978).

In response to the State Water Resources Control Board's request for a voluntary 25% reduction in water consumption during the 1976-1977 California drought (the most severe in terms of intensity), the Hetch Hetchy water customers achieved a 35% reduction. If it is assumed that the water users will again respond with this level of water conservation, their needs can be met during any similar dry period. In the event that conservation measures alone are inadequate, the reduction of stream maintenance flows could provide some additional water to the Grantee, depending on downstream water rights. Streamflow and reservoir conservation pools were commonly reduced below the established minimum levels when the need was justified. It should be noted that the Grantee's request for flow reduction in the Tuolumne River during this period was denied because their supplies were judged adequate.

Alternative 2 (Pre-Canyon Power Project)

Implementation of the flow schedule under this alternative would improve the Grantee's ability to satisfy their maximum anticipated water demand by reducing power only releases and providing concurrent streamflow and water delivery releases. However, during some low runoff periods, slight deficiencies would still occur (Figure 29).

Alternative 3

Under this alternative, the "interim" flow schedule would remain in effect with no change in the Grantee's ability to meet their anticipated maximum diversion. However, during 7 years of the 60 year analysis period, the maximum diversion level would not be attained and during the most severe period (1978), a 13% deficiency would be required (Figure 30).

Alternative 4

Implementation of this alternative would result in minor but frequent water diversion reductions in most years and in much larger reductions (up to 31%) on 6 occasions (Figure 31). Of the alternative considered, the impact on the Grantee's ability to meet their water demand would be greatest under this plan.

Alternative 5

If this plan were implemented, based on the WPRS operation study, the Grantee would be able to divert their maximum anticipated demand during 49 years of the 60 year period (Figure 32). During the 11 deficient periods, water supply reductions ranging from 2% (1924) to 20% (1977) would result. However, of the 90,000 AF deficiency required in 1977, about 30,000 AF resulted from the stream maintenance releases; and 60,000 AF from downstream water rights.

The scheduled flow releases that would be made under alternative 5 are never higher than those of alternative 1 and yet water supply deficiencies would occur more frequently and to a greater extent. This occurs because greater quantities of water are released for power generation alone in accordance with operation criteria developed on information provided by San Francisco. Even though their water supply is the Grantee's first priority, a reasonable balance between generation and water supply is necessary in any realistic operation plan because of the variation in precipitation and runoff.

The Grantee's ability to meet their maximum water demand would be reduced by this alternative. This reduciton is not considered severe and could be further minimized by making tradeoffs with power generation.

Alternative 6

The implementation of this alternative (Figure 33) would have nearly the same impact on water supply as that described in the discussion of alternative 5. However, the recapture provision for a portion of the fishery flow at Early Intake Reservoir would provide for full water demand in 1924, 1931 and 1934, periods which were deficient under alternative 5. The Grantee would be unable to divert their maximum entitlement on 8 occasions, with the water supply reductions ranging from 4% (1930) to 24% (1977). However, only 60,000 AF of the 107,000 AF deficiency required in 1977 is attributable to required

stream maintenance releases. Releases to meet downstream water rights account for the remaining 47,000 AF. Recapture of streamflow releases would have occurred during 17 of the 60 year study period.

The diversion of larger quantities of water from the Tuolumne River at Early Intake Reservoir into Mountain Tunnel presumably could require additional water treatment by filtration or chemical means. The degree of treatment or its necessity has not been determined.

Alternative 7

Under this alternative, water supply deficiencies would occur in 10 years of the 60 year study period, ranging from a low of 2% in 1924 to a high of 26% in 1977 (Figure 34). Only 40,000 AF of the 113,000 AF deficiency required in 1977 is attributable to stream maintenance flows with releases made in order to meet the downstream water rights accounting for the other 73,000 AF. Implementation of this alternative would result in some impairment to the Grantee's ability to meet their water demand relative to interim conditions.

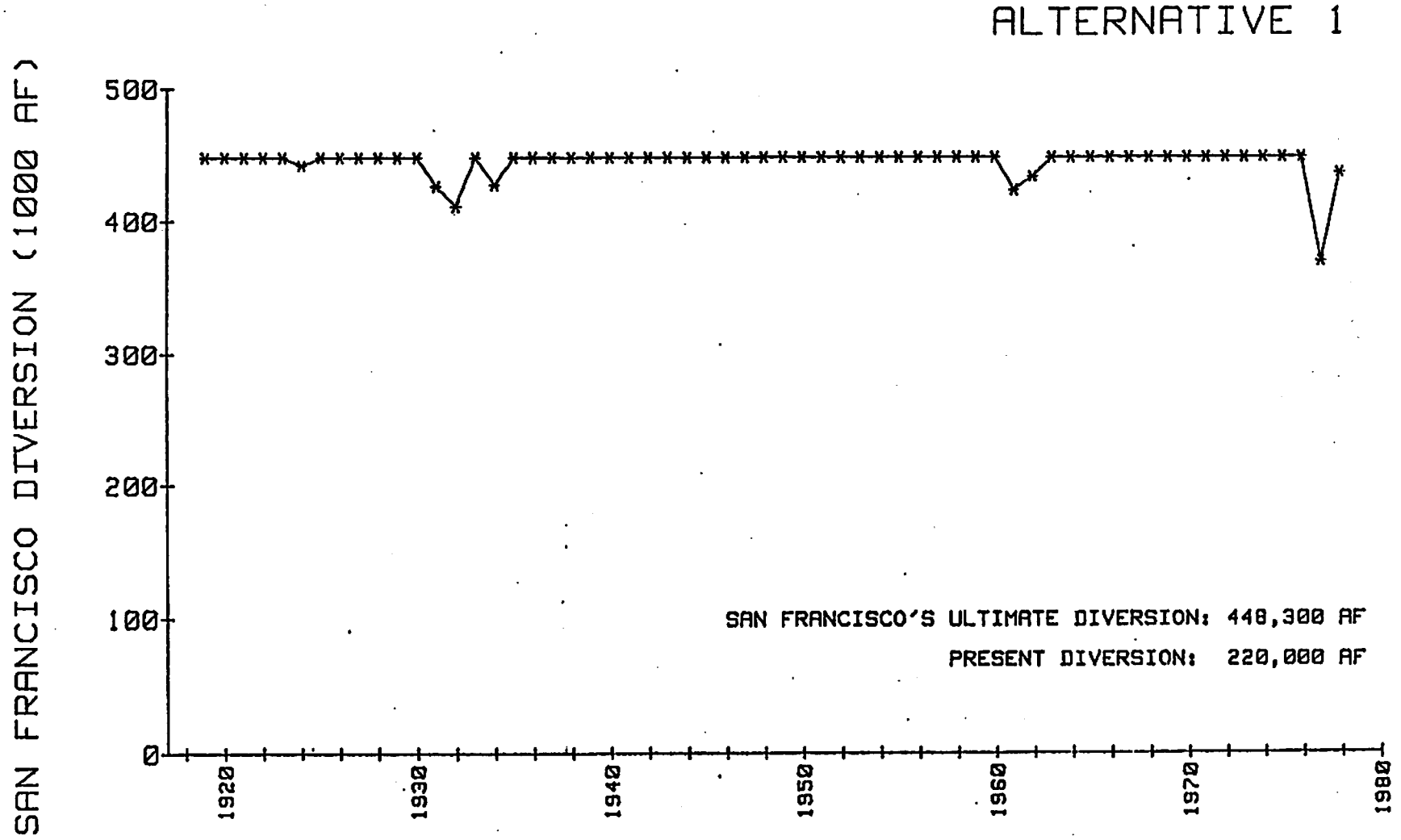
ALTERNATIVE 1
SAN FRANCISCO DIVERSION (1000 AF)
500
400
300
200
100
0
1920
1930
1940
1950
1960
1970
1980
SAN FRANCISCO'S ULTIMATE DIVERSION: 448,300 AF
PRESENT DIVERSION: 220,000 AF

Figure 28

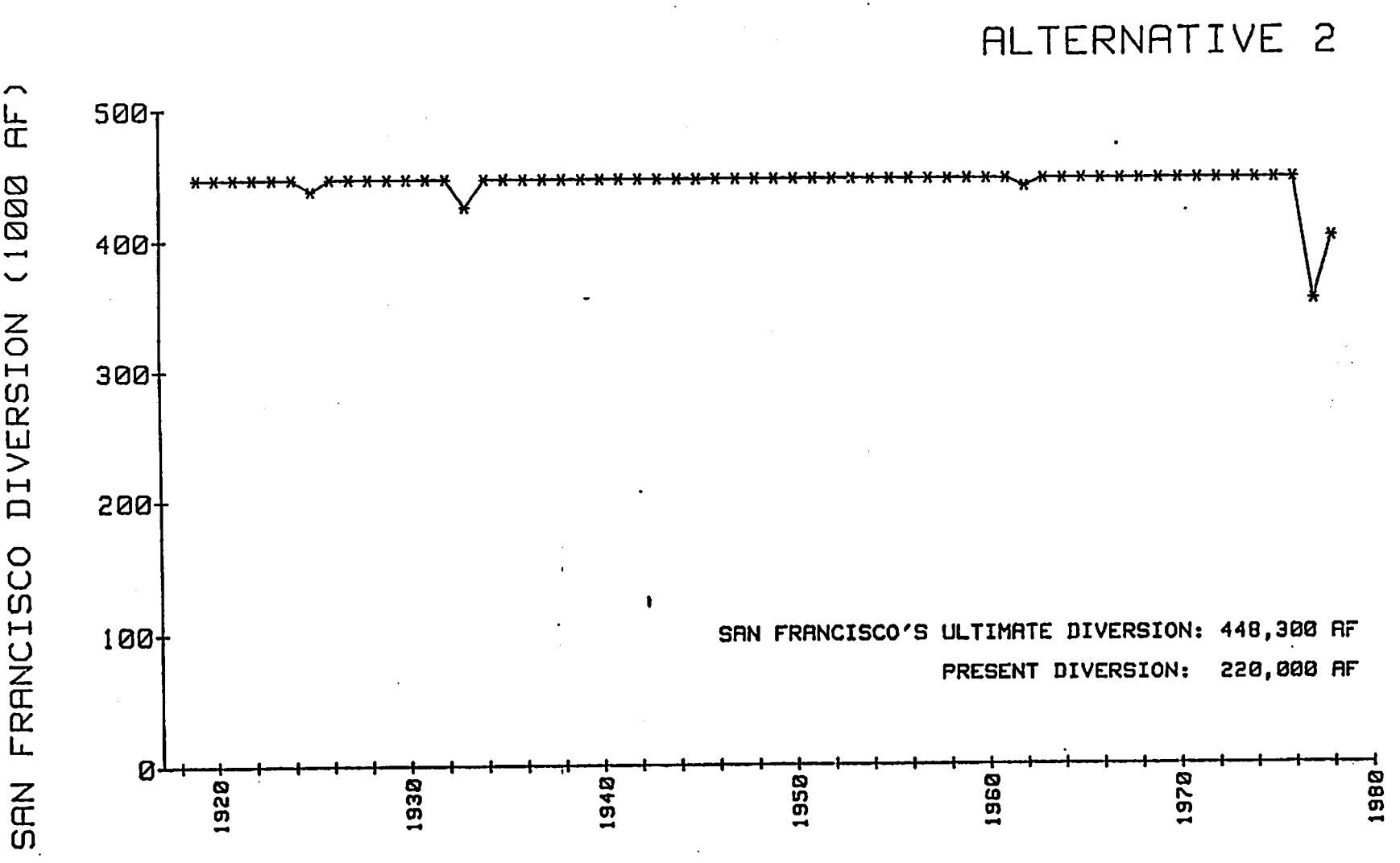
ALTERNATIVE 2
SAN FRANCISCO DIVERSION (1000 AF)
500
400
300
200
100
0
1920
1930
1940
1950
1960
1970
1980
SAN FRANCISCO'S ULTIMATE DIVERSION: 448,300 AF
PRESENT DIVERSION: 220,000 AF

Figure 29

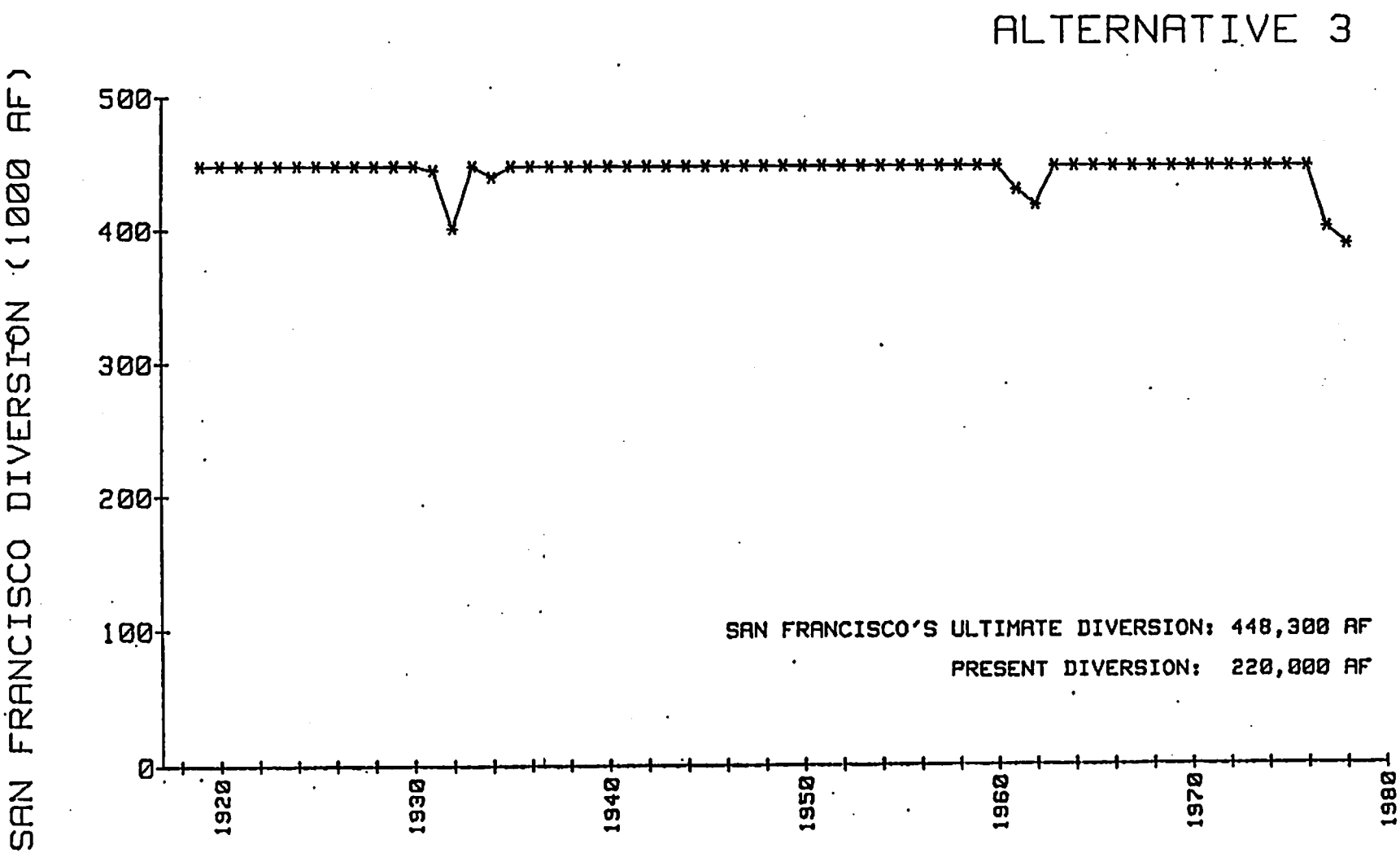
ALTERNATIVE 3
SAN FRANCISCO DIVERSION (1000 AF)
500
400
300
200
100
0
1920
1930
1940
1950
1960
1970
1980
SAN FRANCISCO'S ULTIMATE DIVERSION: 448,300 AF
PRESENT DIVERSION: 220,000 AF

Figure 30

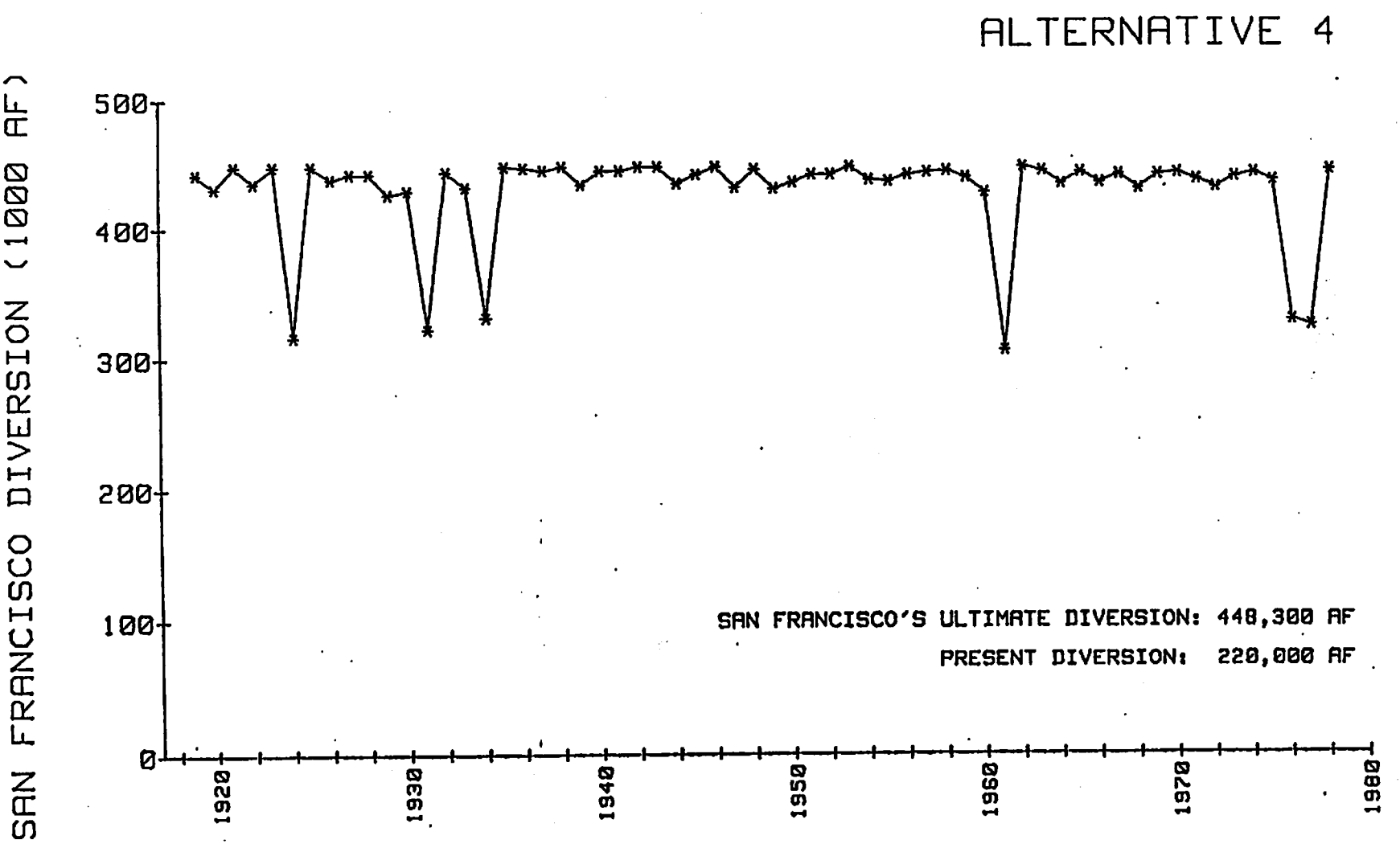
ALTERNATIVE 4
SAN FRANCISCO DIVERSION (1000 AF)
500
400
300
200
100
0
1920
1930
1940
1950
1960
1970
1980
SAN FRANCISCO'S ULTIMATE DIVERSION: 448,300 AF
PRESENT DIVERSION: 220,000 AF

Figure 31

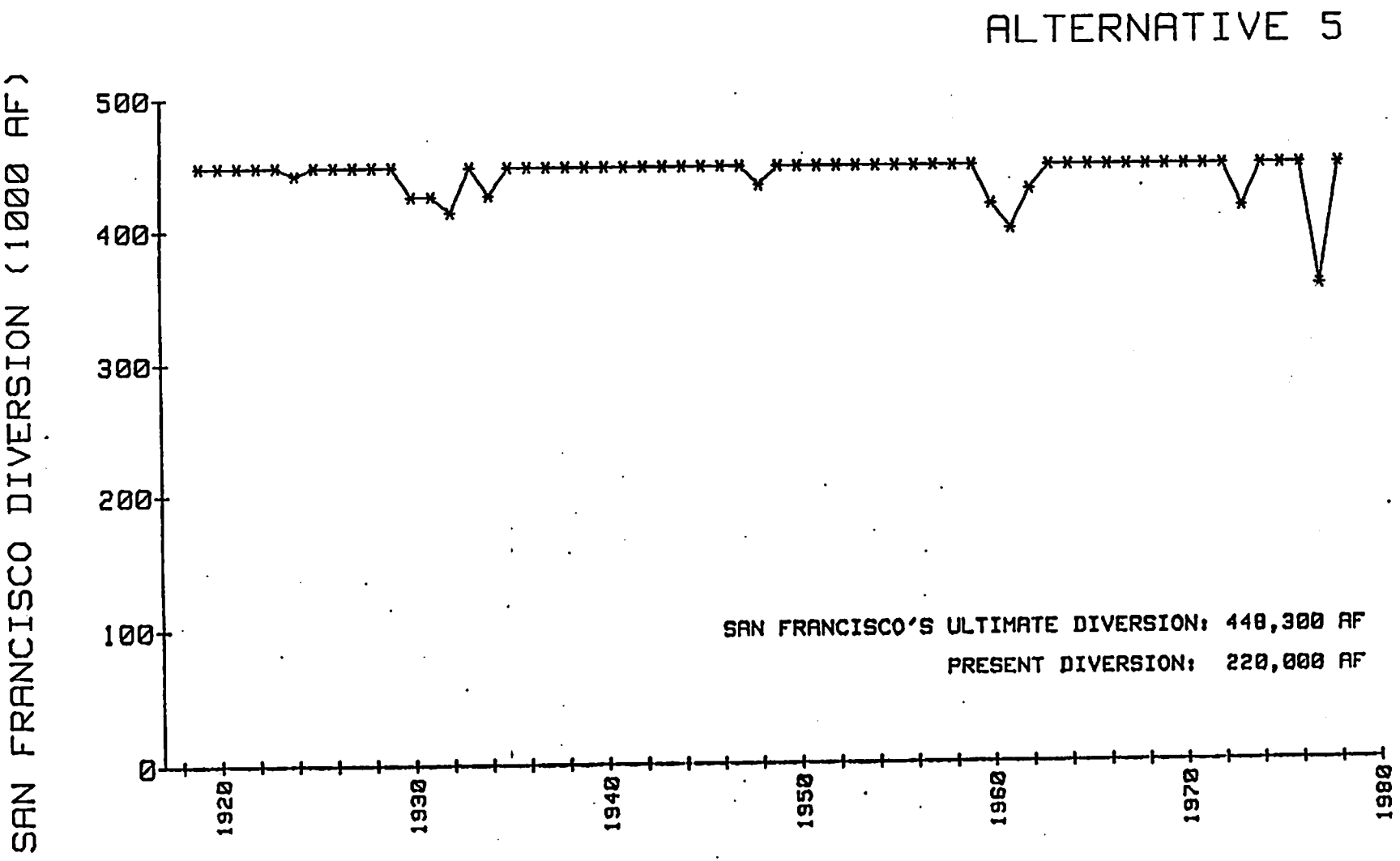
ALTERNATIVE 5
SAN FRANCISCO DIVERSION (1000 AF)
500
400
300
200
100
0
1920
1930
1940
1950
1960
1970
1980
SAN FRANCISCO'S ULTIMATE DIVERSION: 440,300 AF
PRESENT DIVERSION: 220,000 AF

Figure 32

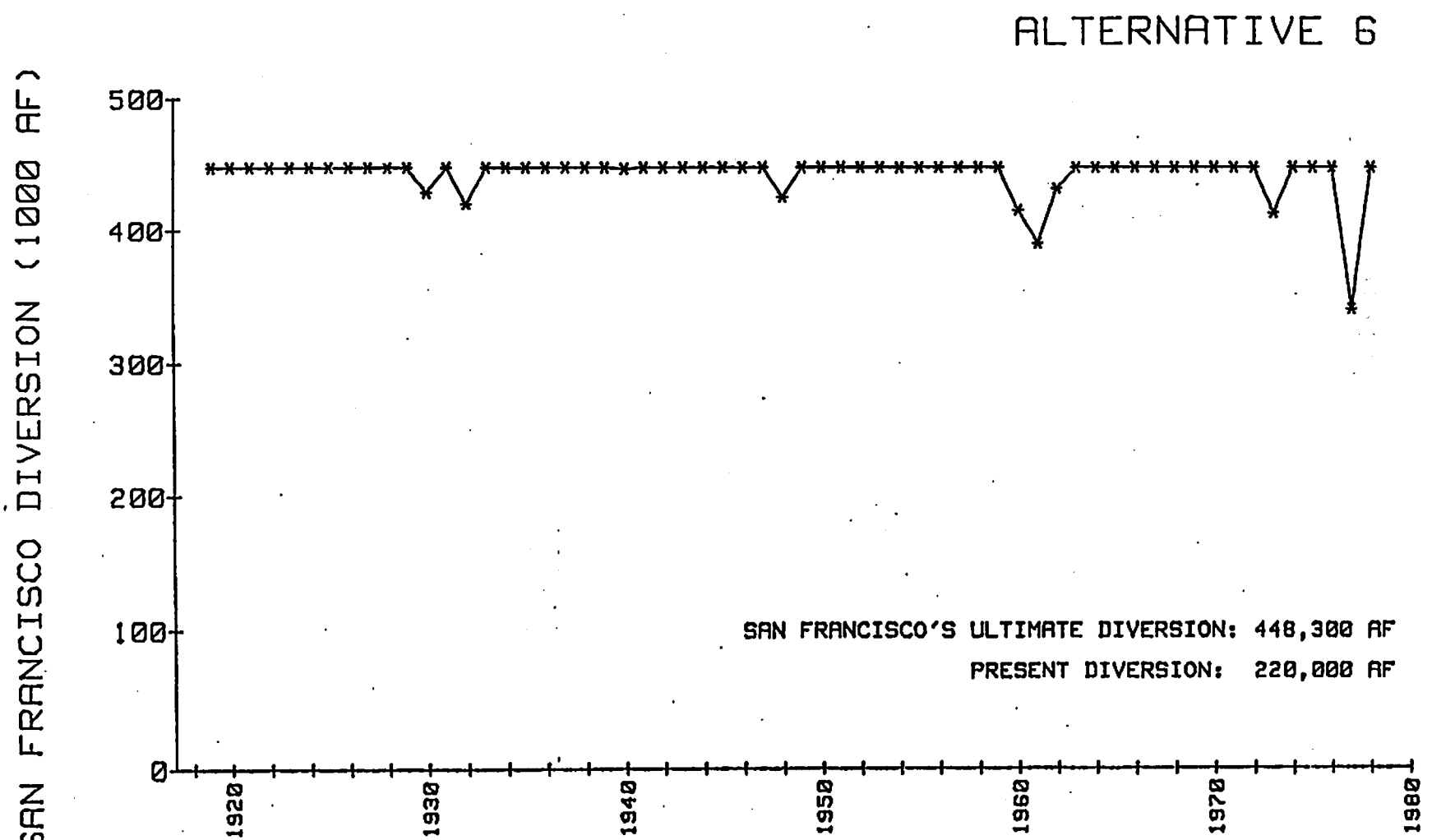
ALTERNATIVE 6
SAN FRANCISCO DIVERSION (1000 AF)
500
400
300
200
100
0
1920
1930
1940
1950
1960
1970
1980
SAN FRANCISCO'S ULTIMATE DIVERSION: 448,300 AF
PRESENT DIVERSION: 220,000 AF

Figure 33

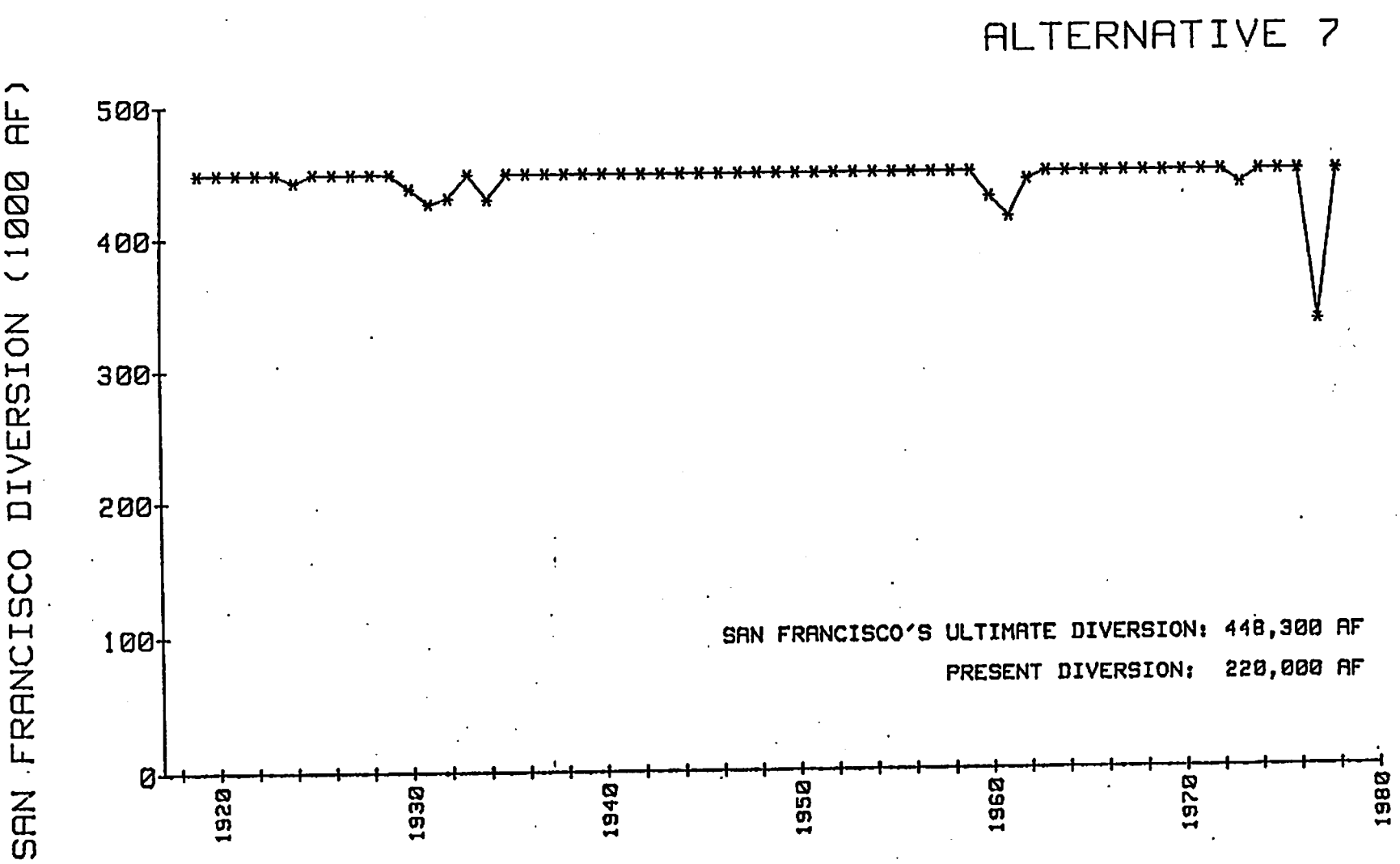
ALTERNATIVE 7
SAN FRANCISCO DIVERSION (1000 AF)
500
400
300
200
100
0
1920
1930
1940
1950
1960
1970
1980
SAN FRANCISCO'S ULTIMATE DIVERSION: 448,300 AF
PRESENT DIVERSION: 220,000 AF

Figure 34

Summary of the Project Alternatives

The anticipated impact of each alternative on the fishery, recreation/ aesthetics, power generation and water supply is presented in Table 7.

Alternative 1 (Recommended Flow Schedule)

Implementation of the recommended action would not return the fishery resource to the high level which existed during the pre-Canyon Power Project period but would improve conditions to a significant degree above that which presently occurs under the interim flow schedule. Trout habitat would increase and satisfactory water temperatures would be provided. With respect to recreational values and aesthetics, acceptable levels would occur. Power generation would increase on the average 425 thousand MW-Hrs (AAG) and 61 MW (SDC) above the pre-Canyon Power Project level and would be equal to 96% and 85% (90% if Don Pedro is included) of the "interim schedule" generation potential. The potential for this alternative to impact water delivery to the San Francisco Bay Area is slight. It would increase by 3% the frequency that the maximum anticipated diversion could not be provided over that provided by the pre-Canyon Power Project flows. No impact would occur under the present rate of diversion (220,000 AF).

Table 7.

ALT	FISHERY	RECREATION/AESTHETICS	POWER GENERATION AAG[2] (1000 MW-Hrs)	POWER GENERATION SDC[3] (MW)	WATER SUPPLY[4]
1	Good	Minimum Acceptable	1855	333	52
2	Best[1]	Good	1454	291	54
3	Impaired	Impaired	1928	371	53
4	Best	Good	1711	285	10
5	Impaired	Impaired	1909	336	49
6	Impaired	Impaired	1903	336	52
7	Impaired	Impaired	1918	337	50

1/ Fishery habitat is estimated to be greatest under this alternative, though actual field measurements are lacking; fishability,however, may be moderately impaired.

2/ Average annual generation from Kirkwood, Moccasin and Holm Powerhouses.

3/ Dependable capacity from Kirkwood, Moccasin, Holm and Don Pedro Powerhouses.

4/ The number of years that San Francisco's full water demand (448,000 AF) would have been available based on the 80-year analysis period, 1918-[illegible].

Alternative 2 (No Canyon Power Project)

The fishery resources would return to its highest level in response to the high and stabilized streamflow of pre-Canyon Power Project period. Recreational and aesthetic values would also be high, though some water contact use would be reduced and possibly even precluded. Power generation would be impacted to the greatest extent under this alternative as there would be no generation from Kirkwood Powerhouse. However, water delivery dependability would be improved and would be the best under this alternative.

Alternative 3 (interim schedule)

The Tuolumne River fishery would continue to be impaired by reason of insufficient flow which results in excessively high water temperatures and significant reductions in fish habitat. Recreation and aesthetic values would also remain at a reduced and imparied level.

The river maintenance flow of this alternative is only one half of quantity (150 cfs) evaluated by the U.S. Forest Service to be the minimum flow necessary to maintain the outstanding scenic and recreational values for public use and enjoyment. The generation of electrical power would remain at the current high level, highest of the alternatives evaluated. Water supply dependability would be second to only the pre-Canyon Power Project alternative. Full water delivery would be provided 88% of the time. Water supply deficiencies of up to 13%, however, would still occur.

Alternative 4

Under this alternative, the fishery resource would not be expected to reach the pre-Canyon Power Project level but would be much improved over the interim condition level. Recreation and aesthetic values would be the highest under this alternative. Power generation in terms of average annual generation and dependable capacity would increase above pre-Canyon Power Project levels by 250 thousand MW-Hrs and 15 MW, respectively. Compared to interim conditions, AAG and SDC would be reduced by 217 thousand MW-Hrs (11%) and 95 MW (33%), respectively. Water supply impacts would be relatively severe with reductions of 1% to 27% occurring in 50 out of 60 years.

Alternative 5

The Tuolumne River fishery would not reach the high level which existed prior to the construction of the Canyon Power Project but would be an improvement over the interim level. The outstanding scenic and recreational values of the Tuolumne River would be maintained during "normal" or wetter periods (60% occurrence) but would be impaired during "moderate" (20%) and "dry" (20%) periods. Each schedule, however, would be an improvement over interim conditions. Power generation relative to interim conditions would only be mildly impacted by implementation of this alternative, resulting in reductions of 1% in average annual generation and 14% in dependable capacity to the Hetch Hetchy System. When compared with pre-Canyon Power Project conditions, increases of 24% in AAG and 17% in SDC would occur. Only minor impacts to water supply dependability

would result from the implementation of this alternative. The Grantee's maximum future demand would be met in 49 of the 60 year analysis period (interim, 53 of 60). The maximum deficiency that would be required as a consequence of the stream maintenance releases would be about 7%.

Alternative 6

The impact of this alternative on the fishery, recreation and aesthetic values of the Tuolumne River between O'Shaughnessy Dam and Early Intake Reservoir would be similar to that presented under Alternative 5. Between Early Intake Reservoir and the Cherry River confluence, the fishery would be improved by higher flows and/or more suitable water temperatures depending on the flow schedule in effect. Recreational use other than fishing would be more influenced by quantity; increasing under schedule A, remaining about the same under schedule B and decreasing under schedule C. Downstream from the Cherry River confluence, the 90 cfs minimum release from Holm Powerhouse during periods of flow recapture at Early Intake Dam, should help maintain the fishery resource at a higher level. As a result, fishermen should increase in number. Since the increase in the minimum flow by 90 cfs would not provide satisfactory rafting conditions or the visual qualities associated with the normal 800+ cfs release, other user groups are expected to increase in number to a limited degree. Compared to pre-Canyon Power Project conditions, AAG and SDC would increase by 24% and 16%, respectively. Implementation of this alternative with respect to interim conditions would result in a 1% reduction on AAG and a 14% reduction in SDC (9% SDC reduction to

Tuolumne System). Water supply dependability would be only slightly impacted under this alternative. Water delivery deficiencies would be more frequent (13% compared to 10%) but not more severe.

Alternative 7

Implementation of this alternative would not result in the maintenance of acceptable fishery, recreation or aesthetic values because of the reductions in river maintenance releases that would occur up to 70% of the time. Compared to interim conditions, fishery, recreation and aesthetic values would improve under schedules A, B and C (85% occurrence) but would be further reduced under schedule D. The impact of this alternative on power generation is slight, resulting in 1% and 13% reductions in AAG and SDC. Water supply dependability would be only slightly imparied. Failure to meet maximum diversion would occur during 3 additional periods but would result in less severe reduction (9% compared with 13% under interim conditions).

Appendix

A. Letter of August 6, 1959, from City Attorney, San Francisco, California to Department of Interior.

B. Letter of April 27, 1961, from Secretary of the Interior, Washington, D.C., to City Attorney, San Francisco, California.

C. "Stipulations for Relocation and Amendment of Right-of-Way for Tunnel Aqueduct ...", May 3, 1961.

D. "Tuolumne River Flow Study - Canyon Power Project, California" Approved by R. Kahler Martinson, Region I (1976).

E. Letter of October 6, 1979, from General Manager, Public Utilities Commission, City and County of San Francisco, California to the Secretary of the Interior.

F. Letter of December 13, 1976, from Assistant Secretary for Fish, Wildlife and Parks to General Manager, Public Utilities Commission, City and County of San Francisco, California.

G. Memorandum of March 4, 1977, form Field Solicitor, San Francisco, California to Associate Solicitor, Conservation and Wildlife.

H. 1970 and 1977 population study comparison for "catchable size" trout.

I. 1970 and 1977 population study comparison for "sub-catchable size" trout.

J. "Stipulation for Amendment of Rights-of-Way for Canyon Power Project ..." January 26, 1965.

K. Letter of January 23, 1973, from General Manager, Hetch Hetchy Water and Power to Field Supervisor, Bureau of Sport Fisheries and Wildlife, Sacramento, California.

L. Tuolumne River Flow Study Report - 1978 by Robert Lewis.

M. Tuolumne River Flow Study Report - 1979 by Robert Lewis.

N. Letter of November 7, 1972, from Deputy Forest Supervisor, U.S. Forest Service (Stanislaus National Forest), Sonora, California, to Field Supervisor, Bureau of Sport Fisheries and Wildlife, Sacramento, California.

O. Letter of March 10, 1972, from Superintendent (Acting), National Park Service, Yosemite National Park, California Field Supervisor, Bureau of Sport Fisheries and Wildlife, Sacramento, California.

P. Letter of December 30, 1958, from Manager, and Chief Engineer, Public Utilities Commission, City and County of San Francisco, California to Regional Forester, Department of Agriculture, U.S. Forest Service, San Francisco, California.

Q. Petioner's Reply Brief, filed March 31, 1960, signed by City Attorney, Dion Holm.

R. Canyon Tunnel Diversions, 1967-1978, from General Manager, Public Utilities Commission, San Francisco, California to staff, U.S. Fish and Wildlife Service, Sacramento, California.

S. "Upper Tuolumne River Operations Logic and Assumptions", Water and Power Resources Service, September 16, 1980.

T. Power Analysis for the Tuolumne River Operation Studies, Water and Power Resources Service, September, 1980.

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UNITED STATES DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE

ENVIRONMENTAL ASSESSMENT

TUOLUMNE RIVER FLOW SCHEDULE REVISION

(CANYON POWER PROJECT)

APPENDIX

A*P*P*E*N*D*I*X

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

REGION I
PORTLAND, OREGON

TUOLUMNE RIVER
FLOW SCHEDULE REVISION
(CANYON POWER PROJECT)
CALIFORNIA

A Report By The U.S. Fish And Wildlife Service On The Proposed Modification Of Minimum Flow Requirements Below O'Shaughnessy Dam, Yosemite National Park, California, With Assistance From The National Park Service, The U.S. Forest Service, The U.S. Geological Survey, The Water and Power Resources Service And The California Department of Fish And Game

Approved: February 6, 1981

By: _____
FOR R. Kahler Martinson
Regional Director

A*P*P*E*N*D*I*X

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T. Power Analysis for the Tuolumne River Operation Studies, Water and Power Resources Service, September, 1980.

APPENDIX A

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MORRIS M. DOW,
Deputy City Attorney
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Attorneys for Petitioner

UNITED STATES DEPARTMENT OF THE INTERIOR

DIRECTOR OF THE BUREAU OF LAND MANAGEMENT

In re

CITY AND COUNTY OF SAN FRANCISCO, a municipal corporation,

Petitioner.

NOTICE OF APPEAL, REASONS AND ARGUMENT

TO THE Manager of the Sacramento Land Office, Mr. Walter E. Beck, Bureau of Land Management, United States Department of the Interior; the Regional Director, Region Four, National Park Service; and the Regional Forester, Forest Service, U.S. Department of Agriculture:

PLEASE TAKE NOTICE that the City and County of San Francisco, a municipal corporation, is adversely affected by a decision of an officer of the Bureau of Land Management and wishes to appeal to the Director of the Bureau of Land Management, United States Department of the Interior, from that certain Decision dated July 9, 1959, bearing serial number Sacramento 010130, over the signature of Mr. Walter Beck, Manager.

REASONS FOR THE APPEAL

I.

The said Decision requires that in return for an amended location of a tunnel right of way, the Applicant, the City and County of San Francisco, accept paragraph No. 14 of stipulations proposed by the National Park Service, and paragraph No. 11 of stipulations proposed by the Forest Service, which said paragraphs are identical in wording and read as follows:

"Applicant will release water to stream flow from O'Shaughnessy Dam according to the following schedule:

Period	Release from O'Shaughnessy Dam in Sec. Ft. Normal Yr.	Dry Yr.
May 1 through September 15	80	40
September 16 through April 30	40	25

"Provided that releases shall be measured at the existing gaging station located approximately three-fourths mile below O'Shaughnessy Dam; and provided that the terms 'normal' and 'dry' as used in the above schedules, shall be based upon the forecasted April-July runoff of the Tuolumne River near Hetch Hetchy as given by the California Department of Water Resources' April 1 forecast; and provided further that within the meaning of the above schedules the normal year shall be one in which such April-July runoff is forecasted to be at least 450,000 acre feet while the dry year shall be one in which such runoff is forecasted at less than 450,000 acre feet."

II.

The said Decision requires that in return for an amended location of a tunnel right of way, the Applicant, the City and County of San Francisco, accept paragraph No. 16 of the

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stipulations proposed by the National Park Service, and paragraph No. 15 of the stipulations proposed by the Forest Service, which said paragraphs are identical in wording and read as follows:

"In addition to the releases provided for in Paragraph 14* of these stipulations, applicant will interpose no objections to the government diverting and using not to exceed 5 C.F.S. of water on federal lands within the watershed of the branch of the Tuolumne River above Early Intake. To the extent any portion of such 5 C.F.S. of water is used by the government between O'Shaughnessy Dam and Early Intake the releases provided in said Paragraph 14* shall be increased to the extent of such use or uses. This paragraph shall not be construed to add or to limit any rights of the government to the use of the water of the Tuolumne River System."

(* In the Forest Service version of the paragraph, the reference is to paragraph 11.)

ARGUMENT

The Facts: Between the years 1901 and 1911 the City and County of San Francisco in its own right and through its agents made filings to appropriate water from the Tuolumne River within the confines of Yosemite National Park and Stanislaus National Forest. In addition, the City spent in excess of one million dollars in purchasing lands and valid filings on water rights then owned by private individuals or corporations.

By an Act of Congress approved December 19, 1913, known as the Raker Act (38 Statutes at Large, p. 242), San Francisco was granted ". . . all necessary rights of way along such locations

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"and of such width, not to exceed two hundred and fifty feet, as in the judgment of the Secretary of the Interior may be required for the purposes of this Act, . . . for the purpose of constructing, operating and maintaining aqueducts, canals, ditches, pipes, pipe lines, flumes, tunnels and conduits for conveying water for domestic purposes and uses . . .; for the purpose of constructing, operating and maintaining power and electric plants, poles and lines for generation and sale and distribution of electric energy . . .;" and for certain other ancillary purposes. The City, as grantee, was required to file within three years after passage of the Raker Act with the Registrar of the United States Land Office a map or maps of the boundary locations and extent of the proposed rights of way and lands required for the foregoing purposes.

Within three years thereafter, San Francisco filed applications covering the complete Canyon Power Project, all of which were approved. Specifically, San Francisco filed its application (Sacramento Serial No. 07186) for the O'Shaughnessy Dam, which was approved by the Secretary of the Interior on June 9, 1914. This dam has been constructed and in operation for many years.

Under Application Sacramento Serial No. 010130, approved by the Secretary of the Interior on September 22, 1917, the necessary land sites and rights of way for a Steel Penstock, Power Plant and the Early Intake Diversion Dam were granted to the City. The Early Intake Diversion Dam has been constructed and in operation for many years.

Section 2 of the Raker Act permits changes of location of any of the rights of way or lands before final completion of the work by filing such additional map or maps as might be necessary to show such changes of location. Any such changes of location are subject to approval by the Secretary of the Interior

before becoming valid.

Under Application Sacramento Serial No. 07187, approved by the Secretary of the Interior on June 9, 1914, a right of way was granted to construct an aqueduct in Yosemite National Park from O'Shaughnessy Dam to the westerly boundary of the Park. Under Application Sacramento Serial No. 07259, approved by the Secretary of the Interior on July 29, 1914, a right of way was granted for an aqueduct tunnel connecting with the tunnel mentioned under the preceding application at the boundary of Yosemite National Park and running within Stanislaus National Forest to a proposed power house site just above Early Intake.

The present application is one to modify (1) Sacramento Serial No. 07187, (2) Sacramento Serial No. 07259, as amended by Sacramento Serial Numbers 09719, 010130 and 010128, and (3) Sacramento Serial No. 010130.

From the foregoing it can be readily seen that the O'Shaughnessy Dam, the power plant above Early Intake, (hereinafter referred to as Canyon Power Plant), the tunnel, the steel penstock line, and the Early Intake Diversion Dam were units for the development of electric power from falling water and the use of the same water for a municipal water supply. All of the necessary structures have been completed and placed in operation except the Canyon Power Plant, the penstock line and connecting tunnel with O'Shaughnessy Dam.

By virtue of the foregoing approved applications, San Francisco has already been granted the rights of way for construction of the Canyon Power Plant and the connecting tunnel and penstocks without being subject to a requirement that water be released down the stream bed of the Tuolumne as demanded by the stipulation contained in the paragraphs set forth under Reasons for the Appeal. Parenthetically, it should be stated that it is understood that the required release of water is primarily for th

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preservation and protection of fish life. It is interesting to note that under Applications not involved in this Appeal, namely, Sacramento Serial No. 041211 approved February 26, 1951, amending the location of the Cherry Valley Reservoir, a maximum release of 15 C.F.S. was acceptable, and under Applications Nos. 013246 and 013247 approved April 27, 1956, amending locations of tunnel aqueduct, steel penstock and power plant sites of the Cherry River Project, a release to stream flow in Eleanor Creek of a maximum of 15 1/2 C.F.S. was accepted.

The existing approved applications locate the tunnel right of way, the penstocks and the powerhouse site along the south bank of the Tuolumne River between O'Shaughnessy Dam and Early Intake. The application from which this appeal results seeks only to shift the tunnel right of way, penstock line and powerhouse site to locations along the north bank of the Tuolumne River, due to substantial savings in construction costs by such relocation. Reference is made to Hetch Hetchy Water Supply Drawing No. R-527, Revision No. 1 dated February 17, 1958, which drawing accompanied the application involved, for purposes of showing the existing locations and the proposed locations on the north bank of the Tuolumne River.

O'Shaughnessy Dam creating Hetch Hetchy Reservoir was completed in 1937 to a capacity of 340,000 acre-feet and drum gates were installed in 1949 increasing the capacity to 360,000 acre-feet. Early Intake Diversion Dam was completed in 1924, creating a reservoir, capacity 115 acre-feet, which will serve as the afterbay for the proposed Canyon Powerhouse. From the foregoing it is evident that a major portion of the Canyon Power Project has already been completed.

Since the major dam (O'Shaughnessy) required for the Canyon Power Project has already been constructed to its maximum capacity, it is not practical or economical to reconstruct this

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dam at this late date to provide the additional storage required to provide a release of 80 second-feet down the stream channel. It will, therefore, be necessary in order to obtain the required releases that space in Hetch Hetchy Reservoir be allocated for the storage necessary to accumulate the waters required for said releases. This will result in a considerable decrease in the amount of water available each year for the primary purposes of the project. It is our understanding that no reimbursement to the City by State or Federal fish and wildlife agencies will be made for the use of said storage space in Hetch Hetchy Reservoir required to provide water for the required releases. City cannot therefore be obligated to provide a flow in the Tuolumne River below O'Shaughnessy Dam in excess of the amount that would have flowed in the river under natural conditions.

The City has now completed a detailed study of the operation of the proposed Canyon Power Project conforming to the required releases. For the purpose of this study the actual releases from Hetch Hetchy Reservoir for the period 1938-1957, inclusive, were used since O'Shaughnessy Dam was raised to its present height in 1937 with a storage capacity of 340,000 acre-feet. Addition of drum gates to the spillway in 1949 increased the storage capacity to 360,000 acre-feet.

Operating the Canyon Power Project under the above conditions during the twenty-year period, 1938-1957, inclusive, would have resulted in a loss of power revenue to the City in the amount of $714,232.52, or an average of $35,711.62 per annum. Capitalizing the above loss in power revenue at 3% results in a capital outlay of $1,190,387.

From the foregoing detailed study we conclude that the operation of the Canyon Power Project in accordance with the required releases is incompatible with the principal purposes of the project and since Hetch Hetchy Dam has been constructed to

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its maximum capacity, the required storage would be, in effect, taken without compensation. It is our position that the required releases would unduly restrict the needed power development of the Tuolumne River watershed to meet the ever-increasing demands of the people of the State of California.

The Law: THE REQUIREMENT OF A RELEASE OF STORED WATERS IN THE QUANTITIES DEMANDED EXCEED THE POWERS OF THE SECRETARY OF THE INTERIOR

The basic source of law governing San Francisco's right to occupy public lands in the Stanislaus National Forest and Yosemite National Park is the Raker Act (Public Law No. 41, 63rd Congress; 38 Stats. at L. 242).

The Act itself is clear that it granted to San Francisco the rights of way and lands necessary for the development of the power and water resources of the Tuolumne River in the Hetch Hetchy Valley and the Cherry Valley and Lake Eleanor Basin tributaries.

(Sec. 1, Raker Act)

The Act expressly provides that nothing within the Act is to be construed as affecting or intending to affect or in any way to interfere with the laws of the State of California relating to the control, appropriation, use, or distribution of water used in irrigation or for municipal or other uses, or any vested right acquired thereunder.

(Sec. 11, Raker Act)

San Francisco has valid appropriative rights to store water to the full capacity of O'Shaughnessy Dam and to put such water to a beneficial use by using it for the generation of power and for municipal and domestic purposes.

Meridian Ltd. v. City and County of San Francisco, 13 Calif. (2d) 424

Indeed, such water as is stored behind O'Shaughnessy Dam has been reduced to possession and therefore is the property of

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San Francisco.

1 Wiel on Water Rights (3d Ed.) §§31, 32 and 690;
25 Cal. Jur., Waters §28, page 1029; and
Riverside Water Co. v. Cage, 89 Cal. 410 [1891]

The rule of the Riverside case has been qualified in later decisions insofar as it holds water in a reservoir on the stream to be personal property, the present rule being that while water is stored in such a reservoir it is real property. Whether personal or real, however, it is the property of the appropriator.

Stanislaus Water Co. v. Bachman
152 Cal. 716, 725

The Raker Act recognizes San Francisco's proprietary interest in its stored waters since, after requiring satisfaction of the prior rights of the Turlock and Modesto Irrigation District it provides for compensation to be paid to San Francisco in return for release of stored waters to those districts.

(Raker Act, Sec. 9, paragraphs (d), (e), (f) and (g); see also paragraph (q) of Sec. 9)

Insofar as supplying water to agencies of the United States are concerned, it is mentioned only in one place of the Raker Act, where it is provided that water at a rate not to exceed the actual cost shall be supplied to War Department installations in or near San Francisco.

(Raker Act. Sec. 9, paragraph (u))

The only provision in the Raker Act for non-compensated water is a de minimis amount and reads: "The said grantee shall further lay and maintain a water pipe, or otherwise provide a

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good and sufficient supply of water for camp purposes at the Meadow, one-third of a mile, more or less, southeasterly from the Hetch Hetchy Dam site."

(Raker Act, Sec. 9, paragraph (p))

It has been suggested that the Fish and Wildlife Co-ordination Act of March 10, 1934 and the amendments thereto under Public Law 85-624 enacted by the 85th Congress on August 12, 1958, is applicable to the Canyon Power Project. The Canyon Power Project does not come under the scope of said Act because (1) said project was authorized by a specific Act of Congress known as the Raker Act, above referred to, (2) the water rights for the project were obtained under the laws of the State of California, (3) the Canyon Power Project was approved by the Secretary of the Interior before the date of enactment of said Fish and Wildlife Co-ordination Act, (4) a major portion of the construction of the Canyon Power Project has already been completed as previously stated, and (5) the Fish and Wildlife Co-ordination Act of March 10, 1934, as amended, applies only to federal water development projects in the planning stage.

Under California law the preservation of fish life is only one of several beneficial uses and to the extent that a release of water to preserve fish life would be inconsistent with the primary uses of the project, a release of water for the preservation of fish life is not required by State law.

Opinion of the Attorney General of California No. 50-89, July 23, 1951 (18 OAG 31)

Therefore, the power of the Secretary of the Interior to attach conditions and regulations to the locations of rights of way and lands granted for the development and utilization of the said power and water resources does not

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extend to matters relating to the control, appropriation, use or distribution of water or any vested right thereto.

DATED: AUGUST 6, 1959

Respectfully submitted,

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McMORRIS M. DOW
Deputy City Attorney

H. E. LLOYD
Manager and Chief Engineer
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APPENDIX B

UNITED STATES
DEPARTMENT OF THE INTERIOR
OFFICE OF THE SECRETARY
WASHINGTON 25, D. C.

Certified Mail
Return Receipt Requested

APRIL 27, 1961

Dear Mr. Holm:

This refers to the appeal of the City and County of San Francisco (hereinafter sometimes referred to as the City or the Grantee) from the decision of the Land Office at Sacramento, California, dated July 9, 1959, which required the City to execute certain stipulations (relating among other things, to minimum releases of water) as a condition to the granting of its application for a change of location of a right-of-way in the Stanislaus National Forest and the Yosemite National Park. The City appealed to the Director, Bureau of Land Management. The Secretary of the Interior assumed direct jurisdiction over this appeal.

The United States Forest Service, the National Park Service, the Fish and Wildlife Service and the California Department of Fish and Game have recommended revised stipulations as to minimum releases of water into the Tuolumne River from O'Shaughnessy Dam (Hetch Hetchy Reservoir). The revised stipulations would require minimum releases of 75 cfs for the period May 1 through September 15 and 35 cfs for the period September 16 through April 30. In addition, the stipulations call for a study to determine whether increases should be required in these minima with final decision as to any recommended increases to be made by the Secretary after notice and hearing.

In accordance with the provisions of the Raker Act, 38 Stat. 242 (1913), the Department of Agriculture has indicated approval of the new right-of-way location, insofar as it relates to the national forest lands.

I have concluded that the City's application should be granted, subject to conditions hereinafter referred to. My reasons follow.

This case is another chapter in the long history of the City's Hetch Hetchy developments under the Raker Act. Specifically, it concerns the City's proposed Canyon power project. The principal features consist of a tunnel about 12 miles long generally following the course of the Tuolumne River from O'Shaughnessy Dam to Early Intake and a power plant at Early Intake with a planned installed capacity of 66,000 kw. For about one-half its length the tunnel would be located in Yosemite National Park. The balance of the tunnel and the power plant itself will be constructed in Stanislaus National Forest.

The existing right-of-way was approved and amended in 1914 and 1917, respectively, pursuant to the Raker Act. This original right-of-way location follows a meandering course on the south side of the Tuolumne River. By its current application, the City seeks to relocate the route of the tunnel to a straight line on the north side of the river.

It is the fact that the City has not proceeded with the project since it received the amended right-of-way in 1917 that has given rise to the principal issue before me.

In brief, the questions for decision are whether there should be a conclusion that the City has not been diligent in prosecuting the work and, if so, whether the City's right-of-way should be declared forfeited.

The reason for the City's delay is conceded. As the Department's Special Hearing Officer found, it is because of lack of earlier need for the Canyon project's power potential due to the refusal of the electorate to approve the City's acquisition of the San Francisco electric utility operations of Pacific Gas and Electric Company.

In his finding No. 21, on diligence, the Special Hearing Officer, while attempting to preserve the issue as a legal question, concluded that the City had no responsibility for the decisions of its electorate. On the other hand, it is argued that under the charter of San Francisco the elections were essential elements in the City's decision-making process and, therefore, the decision of the electorate is perforce the decision of the City.

The Solicitor of the Department has recommended that proposed finding No. 21 be stricken since it involves conclusions of law rather than findings of fact. I accept the Solicitor's recommendation.

The Raker Act forfeiture provision is not mandatory whatever might be the conclusion as to diligence. Section 5 provides that "in the event" the Secretary determines that work has not been diligently prosecuted, the Secretary "may declare forfeited" the City's rights to the unconstructed works and refer the matter to the Attorney General, whose duty upon such referral "shall be" to commence suit to secure a judgment of forfeiture. The juxtaposition of the imperative expression "shall" with "may" in Section 5 makes it clear that the Congress intended by the latter term that the Secretary of the Interior should exercise discretion to determine whether, though lack of diligence be found, the circumstances are such as to call forth a forfeiture.

Such a reading of Section 5 accords with the ordinary meaning of the word "may", particularly when found in juxtaposition with expressions of command; it is also in accord with the traditional gravity with which the courts approach forfeitures.

A forfeiture is harsh. Before considering it, an official should be certain that the public interest can be satisfied in no other way. After most careful judgment, I have concluded that, under the terms and conditions to which the approval will be subject, the public interest can be protected. Therefore, I do not at this time and in the circumstances under which the change in location will be approved, deem it necessary to determine the question of diligence.

At the same time, I must observe in all candor that the argument that the City must take responsibility for the decisions of its electorate is a compelling one and, consequently, the grantee would have a heavy burden to overcome were the diligence question to be in issue.

I am persuaded that the north side location can be approved consistent with the public interest for the following reasons:

(1) The interests of sport fishery and recreation can be protected by requiring continuing releases of water from O'Shaughnessy Dam to maintain the Tuolumne as a live stream between the dam and Early Intake. This will be of great importance as there is no requirement for release of water to maintain a live stream under the original, south side right-of-way. With this requirement added to the stipulations, the National Park Service and the Fish and Wildlife Service, together with the Forest Service and the California Department of Fish and Game, are agreeable to approval of the change in location.

(2) The north side straight line right-of-way, with provision for weathering of rocks and spoil, and considering the location of spoil banks, is a marked improvement aesthetically over the south side route.

(3) The major incursion in Yosemite Park came with the construction of the storage facilities, that is with O'Shaughnessy Dam itself. The tunnel, if constructed in the north side location, will have but minor additional effect on Yosemite Park. On the other hand, forfeiture would have a major impact upon the City's realization of benefits from the large investment already made in constructed works and would result in total loss of the substantial money, time and effort that has been expended in connection with the Canyon project.

(4) The power plant--the principal new external feature to be added by the development--will be outside the boundaries of Yosemite Park, as will the tunnel for one-half of its length. The Federal Power Act, enacted subsequent to the

Raker Act, does not exclude the use of national forest lands for power development under proper safeguards. This suggests a less rigid approach to the policy question than would be the case were the principal impact to be on the Park.

(5) Finally, we deal here with a public not a private body.

I am cognizant of the earnestness and force of the argument that this application should be made the occasion to put an end to the City's further construction of projects under the Raker Act. As in any matter involving judgment and discretion, however, the conflicting factors must be balanced and a decision reached.

Taking collectively all the factors into account, the balance favors approval of the change in location under proper conditions as set out in the stipulations annexed hereto.

Under other circumstances and conditions, I am not prepared to say that the approval of this Department could be forthcoming. I must and shall look with jaundiced eye upon any further initiation of construction activities under the Raker Act grants. It is only the special circumstances here present and above outlined, together with the remedial stipulations, that have impelled me to conclude that the public interest does not in this instance require a present determination as to diligence or a forfeiture.

The application to change the right-of-way location is hereby conditionally approved as shown by endorsement of Map R-527, Revision 1, dated September 15, 1958, which delineates in red the amended right-of-way location, subject to the execution in quadruplicate by the proper officials of the City and County of San Francisco of the revised stipulations enclosed herewith and the filing thereof in the office of the Director, Bureau of Land Management, Washington 25, D. C., within 30 days from receipt of this letter. This conditional approval and grant is null and void if the enclosed stipulations are not executed and filed as herein required. The approval of Map R-527, Revision 1, operates, as you know, as an abandonment of all theretofore approved rights-of-way of the City and County of San Francisco situated south of the Tuolumne River from O'Shaughnessy Dam to Early Intake for a tunnel aqueduct, penstocks, power plant, etc., in the Yosemite National Park and the Stanislaus National Forest, as delineated in green on said drawing.

Sincerely yours,

Secretary of the Interior

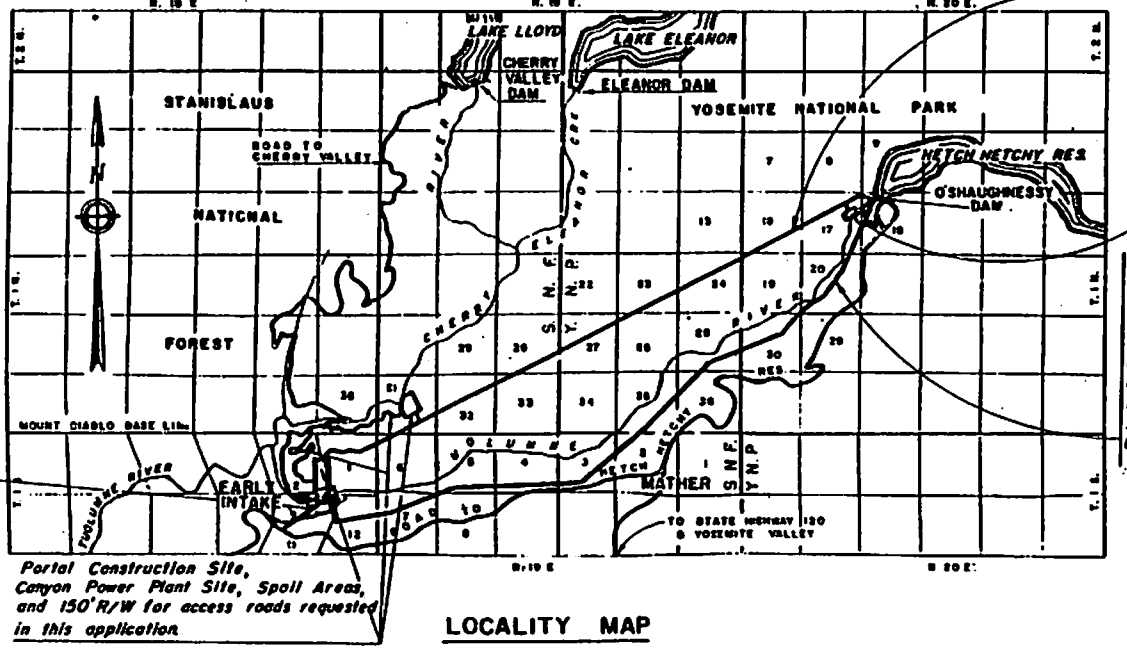
Dion R. Holm, Esquire
City Attorney
City Hall
San Francisco 2, California

Enclosures

100' R/W for Canyon Tunnel aqueduct requested in this application.

Spoil area and 150' R/W for access roads requested in this application.

250' R/W for electric transmission line and 250'R/W for pressure pipe & tunnel line and Power Plant Site granted to City & County of San Francisco under application Sacramento Serial Number 010130 approved by Secretary of Interior Sept. 22, 1917 to be abandoned upon approval of this application.



100' R/W for tunnel aqueduct granted to City and County of San Francisco under applications Sacramento Serial Number 07187, approved by the Secretary of the Interior on June 9, 1914 and Serial No. 07259, approved by the Secretary of the Interior on July 29, 1914, subsequently amended Sept. 12, 1916, Sept. 22, 1917 and Nov. 6, 1917, are to be amended by this application and abandoned by the City and County of San Francisco upon approval of this application.

Portal Construction Site, Canyon Power Plant Site, Spoil Areas, and 150'R/W for access roads requested in this application

LOCALITY MAP

SCALE IN MILES

P2210

APPENDIX C

COPY

STIPULATIONS FOR RELOCATION AND AMENDMENT OF RIGHTS-OF-WAY FOR TUNNEL AQUEDUCT, STEEL PENSTOCK, POWER PLANT SITE, SPOIL AREAS AND ACCESS ROADS AS APPROVED PURSUANT TO MAPS FILED APRIL 10, 1914, JULY 3, 1916 AND DECEMBER 13, 1916 IN UNITED STATES LAND OFFICE AT SACRAMENTO, CALIFORNIA MAP R-527, REVISION NO. 1, FILED OCTOBER 2, 1958.

(Amended Sacramento Serial No. 010130)

Pursuant to the act of December 19, 1913 (38 Stat. 242), and in consideration of relocation and installation of its facilities and the granting to it by the United States of amended rights-of-way applied for, the City and County of San Francisco, a municipal corporation of the State of California, hereinafter referred to as Applicant, does hereby stipulate and agree and does hereby bind itself, its successors and assigns, as follows:

General

1. These stipulations apply to the right-of-way requested by Applicant across national park and national forest land as shown on that map entitled "Hetch Hetchy Water Supply. Canyon Power Project, Amended location of Tunnel Aqueduct, Steel Penstock, Power Plant Site, Spoil Areas and Access Roads. Yosemite National Park and Stanislaus National Forest, California" Drawing No. R-527 revision No. 1, signed by H. E. Lloyd, Manager and Chief Engineer, on February 17, 1958, and revised on September 15, 1958, as filed with the land office at Sacramento, California, on October 2, 1958, as an amendment to the City and County of San Francisco's previous applications for rights-of-way for tunnel aqueduct, pressure pipe, power plant site, and diversion dam site filed under Serial Numbers 07259, 09719, 010128 and 010130.

2. The Applicant shall take all reasonable precautions to avoid and prevent damage to property and resources of the United States. Applicant will pay to the United States Treasury, on demand, for all damage to the said property and resources resulting from the breaking or overflowing,

leaking or seepage, of water from the conduit and for all damage to such property and resources caused by the negligence of the Applicant, its employees, contractors or employees of contractors.

3. All containers of explosives shall be disposed of by the Applicant in such manner that they shall not be accessible to the public, livestock, or wild game.

4. The applicant will not infringe upon the rights of the public to enjoy free access to the Tuolumne River between O'Shaughnessy Dam and Early Intake.

5. The Applicant will prevent its employees, agents, and contractors from releasing debris or fines arising from excavation, deposit of spoil, mining, conveyance, refining, or washing of materials into the Tuolumne River or its tributaries.

6. The Applicant will release water to stream flow from O'Shaughnessy Dam according to the following schedule:

Period	Release from O'Shaughnessy Dam in Sec. Ft.
May 1 through September 15	Minimum of 75 cfs
September 16 through April 30	Minimum of 35 cfs

PROVIDED THAT, in addition to the releases provided for above, Applicant interposes no objection to the Government diverting not to exceed 0.5 cfs for the Federal consumptive use of water in Yosemite National Park and not to exceed 5.0 cfs for the Federal consumptive use of water in Stanislaus National Forest, all within the watershed of the branch of the Tuolumne River above Early Intake. To the extent any portion of such 5.5 cfs of water is diverted from the Tuolumne River between O'Shaughnessy Dam and Early Intake for use by the Government, the releases provided for above shall be increased to the extent of such diversions or uses. This paragraph shall not be construed to add to or to limit any rights of the Government to the use of the water of the Tuolumne River System; and

PROVIDED FURTHER, that the releases shall be measured at the existing gauging station located approximately 3/4 mile below O'Shaughnessy Dam; and

PROVIDED FURTHER, that during two years, not necessarily consecutive, each beginning April 1 and extending through March 31 of the following year, a fishery and recreational (including aesthetic) study shall be made

to determine whether or not the above schedule is adequate and, if not, to determine the magnitudes of the minimum flows required. This study shall be made jointly by the National Park Service, United States Forest Service, and the United States Fish and Wildlife Service during two years when the desired regulated minimum release can be maintained for more than half the period of May 1 through September 15, to assure sound testing for the purposes indicated. The Applicant and the California Department of Fish and Game may participate in this study, if they desire to do so. The two such years shall be selected by the Secretary of the Interior after consultation with the Secretary of Agriculture. During the course of such study the Applicant shall make such adjustments of flows as may be requested as a basis for making observations; and

PROVIDED FURTHER, that if it is found during the study that the September 16 to April 30 schedule is inadequate for the spawning of trout, a modified schedule of releases between 35 cfs and 75 cfs may be recommended for all or part of March and April; and

PROVIDED FURTHER, that at the conclusion of the aforesaid two years of study and based upon such study, the agencies participating in the study shall make recommendations to the Secretary of the Interior as to the required flows. Such recommendations shall become part of these conditions, unless the Applicant, within 30 days from receipt of notice of the recommendations, shall file with the Secretary of the Interior its objections thereto. In such event, at its request, the Applicant shall be afforded a hearing regarding these objections before a special hearing officer who will render proposed findings of fact. The Secretary, after considering the proposed findings of fact and the record, shall determine what additional flows, if any, shall be required over those specified above.

7. Changes in magnitude of water releases into the Tuolumne River from O'Shaughnessy Dam shall be gradual and minimal and shall be restricted to those having a fairly constant rate of change producing not more than double nor less than one-half the previous release over a one-hour period, except as may be required by emergency operations resulting from mechanical failure or other conditions beyond the control of the Applicant.

As to Yosemite National Park

8. The Applicant shall take all reasonable precautions to prevent forest fires and shall assist the Superintendent of Yosemite National Park to extinguish forest fires in the vicinity of any tract which may be used hereunder, and in the preservation of good order within the metes and bounds of the area. Applicant will reimburse the National Park Service for fire suppression costs due to any fires resulting from operations of the Applicant. The cutting or destruction of vegetation shall be held to a minimum. All slash and debris resulting therefrom shall be disposed of as directed by the Superintendent.

9. The Applicant shall allow the National Park Service, without charge, to construct or permit to be constructed in, through or across the land covered by said right-of-way, roads, trails, conduits and other means of transportation or communication not inconsistent with the enjoyment of said right-of-way by the Applicant.

10. The Applicant shall take adequate measures, as directed and approved by the Superintendent of Yosemite National Park, to arrest and prevent soil erosion on the lands covered hereby and shall so utilize such lands as not to contribute to erosion on adjoining lands.

11. The boundaries of the spoil area immediately below O'Shaughnessy Dam are to be adjusted as designated by the Superintendent of Yosemite National Park, to save the screen of trees along the river bank.

12. When required by the Superintendent, the Applicant will have the rock spoil area sprayed, to reduce its conspicuousness. The Superintendent will specify the liquid mixture to be used for this artificial weathering purpose.

13. Within one year after completion of the project, all buildings and other facilities of a temporary character erected within Yosemite National Park, not required for the continued operation and maintenance of the project, will be removed and the sites restored to as near a natural condition as possible.

14. Within one year after completion of the project, the structures on the access roads (trestles, viaducts, bridges, etc.) toward the base of the Dam will be removed and the area occupied by same will be restored to as near a natural condition as possible. All other access roads will be kept locked by the Applicant.

15. In order for the Superintendent to provide for the adequate protection of Park values during the construction and development phases of the Canyon Power Project, the Applicant will reimburse the National Park Service for the salary and expenses of one full time Park Ranger to be assigned to the Hetch Hetchy area from the beginning of construction activities until the close of the cleanup work following the completion of construction. The liability of the Applicant to reimburse the National Park Service under this stipulation will terminate at the time the Applicant has fully complied with stipulation No. 14.

16. The location, design and standard of any road or trail, and the location of any structures or other improvements to be constructed within Yosemite National Park by the Applicant in connection with the Canyon Power Project must be approved by the Superintendent of Yosemite National Park before construction is started.

17. The Applicant shall conform to all regulations now or hereafter adopted and prescribed by the Secretary of the Interior governing Yosemite National Park.

As to Stanislaus National Forest

18. The value of all timber cut or destroyed by the Applicant or its agents which is merchantable in accordance with specifications contained in timber sales current at the time of such cutting or destruction shall be paid at standard stumpage rates then in force for the Stanislaus National Forest, and all slash and debris resulting from the cutting or destruction of such timber shall be disposed of as the Officer-in-Charge may direct.

19. The Applicant will protect the scenic and aesthetic values of the right-of-way and the adjacent land including spoil areas consistent with the authorized use and as prescribed by the Forest Service.

20. The Applicant will construct access roads to standards and specifications approved by the Forest Supervisor in advance of construction.

21. The Applicant will join with the Forest Service in preparing and actively participating in a fire plan which shall set forth in detail their respective responsibilities for the prevention, control and extinguishment of fires on the project areas and on adjacent areas.

22. The Applicant will allow officers of the Forest Service free and unrestricted access to, through, and across all lands covered by said rights-of-way in the performance of their official duties; and will allow the Forest Service without charge to construct, or permit to be constructed in, through, across or under the land covered by said rights-of-way, roads, trails, conduits, ditches, and other means of transportation or communication, not inconsistent with the enjoyment of said rights-of-way by the Applicant.

23. The Applicant will locate and construct all roads and spoil areas to reduce to a minimum the disfigurement of the landscape and erosion of the soil. Such special measures to prevent erosion, as may be required by the Forest Supervisor in writing, shall be installed by the Applicant. Material from slides that occur after construction work is completed shall be disposed of by the Applicant, at locations where not destructive to or in prevention of revegetation, and in such manner as not to be susceptible to erosion or harmful to scenic values.

24. The Applicant will dispose of brush and debris as directed by the Officer-in-Charge. Any brush and debris to be burned will be disposed of in accordance with the fire plan approved by the Forest Supervisor. The Applicant will avoid damage to young growth and will fall all snags over 25 feet in height and within 100 feet of the center line of all roads.

25. The Applicant shall conform to all regulations now or hereafter adopted and prescribed by the Secretary of Agriculture governing Stanislaus National Forest.

AND FURTHER, the City and County of San Francisco agrees to observe the nondiscrimination provisions prescribed by section 301 of Executive Order 10925, dated March 6, 1961 (26 F. R. 1977), which are incorporated herein by reference, and as used therein "contractor" means the grantee of the right-of-way (Exhibit A).

IN WITNESS WHEREOF, the said City and County of San Francisco has caused this instrument to be executed in the City of San Francisco, California, this 3 day of May, 1961.

CITY AND COUNTY OF SAN FRANCISCO

APPENDIX D

UNITED STATES

DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE

REGION I

PORTLAND, OREGON

TUOLUMNE RIVER

FLOW STUDY

Canyon Power Project

California

A Report By The U. S. Fish and Wildlife Service
On A Field Study Conducted In Cooperation With
The National Park Service, The U. S. Forest Service,
And The California Department Of Fish And Game

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And The California Department Of Fish And Game

Approved: AUG 23 1976

By R. Kahler Martinson

R. Kahler Martinson
Regional Director

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View of Hetch Hetchy Valley before inundation, ca. 1915

INTRODUCTION

The so-called Raker Act (38 Stat. 242), approved by the President of the United States on December 19, 1913, granted to the City and County of San Francisco rights-of-way to certain lands in Yosemite National Park and Stanislaus National Forest for construction, operation and maintenance of facilities necessary to regulate and convey waters of the Tuolumne River for the purposes of domestic water supply and electric power generation. Staged construction of water supply and hydroelectric facilities, collectively termed the Hetch Hetchy Project, took place over the next several decades. The Hetch Hetchy Project is operated by the San Francisco Public Utilities Commission. 1/

Among the first project facilities built were O'Shaughnessy Dam, at the lower end of Hetch Hetchy Valley in Yosemite National Park, and a diversion dam and tunnel entrance, at a point 12.1 miles downstream (known as Early Intake) in Stanislaus National Forest. The Tuolumne River and contiguous uplands between Hetch Hetchy and Early Intake also lie within the boundaries of Yosemite National Park and Stanislaus National Forest. From 1925 to 1967, water released from Hetch Hetchy Reservoir was diverted from the river at Early Intake and conveyed by Mountain Tunnel 20 miles to a powerhouse on Moccasin Creek, a tributary of the Tuolumne. Additional facilities were constructed to convey water for municipal supply from Moccasin to San Francisco, a distance of about 120 miles.

Initial project plans approved pursuant to the Raker Act called for eventual diversion of river flow at O'Shaughnessy Dam and conveyance by tunnel on the south side of the Tuolumne to a powerhouse at Early Intake (Canyon Power Project). Subsequent engineering studies demonstrated the superiority of a tunnel alignment on the north side of the river, and, accordingly in 1958, San Francisco filed an application with the Department of the Interior for change of location of tunnel right-of-way from the south to north side of the river. Inasmuch as diversion at O'Shaughnessy Dam would substantially alter the flow regime of the Tuolumne between the dam and Early Intake, and in view of the fact that the environmental consequences of the alteration had not been adequately considered when the rights-of-way across Federal lands were initially granted, the Secretary of the Interior stipulated (Appendix A) in his approval of the change in location of the tunnel right-of-way that water be released from Hetch Hetchy Reservoir into the Tuolumne River in accordance with the following schedule:

1/ Although Hetch Hetchy is a hydroelectric project affecting lands of the United States, it is not subject to regulation by the Federal Power Commission (Sec. 29 of the Federal Power Act).

May 1 through September 15 - Minimum of 75 cubic feet/second

September 16 through April 30 - Minimum of 35 cubic feet/second

The Secretary further stipulated that the National Park Service, the U.S. Forest Service, and the U.S. Fish and Wildlife Service would jointly conduct, with voluntary participation by the applicant and the California Department of Fish and Game, a 2-year study of the Tuolumne River between O'Shaughnessy Dam and Early Intake to determine the adequacy of the prescribed flows for fish life, recreational use, and esthetic considerations.

Under the terms of the authorization granted by the Secretary of the Interior, the designated flows may be changed on the basis of recommendations developed from the 2-year interagency study. The recommended flows become a part of the conditions under which the San Francisco Public Utilities Commission must operate the Canyon Power Project, unless an objection is filed within 30 days of notification by the Secretary of any revised flows. In the event of objection, the Commission is entitled to a hearing before a special hearing officer who will develop a finding of fact for the Secretary's consideration before a final determination is made.

The Canyon power project was completed in 1967 and the interagency field study began the following year.

This report describes the interagency study conducted pursuant to the Secretary's order and presents a recommended release schedule to protect the fishery, recreational use, and esthetics of the affected reach of the Tuolumne River. The U.S. Fish and Wildlife Service and the California Department of Fish and Game jointly conducted the field portion of the fishery study. The U.S. Forest Service and the National Park Service carried out that part of the study pertaining to recreation and esthetics. All agencies participated in the analysis of data collected. Numerous interagency meetings, often including representatives of the San Francisco Public Utilities Commission, were held during the course of the investigation to discuss study procedures and results. The Commission cooperated throughout the study by providing experimental flows and technical assistance and, in accordance with Section 9(r) of the Raker Act, by reimbursing the study agencies for a substantial part of expenses incurred.

DESCRIPTION OF RIVER INCLUDING THE STUDY AREA

The Tuolumne River originates at the base of a glacier on the west slope of 13,000-foot high Mount Lyell in Yosemite National Park. The Tuolumne flows westward from its origin for a distance of 158 miles to join the San Joaquin River near the city of Modesto, draining an area of about 2,000 square miles. Numerous small tributaries augment the flow of the mainstem as it courses downward from its beginnings across Tuolumne Meadow and over the falls and cascades of the "Grand Canyon of the Tuolumne." Beyond, and still within the national park, the river enters 8-mile long Hetch Hetchy Valley where, since construction of O'Shaughnessy Dam in 1923, the valley floor has lain submerged beneath Hetch Hetchy Reservoir (Figure 1). For the next 2 miles, the river drops from pool to pool over cascades and rapids until the gentler gradients of Poopenaut Valley are reached (Figure 2). The river then enters Tuolumne Gorge where for a distance of about 2.5 miles its flow is confined by sheer granite walls (Figure 3). Emerging from the gorge, the river drops over Preston Falls into Preston Meadow (Figure 4), then into Indian Meadow, and on to Early Intake where, prior to 1967, much of its flow was diverted into Mountain Tunnel (Figure 5). Water is still diverted from the Tuolumne at Early Intake, but this is now accomplished by means of a bypass tunnel and conduit connecting Kirkwood Powerhouse and Mountain Tunnel. Below Early Intake, the Tuolumne continues westward to be joined by Cherry Creek, South Fork, Clavey River and other major tributaries before entering the reservoir pool impounded by Don Pedro Dam. From Don Pedro, the Tuolumne completes its exit of the foothills, traverses the western floor of the Central Valley, and enters the northward flowing San Joaquin.

Fishery resources of the Tuolumne River are significant. Rainbow, brown, brook, and golden trout inhabit the upper coldwater reaches of the river. The range of rainbows and browns extends as far downstream as Don Pedro Reservoir. Largemouth and smallmouth bass, bluegill, warmouth, white catfish and other warmwater fishes abound in the lower foothill and valley reaches of the Tuolumne. The Tuolumne River once supported annual runs of chinook salmon ranging upward of 100,000 fish. Modern runs have declined because of the adverse effects of gravel extraction, dams, and water diversions. The 1974 spawning run of adult chinook salmon was estimated at only 1,000 fish. The California Department of Fish and Game has indicated that increased diversions may result in the complete elimination of salmon from the Tuolumne (see appended letter).

Wildlife species frequenting the Tuolumne drainage include black-tailed deer, California mule deer, black bear, black-tailed jackrabbit, gray squirrel, coyote, beaver, mink, muskrat, raccoon, striped skunk, California quail, mountain quail, blue grouse, band-tailed pigeon, mourning dove and dipper. A mountain lion and a southern bald eagle, the latter an endangered species, were sighted by field crews during the study.

The natural values of the Tuolumne River between Hetch Hetchy Reservoir and Don Pedro Reservoir are of sufficient magnitude that the segment was designated in 1970, pursuant to Section 5(d) of the Wild and Scenic Rivers Act (Public Law 90-542), as a potential addition to the National Wild and Scenic Rivers System. In 1975, the Act (Section 5a) was amended (Public Law 93-621) to add the Tuolumne from its headwaters to Don Pedro Reservoir to the active study list. The study was initiated in August 1975 and is to be completed and submitted to the President and to Congress by October 2, 1979.

The study area reported on herein is the 12.1-mile reach of the Tuolumne between O'Shaughnessy Dam and Early Intake (Plate I). As noted above, its principal physiographical features are Poopenaut Valley, Tuolumne Gorge, and Preston Meadow. This reach of the river lies at the bottom of a canyon averaging about 1,500 feet in depth. The river drops at a rate of about 100 feet per mile as it traverses the granitic floor of the canyon. Its overall aspect is that of a series of long pools separated by comparatively short riffles, rapids, and cascades. Sand beaches occur at a few places where the stream gradient is slight. Vegetative cover on the upper slopes of the canyon is relatively sparse because of limiting climatic and edaphic conditions. The bottom of the canyon supports a more dense stand of vegetation. Principal woody species are ponderosa pine, incense cedar, California black oak, California buckeye, willow, alder, ceanothus, birchleaf mahogany, manzanita, elderberry, wild grape, and poison oak.

The natural flow regime of the river was drastically altered following the construction of O'Shaughnessy Dam and Hetch Hetchy Reservoir. Further alteration resulted from the installation of Canyon Tunnel which can divert in excess of 850 cubic feet per second (cfs) from the reservoir. During the decade preceding the beginning of Canyon Tunnel diversion in 1967, average daily river flow below the dam rarely fell below 200 cfs. Since 1967, reservoir releases have generally been near or below 75 cfs except when flood spills or other non-fish related considerations required greater releases.

Access to the study area is difficult because of the steepness of the terrain. Road access is available at either end, but all access between is by means of foot trails extending down the south slope from the public road connecting Early Intake and O'Shaughnessy Dam. The trail leading from the road near Poopenaut Pass to the river below, in Yosemite National Park, descends over 1,300 feet. A well-defined foot trail follows the river from Kirkwood powerhouse, at Early Intake, upstream a distance of 4 miles to Preston Falls.

Figure 1. O'Shaughnessey Dam and Hetch Hetchy Reservoir.

Figure 2. Poopenaut Valley.

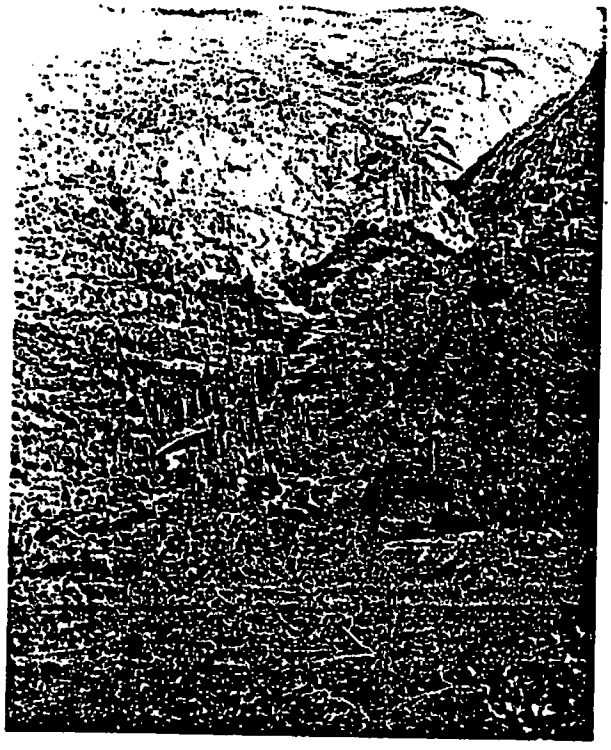


Figure 3. Tuolumne River from Mather Pool northeast to Tuolumne Gorge.

Figure 4. Preston Meadow and Preston Falls.

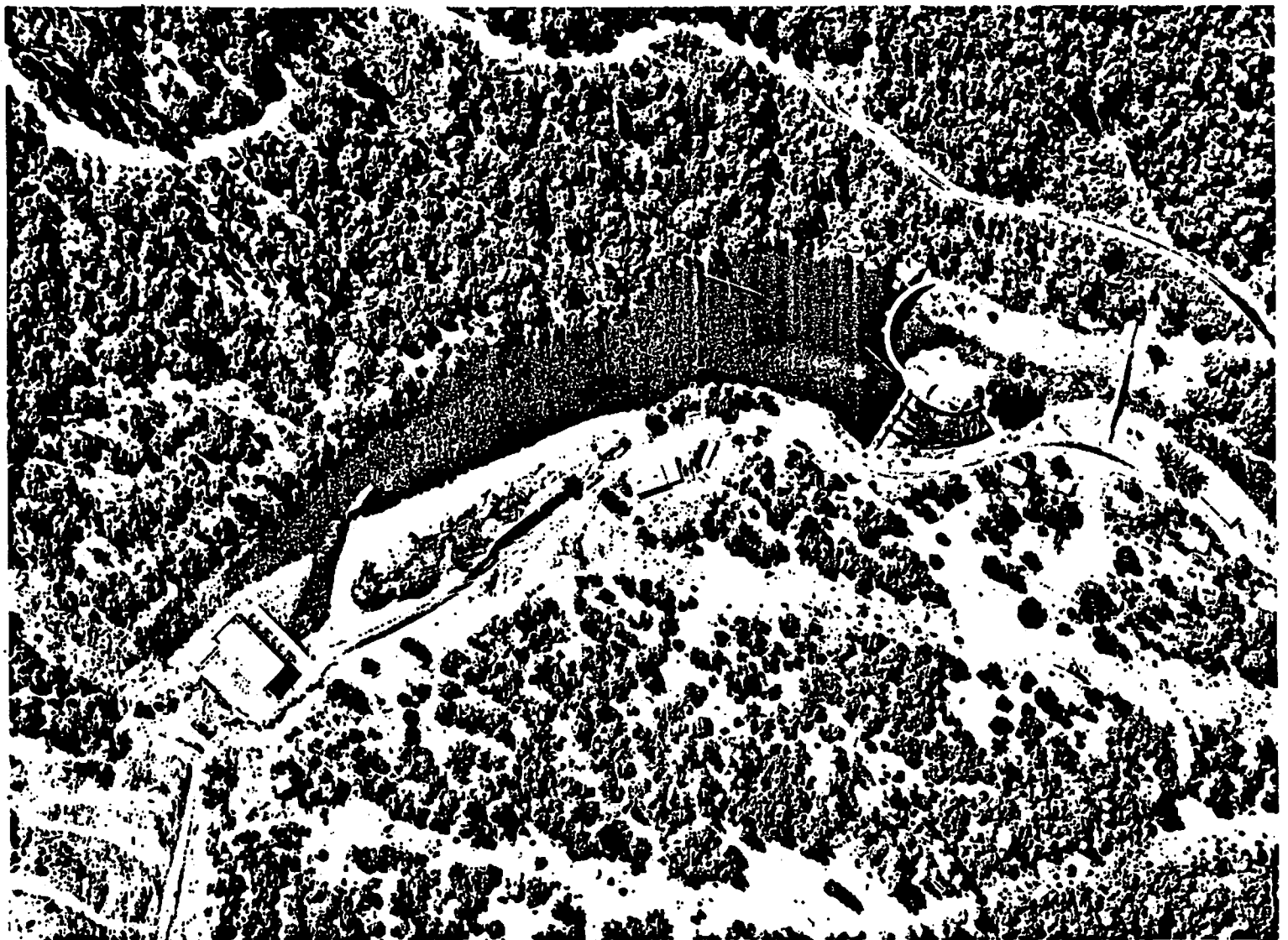


Figure 5. Overhead view of Early Intake Pool. Early Intake Diversion Dam and Mountain Tunnel entrance on left; Robert C. Kirkwood Powerhouse and Penstock (from Canyon Tunnel) on right. After passing through the turbines, Canyon Tunnel Water is conveyed by tunnel and conduit around Early Intake Pool to Mountain Tunnel.

METHODS AND RESULTS

Stream Transects

In August and September 1968 and in July 1970, stream transect measurements were made at five representative riffle areas in the 12.1-mile study reach to determine the amount of habitat available to trout and other aquatic organisms at flows approximating 35, 50, 75, 100, 125, 150, 175 and 200 cfs. The riffle areas selected for transect study (Figures 6, 7, 8, 9 and 10) ranged in length from about 150 to 300 feet and, at a flow of 75 cfs, averaged nearly 70 feet in width. Wetted riffle area and useable riffle area were determined for each of the experimental flows. Wetted riffle area is a measurement of the riffle water surface from bank to bank. Useable riffle area is defined as that part of the riffle over which water flows at depths greater than 0.3 feet, and at velocities ranging from 0.5 to 3.5 feet per second measured 0.3 feet from the streambed. Where these physical parameters are met optimum conditions occur for trout spawning and rearing of young, as well as for streambed production of aquatic organisms on which trout feed.

At each station six parallel and generally equidistant cross-channel lines or transects were laid out and staked on the bank for future reference. Depth and velocity measurements were taken at 2-foot intervals along each transect, marked by an engineer's steel tape stretched from bank to bank (Figure 10a). The linear distance from water's edge to water's edge was also noted. Data collected for each transect line were considered to be representative of streambed conditions for a distance of 12½ feet upstream and 12½ feet downstream from the line. The breadth of any emergent rock occurring along the transect line was recorded so that its transect length could be deducted from the overall length of the transect line before computing the wetted area for the transect (i.e., distance in feet from water's edge to water's edge, minus emergent rocks, multiplied by 25 feet). Total wetted area, unuseable wetted area, and useable wetted area figures for each of the transect stations were compiled by summing the corresponding figures for the six transect lines comprising the station. Consolidated data for all transect stations are presented in Table 1 and displayed graphically in Figure 11.

From Table 1 it may be seen that the amount of wetted area at the transect stations did not change greatly throughout the range of test flows. At the lowest flow (36 cfs) which was only 17 percent of the highest flow (211 cfs), more than 70 percent of the streambed was still within the wetted area. The area which could be used by trout, on the other hand, underwent a marked reduction as the volume of flow ranged downward. At the lowest flow (36 cfs), over 60 percent of the riffle area classified as useable at the highest flow (211 cfs) had been lost. The rates of decline in the amount of wetted area and the amount of useable area did not differ greatly between 211 and 152 cfs. At flows

below 152 cfs, however, useable area dropped off more rapidly than wetted area, especially at flows below 75 cfs. Figures 12a through 12f show the appearance of the riffle area at Transect Station No. 1 at flows ranging from 35 to 150 cfs. The contrast in stream aspect at these extremes is especially striking in Poopenaut Valley where the stream gradient is low (Figures 13a and 13b).

Table 1. Useable and unuseable riffle area at various flows (5 transect stations)

TEST FLOW	WETTED AREA	UNUSEABLE AREA[1/]	USEABLE AREA	
cfs	square ft.	square ft.	square ft.	% decline
211	72,236	22,666	49,570	0
190	70,344	22,778	47,566	4.0
152	66,853	22,727	44,126	11.0
125	63,952	23,556	40,396	18.5
98	61,275	25,518	35,757	27.9
75	58,280	27,010	31,270	36.9
54	54,939	29,990	24,949	49.7
36	51,499	31,989	19,510	60.6

1/ That part of the wetted area unavailable to trout because of shallowness (less than 0.3 feet) or unsuitable rate of flow (less than 0.5 or greater than 3.5 feet per second).

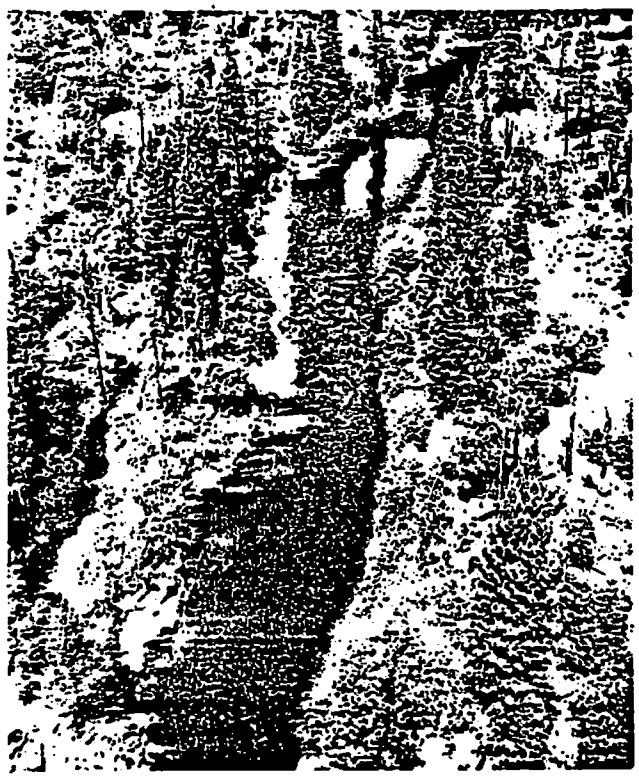


Figure 6. Transect Station No. 1.

Figure 7. Transect Station No. 2.

Figure 8. Transect Station No. 3.

Figure 9. Transect Station No. 4.

Figure 10. Transect Station No. 5.

Figure 10a. Measuring flow velocity with sonic current meter.

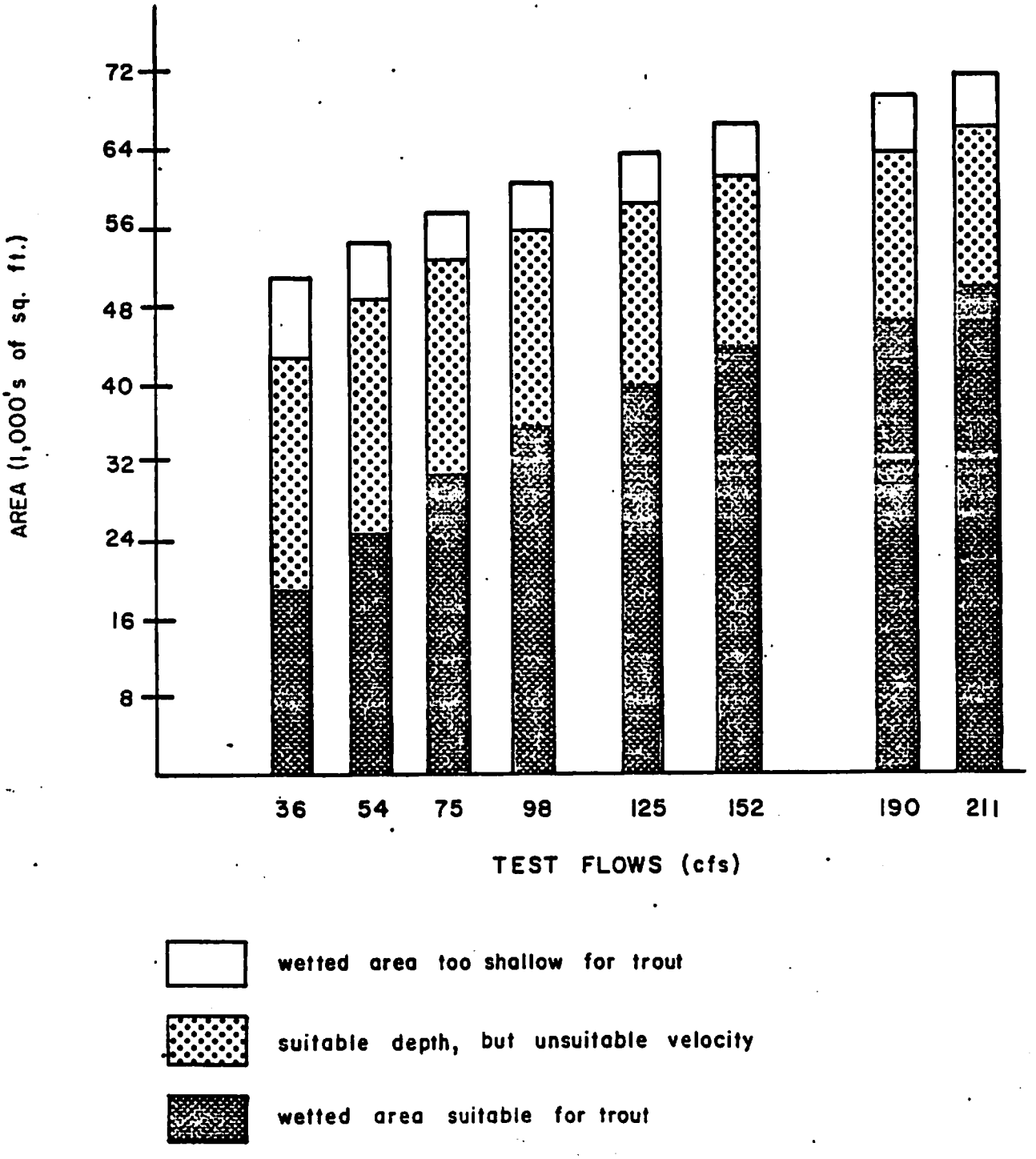


Figure 11. Composition of wetted area at various flows (5 transect stations)

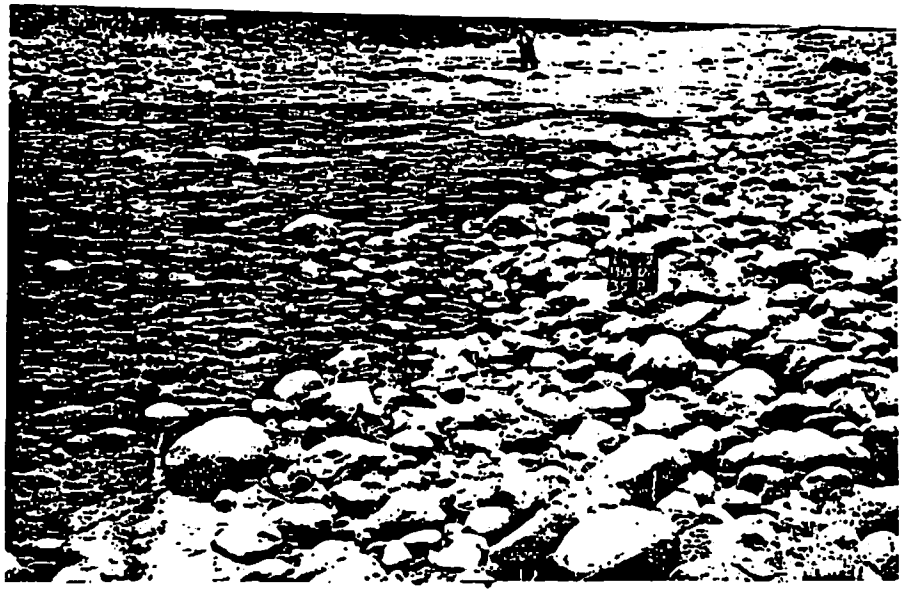


Figure 12a. Transect Station No. 1 (35 cfs).

Figure 12b. Transect Station No. 1 (50 cfs).

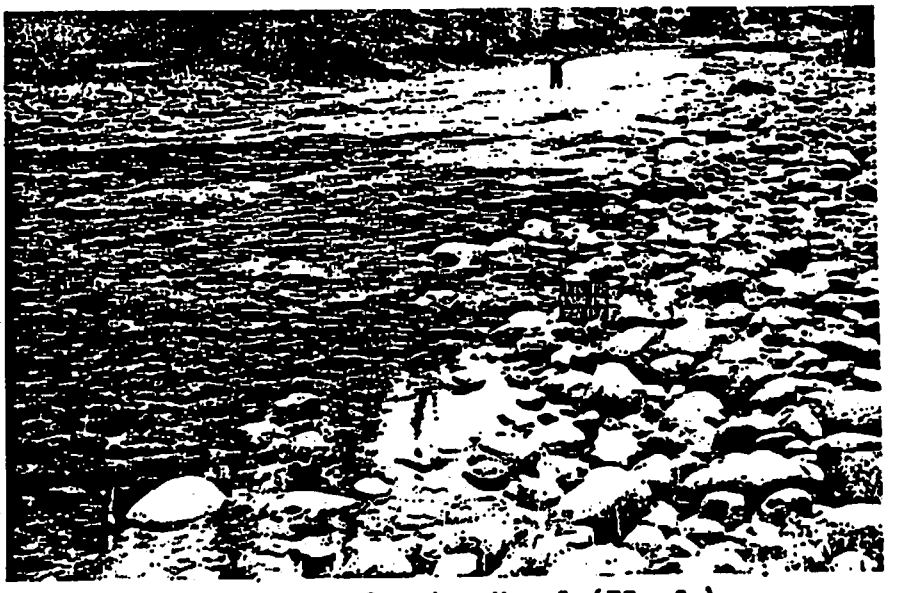


Figure 12c. Transect Station No. 1 (75 cfs).

Figure 12d. Transect Station No. 1 (100 cfs).

Figure 12e. Transect Station No. 1 (125 cfs).

Figure 12f. Transect Station No. 1 (150 cfs).

Figure 13a. Poopenaut Valley, flow at 35 cfs.

Figure 13b. Poopenaut Valley, flow at 150 cfs.

Stream Temperatures

Cool water released from Hetch Hetchy Reservoir during the summer months is perforce warmed by solar radiation and ambient air temperature as the water flows down the 12.1-mile study reach. Manipulation of reservoir releases in 1968, 1970, and 1971 permitted the collection of data concerning the interrelationship of flow volume, air temperature, and stream temperature.

Thermograph stations to record water temperature were established at three points: 1 mile below O'Shaughnessy Dam; the upper end of Preston Meadow; and ½-mile upstream from Early Intake. At each station, a Ryan Model D-45 thermograph (Ryan Instruments, Inc.) was anchored at least 3 feet below the water surface by means of a heavy chain encircling a large rock. Daily air temperature readings used in this analysis were recorded by San Francisco at its Early Intake weather station. Both air and water temperature are given in degrees Fahrenheit.

1968 - From July 1 to August 9 (39 days), the release from Hetch Hetchy Reservoir was held at, or slightly below, the 75 cfs minimum level prescribed for the summer period. On August 9, the release was rapidly increased over a 36-hour period to about 350 cfs, then as suddenly reduced over the next 36 hours to 150 cfs. The release was held at the 150 cfs level for 4 days then reduced in a stepwise fashion by increments of 25 cfs over the remaining 14 days of the 1968 monitoring period. The release was held for 3 days at the 125 cfs level and again at the 100 cfs level, then lowered to 75 cfs where it remained relatively constant until September 16, the beginning of the prescribed minimum winter flow (35 cfs). Flow reduction between steps was generally accomplished over a period of 48 hours. The release pattern is shown in Figure 14a.

During the first part of the test period (July 1-August 9), when the Hetch Hetchy release was near 75 cfs, the maximum daily water temperatures at O'Shaughnessy, Preston Meadow, and Early Intake ranged respectively from 54° to 56°, 66° to 69°, and 70° to 75°F. The average of the maximum daily water temperatures at Early Intake was 73°. Thus, the water gradually warmed as it flowed down the river and at the end of the study reach was about 18 degrees above its temperature at the beginning. By the time water released from Hetch Hetchy had traversed two-thirds of the study area, it had already reached temperatures marginal to the well-being of trout (68°); by the time it reached Early Intake, temperatures suitable for trout were clearly exceeded. Air temperatures during this period, recorded at Early Intake, were seasonal and relatively stable (median daily range of 72° to 85°, with an average of 79°). Median daily air temperature was derived by halving the sum of the daily maximum and minimum temperatures.

In response to the sudden increase in the Hetch Hetchy release from 75 to 350 cfs during August 9 and 10, the maximum daily water temperature at Early Intake fell a full 10 degrees (from 71° to 61°). Although the thermograph at Preston Meadow was not in operation at this time, it can probably be assumed that a comparable reduction in stream temperature occurred there in response to the sudden flow increase. Predictably, stream temperature at O'Shaughnessy gaging station did not drop significantly. The air temperature record for Early Intake shows a striking downward trend in median daily values (from 77° to 54°) beginning on August 11 and extending over the next 10 days. However, it is believed that the reduction in water temperature at Early Intake was due principally to increased flow because the median daily air temperature had dropped less than 5 degrees when the lowest water temperature was recorded at Early Intake.

During the final phase of the 1968 test period, when water was released from Hetch Hetchy in a descending stepwise fashion from 150 to 75 cfs, maximum daily water temperatures at all stations showed a general increase, reaching the levels prevailing during the first part of the test period when the release was stabilized near 75 cfs. A pronounced departure from the overall upward trend in water temperature occurred midway through the final phase. Between August 17 and 21, when the flow release was being reduced from 150 to 125 cfs and held at 125 cfs for 3 days, maximum daily water temperatures at Preston Meadow and Early Intake dropped approximately 5 degrees. An inspection of air and water temperature data for this brief period showed a nearly perfect coincidence of peaks and troughs. From August 18 to 21, median daily air temperature dropped 14 degrees.

1970 -- Stream temperature data were compiled for two periods in 1970: May 1-31 and July 1-September 13. The thermograph stations were inaccessible for much of June because of high flows. During May, releases from Hetch Hetchy varied from 1,000 to 2,000 cfs except for the first 2 days of the month when the release was 85 cfs. Maximum daily water temperature on May 1 and 2 at O'Shaughnessy Dam was 47°. Maximum daily water temperatures at Preston Meadow and Early Intake held at about 56° and 58°, respectively, until May 3 when they rapidly declined to a low of 49° on May 6 in response to the greatly increased release from Hetch Hetchy. Maximum daily water temperatures at Preston Meadow and Early Intake gradually increased as the month progressed, but did not exceed 53°. Median daily air temperature increased during the month, varying between 55° and 74°, except for a sudden drop to 46° on May 6 coincident with the lowest stream temperatures recorded at Preston Meadow and Early Intake.

The July 1 to September 13 segment of the 1970 test program (Figure 14b) was continuous except for an 8-day lapse between July 9 and 17. During the first 9 days of July, the maximum daily water temperature at Early Intake soared from 55° on July 1 to 70° on July 6, then fell to 56° on July 9. During this period the release from Hetch Hetchy fluctuated from about 1,600 cfs on July 1 down to 85 cfs on July 3-5, then back up to over 1,000 cfs by July 7. Median daily air temperature at Early Intake ranged from 67° to 82° and generally followed a distribution pattern corresponding to that of daily water temperatures. The severe changes in flow release were made for reasons of project operation.

Beginning on July 17, releases from Hetch Hetchy were reduced stepwise from flows in excess of 210 cfs to 35 cfs over a period of 48 days. Releases were held from 3 to 6 days at the following levels: 210, 185, 165, 140, 115, 85, and 45 cfs. The 35 cfs level, reached on September 3, was monitored for 10 days. As in 1968, reduction of flow between steps was generally accomplished in 2 days. As expected, the maximum daily water temperature at Early Intake followed an upward trend as Hetch Hetchy releases were reduced. The lowest maximum temperature (62°) was recorded on July 17. Prior to that date, flow had been in excess of 210 cfs. The highest daily maximum temperature (72°) was recorded on September 12. From August 18 to the end of the monitoring period, when flows were at or below 115 cfs, the maximum daily water temperature (with the exception of 3 days) reached or exceeded 68°. Median daily air temperature during the July 17 to September 13 period ranged between 65 and 81 degrees except for 2 days when the median temperature dropped to about 60°.

1971 - Releases of 150 cfs and 125 cfs were monitored for 6 days each from August 9 to 22 in 1971 to further quantify stream temperatures in that flow range. The highest maximum water temperature recorded at Early Intake during the 150 cfs phase was 67°. During that time, median daily air temperatures ranged from 78° to 86°. When flow was reduced to 125 cfs, a maximum water temperature of 68° was reached at Early Intake. Median air temperature during the latter phase varied from 78° to 87°. Beginning on August 22, the Hetch Hetchy release was stepped up over a period of 2 days to 240 cfs where it was held for 4 days. Water temperatures at Early Intake subsequently dropped to a daily maximum of 60°.

An inspection of maximum and minimum daily water temperatures for 1968, 1970, and 1971 revealed that the magnitude of daily variation was directly related to volume of flow. At 75 cfs, the daily fluctuation at Early Intake was typically about 5 degrees Fahrenheit, but on occasion was as great as 9 degrees. In the 125-150 cfs range, daily fluctuation was typically 2-3 degrees. At flows above 200 cfs, fluctuation seldom exceeded 2 degrees.

Examination of scales removed in August and September of 1968 from 49 brown trout showed an unusual condition in 11 cases. It was noted that annuli, or growth checks, had begun to form at the outer margin of the scales. The formation of growth checks is induced by environmental stress and typically occurs during the winter months when growth of the fish slows or ceases as a result of diminished food supply. The fact that some trout were forming annuli in late summer suggests that the adverse environmental condition responsible may have been above-optimum stream temperatures.

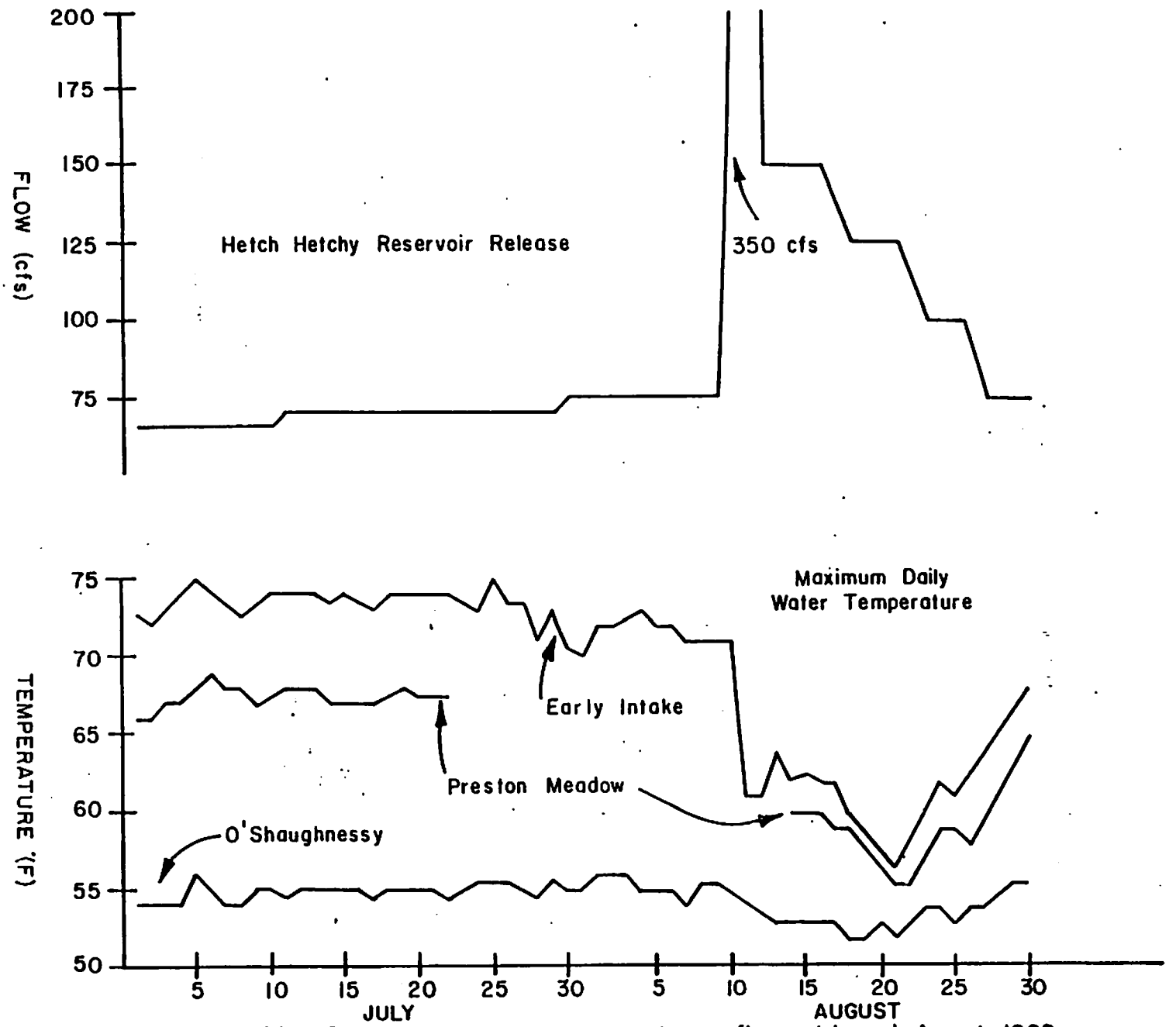


Figure 14a. Stream temperature versus stream flow--July and August 1968.

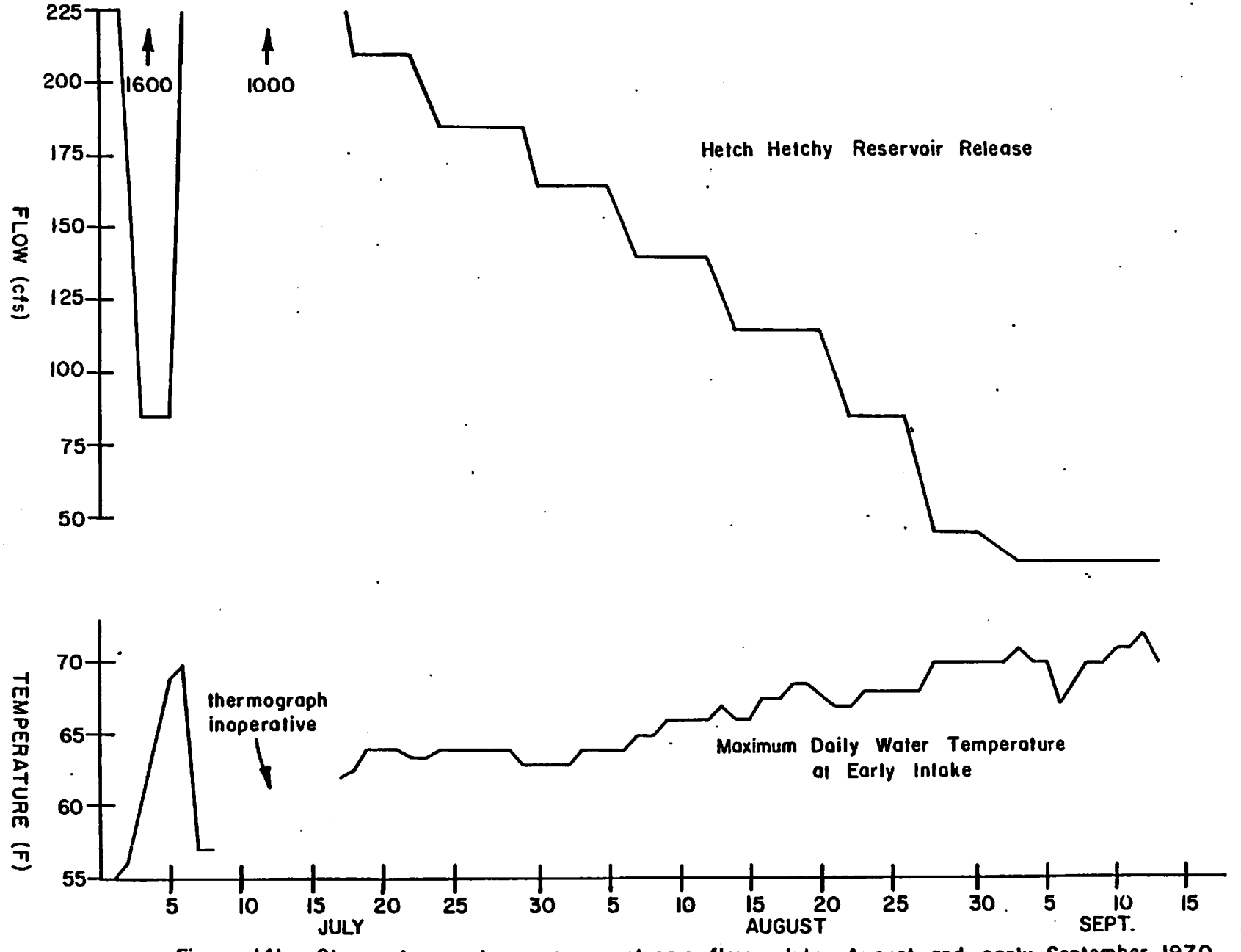


Figure 14b. Stream temperature versus stream flow--July, August and early September 1970

Streamflow Records

Flow records contained in water supply papers published by the U.S. Geological Survey were studied to assess the operational impact of Hetch Hetchy Reservoir and Canyon Tunnel on the flow regime of the 12.1-mile study reach. From 1910 to 1915, streamflow was measured at the site of O'Shaughnessy Dam. Since 1915, flow has been recorded at a gaging station 1 mile downstream from the dam.

An examination of the record shows that the average daily flow was 999 cfs for the 57 years preceding the diversion of water from Hetch Hetchy Reservoir into Canyon Tunnel. During that period, streamflow ranged from a low of 1.3 cfs in November 1923 (following closure of O'Shaughnessy Dam) to a high of 12,900 cfs on June 1, 1943. The overall effect of Hetch Hetchy Reservoir on downstream flow, prior to Canyon Tunnel diversion in 1967, was a reduction in the magnitude of spring runoff flows and an augmentation of naturally occurring low flows in late summer and early fall. Inspection of the record for the decade preceding Canyon Tunnel diversion shows that streamflow at the gaging station rarely fell below 200 cfs. Average daily flow during the 10-year period dropped below 200 cfs on only 25 occasions and then no lower than 188 cfs (September 1961).

Since 1967, when the Canyon Project was completed, with a diversion capacity somewhat in excess of 850 cfs, water has been released from Hetch Hetchy Reservoir to the Tuolumne River in conformance with the schedule stipulated by the Secretary of the Interior: 75 cfs May 1-September 15, and 35 cfs September 16-April 30. In general, releases have been greater than the required minimums only when the storage capacity of the reservoir was exceeded. The record indicates that on three occasions since 1967 reservoir releases to the river were shut-off for periods of 1, 2, and 7 days. A visible consequence of the overall reduction in flow since 1967 is death of riparian vegetation along the banks of the former flow line and the encroachment of willows and alders into parts of the streambed no longer inundated.

Water Quality

Over a 36-hour period during September 10-12, 1968, the U.S. Geological Survey monitored selected water quality parameters near each end of the study reach. Water samples were collected hourly and measured for specific conductance, dissolved oxygen, temperature, pH, and total alkalinity. Percent saturation of dissolved oxygen was calculated from the observed data. The measurements were taken when riverflow was about 75 cfs and 3 days before flow was reduced to 35 cfs in conformance with the prescribed minimum flow schedule. The values obtained are generally consistent with those characterizing the coldwater stream habitat. The low readings for total alkalinity indicate relatively infertile water in terms of dissolved nutrients. It is to be noted that a maximum water temperature of 75.2°F. was recorded at the Early Intake station.

Table 2

Water Quality Values
At Two Tuolumne River Locations
September 10-12, 1968

	UPPER[1]		LOWER[2]	
	range	average	range	average
Specific conductance (micromhos/cm)	9.0 - 22.0	11.1	13.0 - 18.0	15.6
Total alkalinity (mg/l HCO_3)	4.0 - 8.5	6.2	5.0 - 6.5	5.7
Temperature (°F.)	51.4 - 55.4	52.7	65.1 - 75.2	69.1
pH (units)	5.3 - 6.6	6.0	6.4 - 6.9	6.7
Dissolved oxygen (mg/l)	8.3 - 9.9	9.3	7.3 - 8.3	7.8
Oxygen saturation (%)	85.0 - 104.0	-	85.0 -100.0	-

1/ 1 mile downstream from O'Shaughnessy Dam.
2/ ½ mile upstream from Early Intake.

Streambed Food Production

In 1968, 1969, and 1970, bottom-dwelling fishfood organisms were collected from the riffles at the transect stations by means of a "Surber sampler" (Figure 15). Sampling was generally accomplished on a monthly basis from late spring through early fall. The sampling yielded a typical variety of aquatic insect forms (predominately of the Orders TRICHOPTERA, PLECOPTERA, EPHEMEROPTERA, MEGALOPTERA, and DIPTERA), but showed the streambed to be relatively unproductive of fishfood organisms. Analysis by volumetric displacement of the organisms recovered from 100 samples gave an average value of only 0.14 cubic centimeter per square foot of streambed. A riffle is considered to be of average or better productivity if values in excess of 1 cubic centimeter per square foot are obtained.

The paucity of streambed organisms is probably due to the infertility of the water and to the devastation that attends sizeable and sudden changes in volume of flow. It was noted on several occasions during the course of the study that habitat supporting benthic organisms was dewatered when releases from Hetch Hetchy Reservoir were reduced for operational reasons. Channel scouring, caused by rapid increase in flow, is also destructive to streambed life.

An examination of stomach contents from 34 brown and rainbow trout collected during May 1970 revealed the importance of terrestrial insects (HYMENOPTERA and COLEOPTERA) at that time of the year, in addition to the aquatic insects noted above.

Figure 15. Collecting streambed organisms.

Fish Population

In September 1970, when flow was 35 cfs, rotenone was applied to the river at four locations (Plate I) for the purpose of gathering data from which to estimate the number of trout inhabiting the study reach (Figures 16, 17, and 18). The combined length of the sampling areas was nearly one-half mile. They were identified with respect to nearby landmarks, i.e., "old gage station," "upper Poopenaut," "Tuolumne Gorge," and "transect 5." In advance of rotenone application, ¼-inch mesh nets were placed across the stream at the upstream and downstream limits of the sampling area. At the upper and lower sampling areas, known numbers of fin-clipped, hatchery-reared rainbow trout (4 to 14 inches) were planted 1 day before rotenoning so that the percent recovery of wild trout might be assessed. As the current carried the rotenone from the sampling area it was detoxified with potassium permanganate. All wild trout recovered were identified by species, measured (fork length), and weighed.

The number of wild rainbow trout (*Salmo gairdneri* Richardson) and brown trout (*S. trutta* Linneaus) recovered from the four sampling areas is presented in Table 3. At the old gage station sampling site, about 70 percent of the marked, hatchery-reared trout planted prior to rotenone application were recovered. At Transect 5, about 80 percent of the planted trout were recovered. By extrapolation, taking into account the indicated recovery rates, it was estimated that the 12.1-mile study reach supported about 8,000 wild trout of catchable size (6.5 inches and over) near the end of the 1970 recreation season (Table 4).

As shown by Table 3, brown trout predominated among the fish recovered from the rotenone-treated stream segments. Catchable-size brown trout outnumbered rainbow trout at the old gage station area by a ratio of nearly 5 to 1. The ratio was somewhat more balanced (about 2 to 1) farther downstream at the upper Poopenaut and Tuolumne Gorge sampling areas, and was near unity at transect 5. The preponderance of brown trout toward the upper end of the study area may be due to the different spawning habits of the two species. At the upper end of the area in spring, when rainbows normally spawn, water temperatures are low and flow uneven because of variable reservoir releases. In the fall, when browns spawn, the water at the upper end is less cool and the reservoir release pattern has stabilized.

An inspection of length frequency data for the collected specimens (Table 5) indicates that young trout averaged from 5 to 9 cm (2 to 4 inches) fork length near the end of their first summer. Rainbow and brown trout inhabiting the study reach appear to reach harvestable size late in their second summer or early in their third summer.

Non-salmonid fishes were found at two of the sampling areas. Suckers (*Catostomus sp.*) and riffle sculpin (*Cottus sp.*) were abundant at the transect 5 area and are believed to be well established throughout the lower four miles of the study reach from Early Intake to Preston Falls. The falls undoubtedly prevents their movement farther upstream. A few minnows (*Cyprinidae*) were captured at the old gage station sampling area. Minnows of the same kind are abundant in Hetch Hetchy Reservoir, 1 mile upstream.

Figure 16. Applying rotenone to stream section.

Figure 17. Block net at lower end of rotenone - treated stream section.

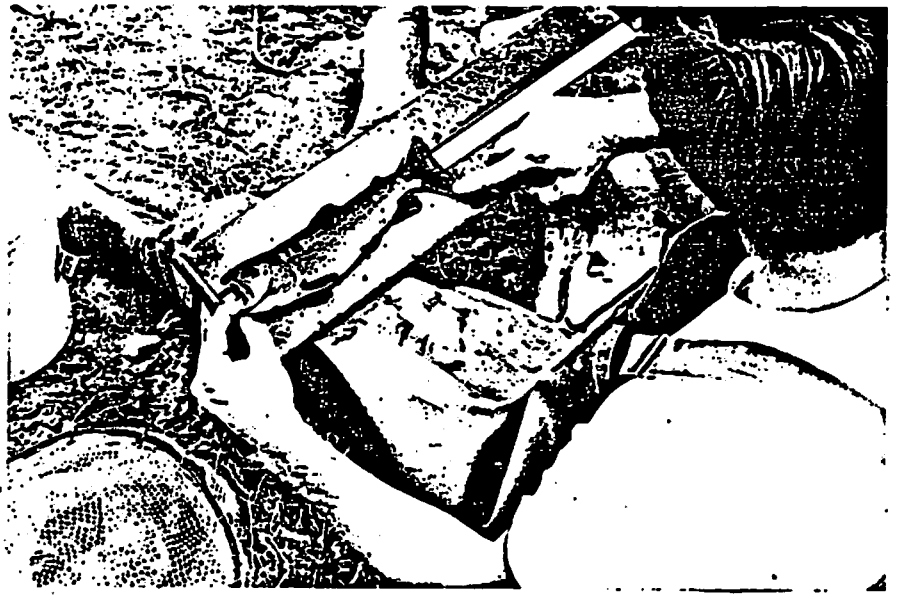


Figure 18. Measuring brown trout.

Table 3

Wild Rainbow and Brown Trout Collected
at Four Tuolumne River Locations
September 1970

Location and Species	Miles of Stream	Trout Recovered	Fork Length (inches) Under 6.5	6.5 plus	Pounds (6.5 inches plus)
Old gage station	.15				
Rainbow		11	1	10	2.6
Brown		188	140	48	10.4
Upper Poopenaut	.13				
Rainbow		55	43	12	2.4
Brown		201	172	29	5.5
Tuolumne Gorge	.08				
Rainbow		85	66	19	4.0
Brown		161	121	40	13.4
Transect 5	.06				
Rainbow		69	53	16	3.0
Brown		65	52	13	5.0
TOTAL	.42				
Rainbow		220	163	57	12.0
Brown		615	485	130	34.3

Table 4

Estimated Population of Catchable-Size Trout
in Tuolumne River Study Reach
September 1970

Stream Segment	Length (miles)	Trout (6.5 inches plus) Rainbow	Brown	Total
Hetch Hetchy to Poopenaut Valley	1.8	168	828	996
Poopenaut Valley to Tuolumne Gorge	1.7	221	546	767
Tuolumne Gorge	2.6	780	1,625	2,405
Tuolumne Gorge to Preston Falls	2.0	634	892	1,526
Preston Falls to Early Intake	4.0	1,333	1,067	2,400
TOTAL	12.1	3,136	4,958	8,094

Table 5

Length Frequency Distribution of Wild Trout Collected
at Four Tuolumne River Locations
September 1970

SUBCATCHABLE (0 - 6.5 inches)			CATCHABLE (6.5 inches plus)		
Fork Length (cm)	Rainbow	Brown	Fork Length (cm)	Rainbow	Brown
1			17	7	24
2			18	10	14
3			19	6	12
4	1		20	9	10
5	30	2	21	10	19
6	52	52	22	6	15
7	36	153	23	3	8
8	2	156	24	5	9
9	1	62	25	1	5
10		6	26		3
11		1	27		3
12	2	2	28		3
13	6	3	29		1
14	12	8	30		
15	10	18	31		1
16	11	22	37		1
			42		1

Recreation-Esthetics Study

Use of the study reach by fishermen and other recreationists was assessed during the 1970 recreation season (May 1-November 15). Visitor registration boxes were placed at the Early Intake trailhead and at the Powerhouse Road, Mather Camp, and Poopenaut Valley trailheads by the Forest Service and the Park Service. In addition, a creel census, covering about 15 percent of the total recreation days, was conducted by the Fish and Wildlife Service. Creel data were segregated by weekdays, weekend days, and holidays before extrapolation to derive use and angler-success estimates for the entire season.

Information compiled from the self-registration forms placed at trailheads, and from on-site interviews, indicated that use of the 12.1-mile study reach amounted to nearly 1,300 visitor-days during the 1970 recreation season (Table 6). Fishing was either the primary or a collateral motivation for 70 percent of the visitation. Pursuit of outdoor experiences not including fishing (e.g., hiking and camping) accounted for the remaining visitation.

On the basis of registration forms and creel census data, it is estimated that 1,815 trout were harvested from the study reach during the 1970 recreation season. This and other estimates pertaining to fisherman success are presented in Table 7. The total catch was comprised of about equal proportions of rainbow and brown trout (55 percent rainbow, 45 percent brown).

From Table 7 it is seen that angler success in Tuolumne Gorge (1.25 trout per hour) was 2 to 3 times greater than that in other sections of the study reach. The use and success figures for Tuolumne Gorge may be questioned because they were derived by extrapolating information gained by interviewing only two fishermen. However, these fishermen accounted for 16 hours of fishing over a 2-day period during which time they creeled at least 20 trout. It is reasonable to conclude that angler success was greater in the gorge because of its difficult access.

Most camping along the study reach within Yosemite National Park takes place in the vicinity of the gaging station one mile below O'Shaughnessy Dam and in Poopenaut Valley. In Stanislaus National Forest, campers use the small flats at Mather Pool, Preston Meadow, Indian Meadow (near transect station 5), and Preston Meadow trailhead above Kirkwood power-house. All of these camping areas are presently undeveloped. Future development for recreationists, as envisioned by the Park Service and the Forest Service, would be guided by consideration of the potential that the study reach has for addition to the National Wild and Scenic Rivers System. Development will likely be limited to minor improvement of existing trails and installation of sanitation and campfire facilities at selected campgrounds. The Forest Service anticipates that use of the study reach within Stanislaus National Park will exceed 3,200 daily visits by 1990. Assuming that use of the study reach within Yosemite National Park increases at the same rate, it may be anticipated that use of the upper 6-mile segment will approach 2,700 daily visits by 1990.

In 1968 and 1970, Forest Service personnel photographed and made other observations of the river at flows of 1,600, 300, 250, 200, 150, 125, 100, 75, 50, and 35 cfs at several locations in Stanislaus National Forest. A report by the Forest Service ("Tuolumne River Flow Study, Stanislaus National Forest," October 25, 1972) containing numerous 8 x 10 inch color photographs of the river at the above flows is on file at the Ecological Services Office, U.S. Fish and Wildlife Service, Sacramento. Based on the study of the recreation and esthetic characteristics of the river within the study area at various flows, the Forest Service considers that the summer (May 15-September 15) flow should be no less than 150 cfs and that the winter (September 16-May 14) flow should be no less than 75 cfs. Because high flows are unfavorable for camping and fishing, the Forest Service believes that flows between May 20 and September 1 should not exceed 350 cfs. Winter flows should not exceed 700 cfs, in the interest of minimizing channel scour and erosion and preventing bank overflow.

Except for dry years, the National Park Service advocates a minimum summer flow of 200 cfs from May 1 to June 30 and 150 cfs from July 1 to September 30. A summer flow of this character would simulate the historical flow regime. A minimum winter (October 1 to April 30) flow of 75 cfs is proposed by the Park Service. In dry years, the Park Service has proposed a minimum summer flow of 150 cfs from May 1 to September 15 and a minimum winter flow of 75 cfs from September 16 to April 30.

Table 6

Visitor Use of
the Tuolumne River between
O'Shaughnessy Dam and Early Intake
May 1 to November 15, 1970

River Section	Length (miles)	Fisherman-Days	Other Recreation-Days	Total Visitor-Days
O'Shaughnessy Dam to Poopenaut Valley	1.8	224	113	337
Poopenaut Valley to Tuolumne Gorge	1.7	165	58	223
Tuolumne Gorge	2.6	15	0	15
Tuolumne Gorge to Early Intake	6.0	495	207	702
TOTAL	12.1	899	378	1,277

Table 7

Estimated Harvest and Angler Success
Tuolumne River between
O'Shaughnessy Dam and Early Intake
May 1 to November 15, 1970

River Section	Trout Caught	Angler-Hours	Catch Rate (trout/hour)	Catch Rate (trout/mile)
O'Shaughnessy Dam to Poopenaut Valley	294	701	0.42	163
Poopenaut Valley to Tuolumne Gorge	304	533	0.57	179
Tuolumne Gorge	75	60	1.25	28
Tuolumne Gorge to Early Intake	1,142	1,774	0.64	191
TOTAL or AVERAGE	1,815	3,068	0.59	150

DISCUSSION

On the basis of streamflow records, 200 cfs may be taken as the minimum flow characteristic of the study reach during the decade preceding the diversion of water through Canyon Tunnel. Since 1967, when tunnel diversion began, the minimum flow has been near 35 cfs in winter and 75 cfs in summer. The stream transect data show that at the reduced flows there is a substantial reduction in riffle area--a critically important component of trout habitat. When flow was reduced from 211 cfs to 75 cfs, it was found that the loss of useable trout habitat at the transect stations amounted to 40 percent. At 35 cfs, the loss reached 60 percent. The importance of the riffles to trout in the study reach is accentuated by the fact that the stream, under the best of flows, has a preponderance of pool area over riffle area. Hence, any reduction in useable riffle area during the spawning and rearing seasons immediately affects the stream's capability to sustain its population of trout. Additionally, the temperature monitoring data demonstrate that the presently required minimum summer flow (75 cfs) is inadequate for the maintenance of suitable stream temperatures throughout the study reach. It is apparent that a summer flow in excess of 100 cfs is essential for maintenance of coldwater fish habitat in the lower portion of the study reach. As noted earlier, the U.S. Forest Service and the National Park Service believe that a minimum winter flow of 75 cfs and a minimum summer flow of 150 cfs (NPS advocates 200 cfs for early summer in wet years) must be provided if recreational and esthetic values are to be protected. Thus, the conservation agencies, including the California Department of Fish and Game, are in agreement that the present minimum flow schedule should be more than doubled. A schedule of minimum flows embracing all of the considerations noted above would appear as follows:

Period	*cfs*
January 1 - April 30	75
May 1 - June 30	200
July 1 - September 30	150
October 1 - December 31	75

After considering the schedule, officials of the San Francisco Public Utilities Commission proposed an alternate schedule of minimum reservoir releases for the consideration of the conservation agencies (Appendix C). The Commission's proposal consists of four series of release patterns, each series keyed to actual precipitation and runoff conditions in a given year. The conservation agencies have examined the Commission's proposal, but conclude that the schedule of releases set forth above must be observed in all years if the fishery, recreational, and esthetic values of the study reach are to be adequately protected.

Stipulation No. 7 of "STIPULATIONS FOR RELOCATION AND AMENDMENT OF RIGHTS OF WAY FOR TUNNEL AQUEDUCT..." (Appendix A) states:

> Changes in magnitude of water releases into the Tuolumne River from O'Shaughnessy Dam shall be gradual and minimal and shall be restricted to those having a fairly constant rate of change producing not more than double nor less than one-half the previous release over a one-hour period, except as may be required by emergency operations resulting from mechanical failure or other conditions beyond the control of the Applicant.

The requirement, as written, allows for substantial changes in the volume of reservoir release over a short period (e.g., from 1,000 cfs up to 2,000 cfs or down to 500 cfs in 1 hour). A sudden and extreme change in the volume of water released from the reservoir has a devastating effect on fishlife and fishfood organisms inhabiting the study reach. A rapid elevation of flow volume scours the streambed and erodes the streambanks. Aquatic insect forms comprising the benthic community are displaced, the water is made turbid, and the downstream reaches are subjected to sedimentation that fills the gravel interstices. The consequences of scouring flows are especially damaging during the trout spawning, egg incubation, and rearing periods. Conversely, a sudden drop in the volume of flow adversely affects the stream biota by desiccating insect forms attached to gravels as well as trout redds. Rapid flow changes in either direction, of course, seriously impact the recreational-use and esthetic values of the stream.

The ecological damages and the hazard to recreationists resulting from rapid change in volume of release would be less severe if the time period specified in the stipulation were changed to read: "over a 4-hour period." Additionally, it is believed that when riverflow is in the range of 75 to 200 cfs, which will generally be the case under the schedule proposed, the rate of change should not exceed 50 cfs over a 4-hour period.

As previously noted, the Forest Service believes that reservoir releases during the summer (May 20 to September 1) should not exceed 350 cfs and that releases during the balance of the year should be held below 700 cfs. If releases did not exceed these maxima, interference with camping, fishing, and other recreational uses of the river would be reduced and the adverse effects of channel scour, erosion, and bank overflow minimized. It is recognized that the storage capacity of the reservoir as well as the vagaries of weather and other exigencies prevent perfect observance of such a requirement. However, it is believed that these release limits should be imposed as a project-operating goal.

There is no requirement under present rights-of-way that the conservation agencies be provided with a periodic report of reservoir releases. We believe that such a report, specifying the amount of the release on a daily basis, should be submitted by the San Francisco Public Utilities Commission to the conservation agencies on a monthly basis. The report should also contain an explanation of any circumstances preventing compliance with the minimum flow requirement for the period reported on. In addition, the agencies should be advised at least 1 week in advance of any anticipated noncompliance so that field observation may be planned, if desired.

Only operating experience can demonstrate the adequacy of the reservoir releases discussed herein in terms of volume and seasonal distribution. For that reason, the conservation agencies believe that followup studies should be carried out subsequent to implementation of the revised schedule of minimum releases. Such studies would be generally comparable to those already described, but could involve an assessment of flows other than those examined thus far. In addition, future studies would consider the need for fish passage facilities at Early Intake Dam. The dam constitutes a barrier to the upstream migration of trout during the spawning season; however, the significance of the blockage from the standpoint of maintaining the native fishery has not been determined. Any followup studies by the conservation agencies, for which reimbursement under Section 9(r) of the Raker Act is sought, would be undertaken pursuant to proposals submitted through administrative channels for approval by the Secretary of the Interior.

A requirement that water released at O'Shaughnessy Dam for fish remain in the Tuolumne River beyond Early Intake Dam is set forth in "STIPULATIONS FOR AMENDMENT OF RIGHTS-OF-WAY FOR CANYON POWER PLANT...," dated February 9, 1965, (Appendix B). Item 3 of those stipulations reads:

> The amendment applied for is also subject to provision that water diversions by applicant below Early Intake Dam do not decrease the magnitude of water releases from O'Shaughnessy Dam for fish, and provided these releases in addition to accretional runoff be permitted to enter and continue in the Tuolumne River below Early Intake.

Continuation of the foregoing stipulation in conjunction with the increased Hetch Hetchy releases will improve river conditions to Don Pedro Reservoir. Presently, the Tuolumne River below Cherry Creek confluence is subject to widely fluctuating flows resulting from the operation of Holm Powerhouse on Cherry Creek. The fishery and recreational values of the Tuolumne River to Don Pedro are significantly reduced when flows drop coincident with routine curtailment of power generation.

CONCLUSIONS

On the basis of a study conducted by the U.S. Fish and Wildlife Service in conjunction with the U.S. Forest Service, the National Park Service, and the California Department of Fish and Game pursuant to a stipulation 1/ contained in the rights-of-way governing operation of Canyon Power Project, it is concluded that the present schedule of minimum releases (ranging from 35 to 75 cfs) from Hetch Hetchy Reservoir to the Tuolumne River at O'Shaughnessy Dam is inadequate for the protection of downstream fishery, recreational, and esthetic values. It is believed that a schedule of minimum reservoir releases ranging from 75 to 200 cfs (as set forth in the DISCUSSION section of this report), together with certain related measures, would provide an acceptable level of protection for the natural values associated with the 12.1-mile reach of the river traversing lands within Yosemite National Park and Stanislaus National Forest between O'Shaughnessy Dam and Early Intake and the 1.5-mile reach of river from Early Intake to Cherry Creek confluence. Recommendations are made for implementation of a revised schedule of minimum releases and related conservation measures by amendment and supplementation of the federally granted rights-of-way under which the San Francisco Public Utilities Commission operates the Canyon Power Project.

1/ Appendix A: STIPULATIONS FOR RELOCATION AND AMENDMENT OF RIGHTS-OF-WAY FOR TUNNEL AQUEDUCT, STEEL PENSTOCK, POWER PLANT SITE, SPOIL AREAS AND ACCESS ROADS AS APPROVED PURSUANT TO MAPS FILED APRIL 10, 1914, JULY 3, 1916, AND DECEMBER 13, 1916, IN UNITED STATES LAND OFFICE AT SACRAMENTO, CALIFORNIA, MAP R-527; REVISION NO. 1, FILED OCTOBER 2, 1958. (Amended Sacramento Serial No. 010130).

RECOMMENDATIONS

To protect the fishery, recreational, and esthetic values of the Tuolumne River downstream from O'Shaughnessy Dam (Hetch Hetchy Reservoir), the U.S. Fish and Wildlife Service (with the concurrence of the U.S. Forest Service, the National Park Service, and the California Department of Fish and Game) recommends that the rights-of-way under which the San Francisco Public Utilities Commission operates its Canyon Power Project be amended or supplemented, as appropriate, to provide for the following measures:

1. That the minimum amounts of water released from Hetch Hetchy Reservoir to the Tuolumne River at O'Shaughnessy Dam be in accordance with the following schedule:

Period	*cfs*
January 1 - April 30	75
May 1 - June 30	200
July 1 - September 30	150
October 1 - December 31	75

2. That the allowable rate of change in the magnitude of water releases from Hetch Hetchy Reservoir to the river at O'Shaughnessy Dam be changed from the present stipulation of "...not more than double nor less than one-half the previous release over a one-hour period..." to "not more than double nor less than one-half the previous release over a 4-hour period except when the previous release is 200 cfs or less, in which case the rate of change shall not exceed 50 cfs over a 4-hour period."

3. That insofar as the storage capacity of Hetch Hetchy Reservoir and emergency situations allow, the amount of water released to the river at O'Shaughnessy Dam shall not exceed 350 cfs from May 20 through August 31 and 700 cfs from September 1 through May 19.

4. That the San Francisco Public Utilities Commission provide the appropriate field offices of the U.S. Forest Service, the National Park Service, the U.S. Fish and Wildlife Service, and the California Department of Fish and Game with periodic reports of releases from Hetch Hetchy Reservoir to the Tuolumne River at O'Shaughnessy Dam. The reports should (1) be furnished on a monthly basis by the 10th work-day of the month following that reported on, (2) indicate the magnitude of the release at any given time during the report period, and (3) contain an explanation of any circumstances preventing compliance with the schedule of minimum reservoir releases specified in Recommendation No. 1.

5. That the San Francisco Public Utilities Commission notify the appropriate field offices of the U.S. Forest Service, the National Park Service, the U.S. Fish and Wildlife Service, and the California Department of Fish and Game at least 7 days in advance of any anticipated noncompliance with the schedule of minimum reservoir releases specified in Recommendation No. 1.

6. That the San Francisco Public Utilities Commission agree to reimburse the U.S. Fish and Wildlife Service for the cost of any followup studies it may undertake in cooperation with the California Department of Fish and Game, the National Park Service, and the U.S. Forest Service, or that may be undertaken by the California Department of Fish and Game in cooperation with the above named agencies. Such followup studies would be implemented on the basis of study plans approved by the Secretary of the Interior and would have as their purpose (1) a determination of the adequacy of the revised reservoir release schedule for protection of the fishery, recreational, and esthetic values of the Tuolumne River from O'Shaughnessy Dam to the confluence of Cherry Creek, and (2) an assessment of the need for fish passage facilities at Early Intake Dam.

APPENDIX

A. Letter of April 27, 1961, from Secretary of the Interior, Washington, D.C., to City Attorney, San Francisco, California, with enclosed "STIPULATIONS FOR RELOCATION AND AMENDMENT OF RIGHTS-OF-WAY FOR TUNNEL AQUEDUCT..."

B. Letter of February 9, 1965, from Assistant Manager, Adjudication Branch, Bureau of Land Management, Sacramento, California, to General Manager, Power and Utilities Engineering Bureau, Public Utilities Commission, San Francisco, California, with enclosed "STIPULATIONS FOR AMENDMENT OF RIGHTS-OF-WAY FOR CANYON POWER PROJECT..."

C. Letter of January 23, 1973, from General Manager, Hetch Hetchy Water and Power, Public Utilities Commission, San Francisco, California, to Field Supervisor, Division of River Basin Studies, U.S. Fish and Wildlife Service, Sacramento, California

D. Letters of concurrence from U.S. Forest Service, dated August 13 and September 26, 1975

E. Letter of concurrence from National Park Service, dated August 27, 1975

F. Letter of concurrence from California Department of Fish and Game, dated May 18, 1976

COPY

UNITED STATES
DEPARTMENT OF THE INTERIOR
OFFICE OF THE SECRETARY
Washington 25, D.C.

Certified Mail
Return Receipt Requested

April 27, 1961

Dear Mr. Holm:

This refers to the appeal of the City and County of San Francisco (hereinafter sometimes referred to as the City or the Grantee) from the decision of the Land Office at Sacramento, California, dated July 9, 1959, which required the City to execute certain stipulations (relating among other things, to minimum releases of water) as a condition to the granting of its application for a change of location of a right-of-way in the Stanislaus National Forest and the Yosemite National Park. The City appealed to the Director, Bureau of Land Management. The Secretary of the Interior assumed direct jurisdiction over this appeal.

The United States Forest Service, the National Park Service, the Fish and Wildlife Service and the California Department of Fish and Game have recommended revised stipulations as to minimum releases of water into the Tuolumne River from O'Shaughnessy Dam (Hetch Hetchy Reservoir). The revised stipulations would require minimum releases of 75 cfs for the period May 1 through September 15 and 35 cfs for the period September 16 through April 30. In addition, the stipulations call for a study to determine whether increases should be required in these minima with final decision as to any recommended increases to be made by the Secretary after notice and hearing.

In accordance with the provisions of the Raker Act, 38 Stat. 242 (1913), the Department of Agriculture has indicated approval of the new right-of-way location, insofar as it relates to the national forest lands.

I have concluded that the City's application should be granted, subject to conditions hereinafter referred to. My reasons follow.

This case is another chapter in the long history of the City's Hetch Hetchy developments under the Raker Act. Specifically, it concerns the City's proposed Canyon power project. The principal features consist of a tunnel about 12 miles long generally following the course of the Tuolumne River from O'Shaughnessy Dam to Early Intake and a power plant at Early Intake with a planned installed capacity of 66,000 kw. For about one-half its length the tunnel would be located in Yosemite National Park. The balance of the tunnel and the power plant itself will be constructed in Stanislaus National Forest.

The existing right-of-way was approved and amended in 1914 and 1917, respectively, pursuant to the Raker Act. This original right-of-way location follows a meandering course on the south side of the Tuolumne River. By its current application, the City seeks to relocate the route of the tunnel to a straight line on the north side of the river.

It is the fact that the City has not proceeded with the project since it received the amended right-of-way in 1917 that has given rise to the principal issue before me.

In brief, the questions for decision are whether there should be a conclusion that the City has not been diligent in prosecuting the work and, if so, whether the City's right-of-way should be declared forfeited.

The reason for the City's delay is conceded. As the Department's Special Hearing Officer found, it is because of lack of earlier need for the Canyon project's power potential due to the refusal of the electorate to approve the City's acquisition of the San Francisco electric utility operations of Pacific Gas and Electric Company.

In his finding No. 21, on diligence, the Special Hearing Officer, while attempting to preserve the issue as a legal question, concluded that the City had no responsibility for the decisions of its electorate. On the other hand, it is argued that under the charter of San Francisco the elections were essential elements in the City's decision-making process and, therefore, the decision of the electorate is perforce the decision of the City.

The Solicitor of the Department has recommended that proposed finding No. 21 be stricken since it involves conclusions of law rather than findings of fact. I accept the Solicitor's recommendation.

The Raker Act forfeiture provision is not mandatory whatever might be the conclusion as to diligence. Section 5 provides that "in the event" the Secretary determines that work has not been diligently prosecuted, the Secretary "may declare forfeited" the City's rights to the unconstructed works and refer the matter to the Attorney General, whose duty upon such referral "shall be" to commence suit to secure a judgment of forfeiture. The juxtaposition of the imperative expression "shall" with "may" in Section 5 makes it clear that the Congress intended by the latter term that the Secretary of the Interior should exercise discretion to determine whether, though lack of diligence be found, the circumstances are such as to call forth a forfeiture.

Such a reading of Section 5 accords with the ordinary meaning of the word "may", particularly when found in juxtaposition with expressions of command; it is also in accord with the traditional gravity with which the courts approach forfeitures.

A forfeiture is harsh. Before considering it, an official should be certain that the public interest can be satisfied in no other way. After most careful judgement, I have concluded that, under the terms and conditions to which the approval will be subject, the public interest can be protected. Therefore, I do not at this time and in the circumstances under which the change in location will be approved, deem it necessary to determine the question of diligence.

At the same time, I must observe in all candor that the argument that the City must take responsibility for the decisions of its electorate is a compelling one and, consequently, the grantee would have a heavy burden to overcome were the diligence question to be in issue.

I am persuaded that the north side location can be approved consistent with the public interest for the following reasons:

(1) The interests of sport fishery and recreation can be protected by requiring continuing releases of water from O'Shaughnessy Dam to maintain the Tuolumne as a live stream between the dam and Early Intake. This will be of great importance as there is no requirement for release of water to maintain a live stream under the original, south side right-of-way. With this requirement added to the stipulations, the National Park Service and the Fish and Wildlife Service, together with the Forest Service and the California Department of Fish and Game, are agreeable to approval of the change in location.

(2) The north side straight line right-of-way, with provision for weathering of rocks and spoil, and considering the location of spoil banks, is a marked improvement aesthetically over the south side route.

(3) The major incursion in Yosemite Park came with the construction of the storage facilities, that is with O'Shaughnessy Dam itself. The tunnel, if constructed in the north side location, will have but minor additional effect on Yosemite Park. On the other hand, forfeiture would have a major impact upon the City's realization of benefits from the large investment already made in constructed works and would result in total loss of the substantial money, time and effort that has been expended in connection with the Canyon project.

(4) The power plant--the principal new external feature to be added by the development--will be outside the boundaries of Yosemite Park, as will the tunnel for one-half of its length. The Federal Power Act, enacted subsequent to the

Raker Act, does not exclude the use of national forest lands for power development under proper safeguards. This suggests a less rigid approach to the policy question than would be the case were the principal impact to be on the Park.

(5) Finally, we deal here with a public not a private body.

I am cognizant of the earnestness and force of the argument that this application should be made the occasion to put an end to the City's further construction of projects under the Raker Act. As in any matter involving judgment and discretion, however, the conflicting factors must be balanced and a decision reached.

Taking collectively all the factors into account, the balance favors approval of the change in location under proper conditions as set out in the stipulations annexed hereto.

Under other circumstances and conditions, I am not prepared to say that the approval of this Department could be forthcoming. I must and shall look with jaundiced eye upon any further initiation of construction activities under the Raker Act grants. It is only the special circumstances here present and above outlined, together with the remedial stipulations, that have impelled me to conclude that the public interest does not in this instance require a present determination as to diligence or a forfeiture.

The application to change the right-of-way location is hereby conditionally approved as shown by endorsement of Map R-527, Revision 1, dated September 15, 1958, which delineates in red the amended right-of-way location, subject to the execution in quadruplicate by the proper officials of the City and County of San Francisco of the revised stipulations enclosed herewith and the filing thereof in the office of the Director, Bureau of Land Management, Washington 25, D.C., within 30 days from receipt of this letter. This conditional approval and grant is null and void if the enclosed stipulations are not executed and filed as herein required. The approval of Map R-527, Revision 1, operates, as you know, as an abandonment of all theretofore approved rights-of-way of the City and County of San Francisco situated south of the Tuolumne River from O'Shaughnessy Dam to Early Intake for a tunnel aqueduct, penstocks, power plant, etc., in the Yosemite National Park and the Stanislaus National Forest, as delineated in green on said drawing.

Sincerely yours,

(signed) STEWART L. UDALL

Secretary of the Interior

Dion R. Holm, Esquire
City Attorney
City Hall
San Francisco 2, California

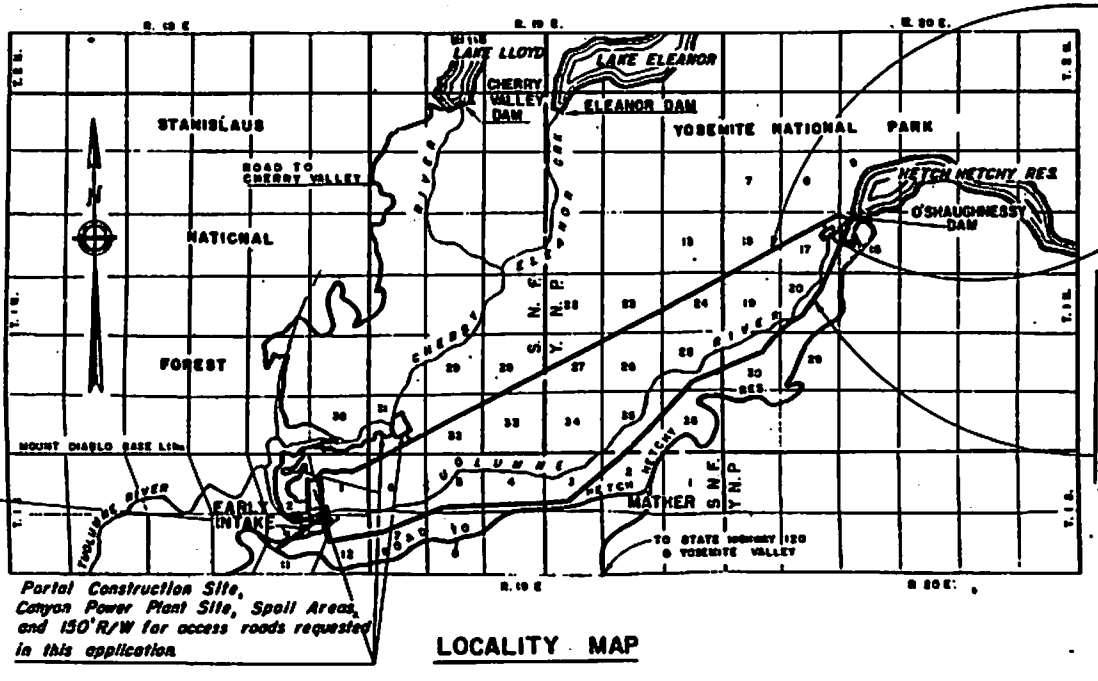
Enclosures

100' R/W for Canyon Tunnel aqueduct requested in this application.

Spoil area and 150' R/W for access roads requested in this application.

250' R/W for electric transmission line and 250'R/W for pressure pipe & tunnel line and Power Plant Site granted to City & County of San Francisco under application Sacramento Serial Number 010130 approved by Secretary of Interior Sept. 22, 1917 to be abandoned upon approval of this application.

100'R/W for tunnel aqueduct granted to City and County of San Francisco under applications Sacramento Serial Number . 07187, approved by the Secretary of the Interior on June 9, 1914 and Serial No. 07259, approved by the Secretary of the Interior on July 29, 1914, subsequently amended Sept. 12, 1916, Sept. 22, 1917 and Nov. 6, 1917, are to be amended by this application and abandoned by the City and County of San Francisco upon approval of this application.



Portal Construction Site, Canyon Power Plant Site, Spoil Areas, and 150'R/W for access roads requested in this application

LOCALITY MAP

SCALE IN MILES

0 1 0 1 2 3

93218

COPY

STIPULATIONS FOR RELOCATION AND AMENDMENT OF RIGHTS-OF-WAY FOR TUNNEL AQUEDUCT, STEEL PENSTOCK, POWER PLANT SITE, SPOIL AREAS AND ACCESS ROADS AS APPROVED PURSUANT TO MAPS FILED APRIL 10, 1914, JULY 3, 1916 AND DECEMBER 13, 1916 IN UNITED STATES LAND OFFICE AT SACRAMENTO, CALIFORNIA MAP R-527, REVISION NO. 1, FILED OCTOBER 2, 1958.

(Amended Sacramento Serial No. 010130)

Pursuant to the act of December 19, 1913 (38 Stat. 242), and in consideration of relocation and installation of its facilities and the granting to it by the United States of amended rights-of-way applied for, the City and County of San Francisco, a municipal corporation of the State of California, hereinafter referred to as Applicant, does hereby stipulate and agree and does hereby bind itself, its successors and assigns, as follows:

General

1. These stipulations apply to the right-of-way requested by Applicant across national park and national forest land as shown on that map entitled "Hetch Hetchy Water Supply. Canyon Power Project, Amended location of Tunnel Aqueduct, Steel Penstock, Power Plant Site, Spoil Areas and Access Roads. Yosemite National Park and Stanislaus National Forest, California" Drawing No. R-527 revision No. 1, signed by H. E. Lloyd, Manager and Chief Engineer, on February 17, 1958, and revised on September 15, 1958, as filed with the land office at Sacramento, California, on October 2, 1958, as an amendment to the City and County of San Francisco's previous applications for rights-of-way for tunnel aqueduct, pressure pipe, power plant site, and diversion dam site filed under Serial Numbers 07259, 09719, 010128 and 010130.

2. The Applicant shall take all reasonable precautions to avoid and prevent damage to property and resources of the United States. Applicant will pay to the United States Treasury, on demand, for all damage to the said property and resources resulting from the breaking or overflowing,

leaking or seepage, of water from the conduit and for all damage to such property and resources caused by the negligence of the Applicant, its employees, contractors or employees of contractors.

3. All containers of explosives shall be disposed of by the Applicant in such manner that they shall not be accessible to the public, livestock, or wild game.

4. The applicant will not infringe upon the rights of the public to enjoy free access to the Tuolumne River between O'Shaughnessy Dam and Early Intake.

5. The Applicant will prevent its employees, agents, and contractors from releasing debris or fines arising from excavation, deposit of spoil, mining, conveyance, refining, or washing of materials into the Tuolumne River or its tributaries.

6. The Applicant will release water to stream flow from O'Shaughnessy Dam according to the following schedule:

Period	Release from O'Shaughnessy Dam in Sec. Ft.
May 1 through September 15	Minimum of 75 cfs
September 16 through April 30	Minimum of 35 cfs

PROVIDED THAT, in addition to the releases provided for above, Applicant interposes no objection to the Government diverting not to exceed 0.5 cfs for the Federal consumptive use of water in Yosemite National Park and not to exceed 5.0 cfs for the Federal consumptive use of water in Stanislaus National Forest, all within the watershed of the branch of the Tuolumne River above Early Intake. To the extent any portion of such 5.5 cfs of water is diverted from the Tuolumne River between O'Shaughnessy Dam and Early Intake for use by the Government, the releases provided for above shall be increased to the extent of such diversions or uses. This paragraph shall not be construed to add to or to limit any rights of the Government to the use of the water of the Tuolumne River System; and

PROVIDED FURTHER, that the releases shall be measured at the existing gauging station located approximately 3/4 mile below O'Shaughnessy Dam; and

PROVIDED FURTHER, that during two years, not necessarily consecutive, each beginning April 1 and extending through March 31 of the following year, a fishery and recreational (including aesthetic) study shall be made

to determine whether or not the above schedule is adequate and, if not, to determine the magnitudes of the minimum flows required. This study shall be made jointly by the National Park Service, United States Forest Service, and the United States Fish and Wildlife Service during two years when the desired regulated minimum release can be maintained for more than half the period of May 1 through September 15, to assure sound testing for the purposes indicated. The Applicant and the California Department of Fish and Game may participate in this study, if they desire to do so. The two such years shall be selected by the Secretary of the Interior after consultation with the Secretary of Agriculture. During the course of such study the Applicant shall make such adjustments of flows as may be requested as a basis for making observations; and

PROVIDED FURTHER, that if it is found during the study that the September 16 to April 30 schedule is inadequate for the spawning of trout, a modified schedule of releases between 35 cfs and 75 cfs may be recommended for all or part of March and April; and

PROVIDED FURTHER, that at the conclusion of the aforesaid two years of study and based upon such study, the agencies participating in the study shall make recommendations to the Secretary of the Interior as to the required flows. Such recommendations shall become part of these conditions, unless the Applicant, within 30 days from receipt of notice of the recommendations, shall file with the Secretary of the Interior its objections thereto. In such event, at its request, the Applicant shall be afforded a hearing regarding these objections before a special hearing officer who will render proposed findings of fact. The Secretary, after considering the proposed findings of fact and the record, shall determine what additional flows, if any, shall be required over those specified above.

7. Changes in magnitude of water releases into the Tuolumne River from O'Shaughnessy Dam shall be gradual and minimal and shall be restricted to those having a fairly constant rate of change producing not more than double nor less than one-half the previous release over a one-hour period, except as may be required by emergency operations resulting from mechanical failure or other conditions beyond the control of the Applicant.

As to Yosemite National Park

8. The Applicant shall take all reasonable precautions to prevent forest fires and shall assist the Superintendent of Yosemite National Park to extinguish forest fires in the vicinity of any tract which may be used hereunder, and in the preservation of good order within the metes and bounds of the area. Applicant will reimburse the National Park Service for fire suppression costs due to any fires resulting from operations of the Applicant. The cutting or destruction of vegetation shall be held to a minimum. All slash and debris resulting therefrom shall be disposed of as directed by the Superintendent.

9. The Applicant shall allow the National Park Service, without charge, to construct or permit to be constructed in, through or across the land covered by said right-of-way, roads, trails, conduits and other means of transportation or communication not inconsistent with the enjoyment of said right-of-way by the Applicant.

10. The Applicant shall take adequate measures, as directed and approved by the Superintendent of Yosemite National Park, to arrest and prevent soil erosion on the lands covered hereby and shall so utilize such lands as not to contribute to erosion on adjoining lands.

11. The boundaries of the spoil area immediately below O'Shaughnessy Dam are to be adjusted as designated by the Superintendent of Yosemite National Park, to save the screen of trees along the river bank.

12. When required by the Superintendent, the Applicant will have the rock spoil area sprayed, to reduce its conspicuousness. The Superintendent will specify the liquid mixture to be used for this artificial weathering purpose.

13. Within one year after completion of the project, all buildings and other facilities of a temporary character erected within Yosemite National Park, not required for the continued operation and maintenance of the project, will be removed and the sites restored to as near a natural condition as possible.

14. Within one year after completion of the project, the structures on the access roads (trestles, viaducts, bridges, etc.) toward the base of the Dam will be removed and the area occupied by same will be restored to as near a natural condition as possible. All other access roads will be kept locked by the Applicant.

15. In order for the Superintendent to provide for the adequate protection of Park values during the construction and development phases of the Canyon Power Project, the Applicant will reimburse the National Park Service for the salary and expenses of one full time Park Ranger to be assigned to the Hetch Hetchy area from the beginning of construction activities until the close of the cleanup work following the completion of construction. The liability of the Applicant to reimburse the National Park Service under this stipulation will terminate at the time the Applicant has fully complied with stipulation No. 14.

16. The location, design and standard of any road or trail, and the location of any structures or other improvements to be constructed within Yosemite National Park by the Applicant in connection with the Canyon Power Project must be approved by the Superintendent of Yosemite National Park before construction is started.

17. The Applicant shall conform to all regulations now or hereafter adopted and prescribed by the Secretary of the Interior governing Yosemite National Park.

As to Stanislaus National Forest

18. The value of all timber cut or destroyed by the Applicant or its agents which is merchantable in accordance with specifications contained in timber sales current at the time of such cutting or destruction shall be paid at standard stumpage rates then in force for the Stanislaus National Forest, and all slash and debris resulting from the cutting or destruction of such timber shall be disposed of as the Officer-in-Charge may direct.

19. The Applicant will protect the scenic and aesthetic values of the right-of-way and the adjacent land including spoil areas consistent with the authorized use and as prescribed by the Forest Service.

20. The Applicant will construct access roads to standards and specifications approved by the Forest Supervisor in advance of construction.

21. The Applicant will join with the Forest Service in preparing and actively participating in a fire plan which shall set forth in detail their respective responsibilities for the prevention, control and extinguishment of fires on the project areas and on adjacent areas.

22. The Applicant will allow officers of the Forest Service free and unrestricted access to, through, and across all lands covered by said rights-of-way in the performance of their official duties, and will allow the Forest Service without charge to construct, or permit to be constructed in, through, across or under the land covered by said rights-of-way, roads, trails, conduits, ditches, and other means of transportation or communication, not inconsistent with the enjoyment of said rights-of-way by the Applicant.

23. The Applicant will locate and construct all roads and spoil areas to reduce to a minimum the disfigurement of the landscape and erosion of the soil. Such special measures to prevent erosion, as may be required by the Forest Supervisor in writing, shall be installed by the Applicant. Material from slides that occur after construction work is completed shall be disposed of by the Applicant, at locations where not destructive to or in prevention of revegetation, and in such manner as not to be susceptible to erosion or harmful to scenic values.

24. The Applicant will dispose of brush and debris as directed by the Officer-in-Charge. Any brush and debris to be burned will be disposed of in accordance with the fire plan approved by the Forest Supervisor. The Applicant will avoid damage to young growth and will fall all snags over 25 feet in height and within 100 feet of the center line of all roads.

25. The Applicant shall conform to all regulations now or hereafter adopted and prescribed by the Secretary of Agriculture governing Stanislaus National Forest.

AND FURTHER, the City and County of San Francisco agrees to observe the nondiscrimination provisions prescribed by section 301 of Executive Order 10925, dated March 6, 1961 (26 F. R. 1977), which are incorporated herein by reference, and as used therein "contractor" means the grantee of the right-of-way (Exhibit A).

IN WITNESS WHEREOF, the said City and County of San Francisco has caused this instrument to be executed in the City of San Francisco, California, this 3 day of May, 1961.

CITY AND COUNTY OF SAN FRANCISCO

C O P Y

In reply refer to:

Sacramento 010130
L:GAC

Your reference:
Hetch Hetchy Water Supply - Canyon - Cherry Power Development - Canyon Power Project
Early Intake Resvr Bypass and Tunnel Aqueduct

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

LAND OFFICE
4201 U.S. Courthouse and Federal Bldg.
650 Capitol Mall
Sacramento, California
95814

February 9, 1965

DECISION

City and County of San Francisco :
c/o O.L. Moore, General Manager :
Power and Utilities Engineering : Right-of-Way
Bureau :
425 Mason Street :
San Francisco, California 94101 :

Amended Location Approved

On May 26, 1964, the City and County of San Francisco filed amended right-of-way application, Sacramento 010130, pursuant to the Act of December 19, 1913 (38 Stat. 242). The right-of-way was originally approved on September 22, 1917, and amended approval granted on April 27, 1961.

The present amendment pertains to the Canyon Power Project approved by Drawing No. 527, Revision 1, for the installation of the proposed reservoir bypass. The application involves a small triangular area, 2.53 acres, to be added to the power plant site, as delineated on Drawing C-3148, in sec. 11, T. 1 S., R. 18 E., M.D.M.

The application also covered an amendment for a tunnel aqueduct right-of-way 100 feet wide as shown in red on Drawing No. C-3148. The applicant stated that they discovered that the section of the Mountain Tunnel was not covered by a Raker Act application. The City and County of San Francisco had an approved right-of-way 250 feet wide for a canal or aqueduct extending from the Early Intake Diversion Dam to the Mountain Tunnel. This right-of-way was approved by the Secretary of the Interior on September 22, 1917 under Serial No. 010130, however, the City constructed a tunnel aqueduct instead of a canal and apparently neglected to file for an amended location. Accordingly, the application, as amended for the tunnel aqueduct right-of-way 100 feet wide as shown in red on said Drawing No. C-3148, is to correct this situation.

Reports have been received from all of the interested agencies, indicating that there would be no objection to the amendment of the right-of-way subject to certain stipulations. The execution of the stipulations by the City was authorized by Resolution No. 28-65 of the Board of Supervisors of the City and County of San Francisco on January 11, 1965, and the set of stipulations were executed by Mayor John F. Shelley on January 26, 1965.

Accordingly, the application for the amendment of the right-of-way for the additional area to be added to the power plant site and the tunnel aqueduct as delineated in red on Map No. C-3148 is hereby approved. The approval is subject to all valid existing rights, and to the stipulations signed by the permittee and made a part hereof, and to the provisions, limitations, terms and conditions of the Act of December 19, 1913 (38 Stat. 242).

The request for the amended location stated that upon approval thereof that the City will abandon the right-of-way granted in 1917, which was outlined in green on Drawing No. C-3148. Relinquishment Forms 4-621a are enclosed for execution by the permittee and to be returned to this office for further appropriate action.

signed: Jesse H. Johnson

Jesse H. Johnson
Assistant Manager
Adjudication Branch

Enclosures 2
Form 4-621a

COPY

STIPULATIONS FOR AMENDMENT OF RIGHTS-OF-WAY
FOR CANYON POWER PROJECT APPROVED BY
SECRETARY OF THE INTERIOR ON MAY 26, 1961
TO ADD ADDITIONAL AREA FOR EARLY INTAKE
RESERVOIR BYPASS
MAP C-3148 FILED MAY 26, 1964 IN UNITED STATES
LAND OFFICE AT SACRAMENTO, CALIFORNIA

(Amended Sacramento Serial No. 010130)

Pursuant to the act of December 19, 1913 (38 Stat. 242), and in consideration of the granting to it by the United States of amended rights-of-way applied for, the City and County of San Francisco, a municipal corporation of the State of California, hereinafter referred to as Applicant, does hereby stipulate and agree and does hereby bind itself, it successors and assigns, as follows:

1. The amendment applied for is subject to the set of stipulations executed by Applicant on May 23, 1961 relative to application for amendment of necessary rights-of-way for its Canyon Power Project. (Amended Sacramento Serial No. 010130).

2. Construction will not start until plans for disposal of tunnel spoil and stabilization of same in place are submitted by Applicant and approved by the United States Forest Service.

3. The amendment applied for is also subject to provision that water diversions by Applicant below Early Intake Dam do not decrease the magnitude of water releases from O'Shaughnessy Dam for fish, and provided these releases in addition to accretional runoff be permitted to enter and continue in the Tuolumne River below Early Intake.

C O P Y

IN WITNESS WHEREOF, the said City and County of San Francisco has caused this instrument to be executed in the City of San Francisco, California, this 26th day of January, 1965.

CITY AND COUNTY OF SAN FRANCISCO

ATTEST:

/s/ John F. Shelley
Mayor

/s/ Robert J. Dolan
Clerk of the Board of Supervisors
of the City and County of San Francisco
State of California

/s/ James J. Finn
Acting General Manager of Public Utilities
City and County of San Francisco

FORM APPROVED:

Subscribed and sworn to before me

this 26th day of Jan., 1965

/s/ Thomas M. O'Connor
City Attorney
City and County of San Francisco

/s/ Martin Mongan
County Clerk
in and for the City and County of
San Francisco, State of California

By /s/ William F. Bourne
Public Utilities Counsel

PUBLIC UTILITIES COMMISSION
CITY AND COUNTY OF SAN FRANCISCO

HETCH HETCHY WATER AND POWER

BUREAU OF LIGHT, HEAT AND POWER

855 HARRISON STREET
SAN FRANCISCO, CALIFORNIA 94107
558-3821

January 23, 1973

Subject: Hetch Hetchy Releases for Fish Enhancement and Environmental Aesthetics

Mr. Felix Smith
Field Supervisor
U. S. Department of the Interior
Bureau of Sports Fisheries and Wildlife
Division of River Basin Studies
2800 Cottage Way, Room E-2727
Sacramento, California 95825

Attention: Mr. Jody Hoffman

Dear Mr. Smith:

Based on our informal review of your preliminary report, transmitted herewith are twelve copies of "Tentative Schedule for River Releases for Fish Enhancement and Environmental Aesthetics Below O'Shaughnessy Dam". Copies are enclosed for your distribution to the various interested agencies for their review.

This tentative schedule is for your consideration as an alternative proposal to Volume II of the Summary Report prepared for the City by Bechtel and sent to the various agencies last November 30.

We believe this schedule is fair as it is based upon the actual amount of water available from the watershed as indicated by precipitation and runoff. The apportionment is commensurate with available waters during wet years through relatively dry years.

Under columns "C" and "D", the City would be receptive, as permitted by the California Department of Public Health, to recapture the river release at Early Intake by diversion into Mountain Tunnel.

Based upon historical data, calculations indicate that Schedule "A" would be applicable 44% of the time; Schedule "A" or "B" would be applicable 63% of the time; Schedule "A" "B" or "C" would be applicable 89% of the time.

We would be happy to meet with your group at your convenience to discuss this tentative schedule. If you have any questions or comments regarding this schedule, or the river release matter in general, feel free to contact Mr. C. T. Beggs (415-558-5924) of this office.

Very truly yours,

O. L. MOORE
General Manager

Enc.

TENTATIVE SCHEDULE

River Releases For Fish Enhancement & Environmental Aesthetics
Below O'Shaughnessy Dam
(Releases Varying With Precipitation or Runoff as Applicable)

PERIOD	A	B	C	D
	Indicator / Released Flow in cfs			
Jan. 1 — Jan. 31	14.50 / 75	10.00 / 50	6.00 / 35	< 6.00 / 25
Feb. 1 — Feb. 28	19.00 / 75	15.00 / 50	10.00 / 35	< 10.00 / 25
Mar. 1 — Mar. 31	25.50 / 75	18.70 / 60	14.25 / 50	< 14.25 / 25
Apr. 1 — Apr. 15	29.50 / 75	23.00 / 60	18.50 / 50	< 18.50 / 25
Apr. 16 — Apr. 30	↓ / 110	↓ / 100	↓ / 50	↓ / 25
May 1 — May 15	31.00 / 150	26.00 / 125	21.00 / 75	< 21.00 / 50
May 16 — May 31	↓ / 200	↓ / 125	↓ / 100	↓ / 75
June 1 — June 30	32.35 / 200	27.00 / 125	21.75 / 100	< 21.75 / 75
July 1 — July 31	680,000 / 150	545,000 / 125	415,000 / 100	< 415,000 / 75
Aug. 1 — Aug. 31	720,000 / 150	580,000 / 125	440,000 / 100	< 440,000 / 75
Sept. 1 — Sept. 15	↓ / 150	↓ / 125	↓ / 100	↓ / 75
Sept. 16 — Sept. 30	110	100	75	50
Oct. 1 — Oct. 31	75	60	50	35
Nov. 1 — Nov. 30	75	50	35	25
Dec. 1 — Dec. 31	↓ / 75	↓ / 50	↓ / 35	↓ / 25
Total in Acre-feet	81,472	61,231	46,314	32,400

1. — Indicators from Jan. 1 to June 1 to be the precipitation measured at O'Shaughnessy since Oct. 1
From July 1 to Jan. 1, indicators are to be measured inflow into Hetch Hetchy Res'r since Oct. 1
2. — All measurements as of the first of the period.

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
630 Sansome Street
San Francisco, California 94111

2700 (2600)
August 13, 1975

Mr. Felix E. Smith, Field Supervisor
Division of River Basin Studies
U.S. Fish and Wildlife Service
2800 Cottage Way, Rm E-2727
Sacramento, California 95825

Dear Mr. Smith:

We have Mr. Carson's letter of August 6 concerning review of the Canyon Power Project draft report.

The Stanislaus Forest Supervisor, Mr. Gary Cargill, will be consolidating Region 5 review comments and making our response to the draft report, directly to Regional Director Martinson as requested (with information copy to your office).

By copy of this letter we are informing Mr. Martinson of this action.

We appreciate this opportunity to review the draft report, and are pleased to have participated in the studies and work leading to it. This has been a long, complex, and highly significant activity in resource protection and management, and your office is commended for its lead role.

Sincerely,

John A. Vance

DOUGLAS R. LEISZ
Regional Forester

6200-11 (1/69)

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
Stanislaus National Forest
175 South Fairview Lane, Sonora, California 95370

2750
September 26, 1975

Mr. Kayler Martinson, Regional Director
U. S. Fish and Wildlife Service
1500 N.E. Irving Street
P.O. Box 3737
Portland, Oregon 97208

Dear Mr. Martinson:

We have reviewed the Fish and Wildlife Service draft report on the Canyon Power Project. We have no additional comments and concur with the recommendations in the report.

Sincerely,

Gary E. Cargill

GARY E. CARGILL
Forest Supervisor

United States Department of the Interior

NATIONAL PARK SERVICE
WESTERN REGION
450 GOLDEN GATE AVENUE, BOX 36063
SAN FRANCISCO, CALIFORNIA 94102

IN REPLY REFER TO:
L7423
(WR)PSN

August 27, 1975

Mr. R. Kahler Martinson
Regional Director
U. S. Fish and Wildlife Service
P. O. Box 3737-1500 N.E. Irving Street
Portland, Oregon 97208

Dear Mr. Martinson:

The draft of the proposed report, "Tuolumne River Flow Study, Canyon Power Project (Robert C. Kirkwood Power Project), California," has been reviewed in Yosemite National Park and in the Regional Office. We concur with the report and the recommendations and conclusions it contains. We recommend that it be prepared in final form for transmittal to the Secretary of the Interior for his attention and appropriate action. If fully implemented, recommendations in this report should provide for the appropriate recreational use and perpetuation of the natural resources affected by this project.

Drafts of this report were forwarded to this Office and to Park Superintendent Leslie Arnberger, Yosemite National Park, by Acting Field Supervisor James D. Carson, Division of River Basin Studies, Sacramento, California, on August 6. To expedite the review process, typographical discrepancies and minor omissions to the report were sent directly to your Sacramento Office by Assistant Superintendent John Good. A copy of his correspondence is enclosed for your information.

We acknowledge, with appreciation, the active interest and effective direction the U. S. Fish and Wildlife Service has given to this cooperative endeavor. Many thanks to all of those who have participated in this program.

Sincerely yours,

Howard H. Chapman

Howard H. Chapman
Regional Director
Western Region

Enclosure

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

STATE OF CALIFORNIA—RESOURCES AGENCY

EDMUND G. BROWN JR
[redacted], Gc

DEPARTMENT OF FISH AND GAME
1416 Ninth Street
Sacramento, CA 95814
(916) 445-3531

May 18, 1976

Mr. R. Kahler Martinson
Regional Director
U. S. Fish and Wildlife Service
P. O. Box 3737
Portland, Oregon 97208

Dear Mr. ~~Martinson~~ Kahler:

We have completed our review of the Service's draft report on the Canyon Power Project flow study and offer the following comments.

We concur with the general recommendations of the report. Our concurrence includes the recommended flow schedule (page 50) which is repeated here for convenience.

Period	CFS
January 1 - April 30	75
May 1 - June 30	200
July 1 - September 30	150
October 1 - December 31	75

This minimum flow schedule should be adhered to regardless of runoff.

It is essential that there be follow-up studies to evaluate the effectiveness of this flow schedule. We would further recommend that the water be made available as an annual block of water (83,000 a.f.) in order to facilitate post-project evaluation and management.

A problem of considerable importance is the relationship between water diversions from the Tuolumne (including present and ultimate diversions by the City of San Francisco) and the reproduction of the Tuolumne River king salmon. Studies show a strong correlation between spring outflow and the number of young salmon which survive to return as adults.

Present flows available for salmon are released from Don Pedro reservoir under stipulations set forth in Federal Power Commission license 2299. These flows run concurrent with a salmon-flow study which is to be carried out for 20 years until 1991. Upon termination of the study the Federal

Power Commission will rule on what flows will be maintained in the future.

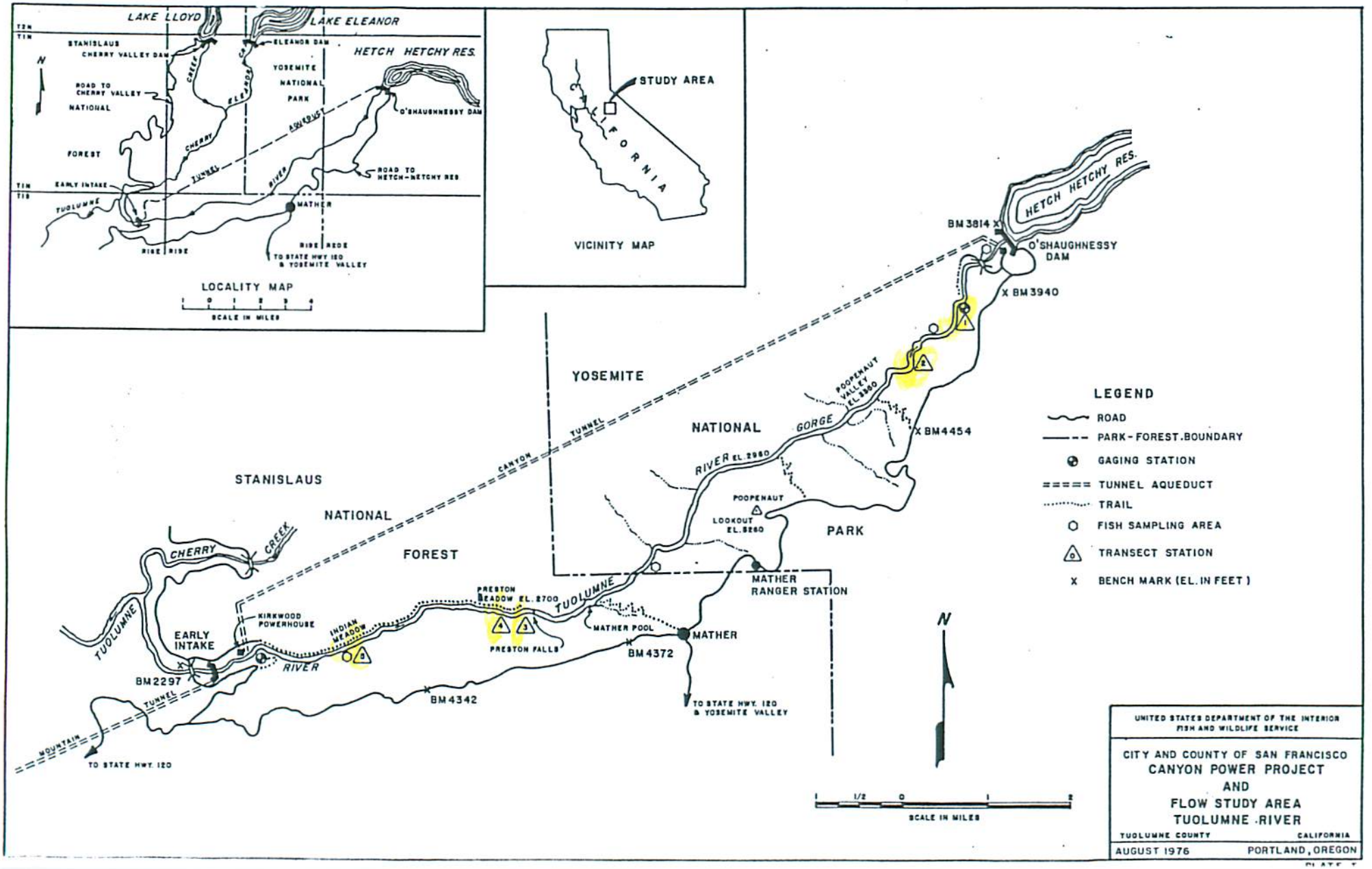
The existing flow schedules in the salmon spawning and rearing area of the river (La Grange to Waterford) are aimed at providing water during the prime spawning period (October through December). While this is important we now believe the spring outflow (March through June) is most critical. At this time the young salmon are growing and moving out of the spawning area downstream to the Delta and eventually out to the ocean.

Increasing demands on Tuolumne water by the City of San Francisco and the irrigation districts may make it impossible to maintain adequate spring flows in the river. We would recommend that the flows stipulated in the Canyon Power Project agreement be considered as "fish water" releases and be allowed to flow the entire length of the Tuolumne River. These flows are to be added to the flow releases made below the New Don Pedro Project that are stipulated in the FPC license for that project. The benefits to the fisheries from such a water release warrant support from the Secretary of Interior and the U. S. Fish and Wildlife Service.

We appreciate the opportunity to review the report and to express our views on the proposed flow schedules. Should you have any questions, please contact Mr. A. E. Naylor, Regional Manager, Region 4, 1234 East Shaw Avenue, Fresno, CA 93710, telephone (209) 222-3761.

Sincerely,

Director


LAKE LLOYD
LAKE ELEANOR
HETCH HETCHY RES.
STANISLAUS
CHERRY VALLEY DAM
ELEANOR DAM
YOSEMITE
NATIONAL
PARK
ROAD TO CHERRY VALLEY
NATIONAL
FOREST
O'SHAUGHNESSY DAM
ROAD TO HETCH-HETCHY RES
EARLY INTAKE
MATHER
TO STATE HWY 120 & YOSEMITE VALLEY
LOCALITY MAP
SCALE IN MILES
STUDY AREA
VICINITY MAP
BM 3814
O'SHAUGHNESSY DAM
X BM 3940
YOSEMITE
NATIONAL
PARK
POOPENAUT VALLEY EL. 3980
GORGE
X BM 4454
RIVER EL. 2980
POOPENAUT
LOOKOUT EL. 8260
STANISLAUS
NATIONAL
FOREST
CANYON TUNNEL
CHERRY CREEK
TUOLUMNE
EARLY INTAKE
KIRKWOOD POWERHOUSE
INDIAN MEADOW
PRESTON MEADOW EL. 2700
PRESTON FALLS
MATHER POOL
MATHER
MATHER RANGER STATION
BM 4372
BM 2297
BM 4342
TUNNEL
MOUNTAIN
TO STATE HWY. 120
TO STATE HWY. 120 & YOSEMITE VALLEY
LEGEND
ROAD
PARK-FOREST BOUNDARY
GAGING STATION
TUNNEL AQUEDUCT
TRAIL
FISH SAMPLING AREA
TRANSECT STATION
BENCH MARK (EL. IN FEET)
SCALE IN MILES
UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
CITY AND COUNTY OF SAN FRANCISCO
CANYON POWER PROJECT
AND
FLOW STUDY AREA
TUOLUMNE RIVER
TUOLUMNE COUNTY
CALIFORNIA
AUGUST 1976
PORTLAND, OREGON
PLATE 1

APPENDIX E

CITY AND COUNTY OF SAN FRANCISCO

HETCH HETCHY WATER AND POWER

BUREAU OF LIGHT, HEAT AND POWER

835 HARRISON STREET
SAN FRANCISCO, CALIFORNIA 94107
558-3821

October 6, 1976

Subject: Tuolumne River Flow Study
Canyon Power Project
California

The Honorable Thomas Kleppe
Secretary of the Interior
United States Department of Interior
Washington, D.C. 20240

Dear Mr. Secretary:

On September 15, 1976, this office received copies of the report entitled "Tuolumne River Flow Study, Canyon Power Project, California". The report was prepared by the U.S. Fish and Wildlife Service and pertains to a field study conducted by them in cooperation with the National Park Service, the U.S. Forest Service, and the California Department of Fish and Game pursuant to "Stipulations For Relocation And Amendment Of Rights-Of-Way For Tunnel Aqueduct, Steel Penstock, Power Plant Site Spoil Areas And Access Roads As Approved Pursuant To Maps Filed April 10, 1914, July 3, 1916 and December 13, 1916 in United States Land Office at Sacramento, California, Map R-527, Revision No. 1, Filed October 2, 1958 (Amended Sacramento Serial No. 010130)".

Stipulation No. 6 of the above stipulations established a provisional stream flow release schedule from O'Shaughnessy Dam into the Tuolumne River. It further stipulated that during two one-year periods, a fishery and recreational (including aesthetic) study was to be made to determine the adequacy of the provisional release schedule, and if the schedule was found to be inadequate, to determine the magnitude of the minimum flows required. In addition, it stipulated that the agencies participating in the study make recommendations to the Secretary as to the minimum flows required.

The City and County of San Francisco, known as the Applicant in the stipulations, by this letter formally objects to the recommendations set forth in the subject report and requests that a hearing be held regarding its objections.

The principal objection the City has to the subject report is that the recommended stream flow release schedule below O'Shaugnessy Dam is excessive and unjustifiable. Current minimum releases by the City into the Tuolumne River are 36,305 acre-feet annually. The releases recommended by the Fish and Wildlife Service would be 83,144 acre-feet annually, 230% of the current releases. The recommended releases represen 11.3% of the annual average runoff of the Hetch Hetchy watershed and 23.1% of the storage capacity of Hetch Hetchy Reservoir. The recommended releases would result in reduced capability by the Hetch Hetchy system to deliver water to the San Francis Bay Area for domestic consumption. Furthermore, the recommended releases would result in the unavailability of 37,000 acre-feet of water yearly for hydroelectric power generation at Kirkwood (Canyon) and Moccasin Powerhouses, resulting in the loss of 82 million kwh of electric power and $1.3 million in revenue.

The sizing of the various components of the Canyon Power and the Moccasin Powerhouse Projects was conditioned upon the water release schedule set forth in Stipulation 6. The provisional release schedule was utilized to establish the amount of water from the Hetch Hetchy watershed that could be expected to be available for power generation. San Francisco had no way of anticipating that the recommended releases would be 2.3 times the provisional releases established by the Secretary in 1961.

It is the opinion of the City that the data presented in the report does not sufficiently demonstrate nor justify the conclusions reached and the recommendations put forth. The implementation of the recommended water release schedule would impose an undue and unjustifiable hardship upon the domestic water supply and electric power generation potential of San Francisco's Hetch Hetchy Water and Power Project.

Very truly yours,

O. L. MOORE
General Manager

cc: Mr. R. Kahler Martinson
Regional Director
U.S. Fish and Wildlife Service
P. O. Box 3737
Portland, Oregon 97208

APPENDIX F

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

In Reply Refer To:
FWS/ES
SS 21191

DEC 13 1976

Dear Mr. Moore:

The Secretary is in receipt of your October 6, 1976, letter requesting a public hearing and has asked me to advise you of our response to your request for a hearing. The report, Tuolumne River Flow Study, Canyon Power Project California, was prepared following a two-year interagency study pursuant to amended right-of-way stipulations proffered by former Secretary of the Interior Udall on April 27, 1961, and agreed to for the amending document by the City and County of San Francisco on May 3, 1961. The recently completed study promulgates six recommendations, the salient recommendation entailing increased minimum flow regimes for protecting the fishery, recreational use, and esthetics of the Tuolumne River downstream from the Hetch-Hetchy Reservoir and O'Shaughnessy Dam.

On the basis of the studies and the ensuing recommendations, the Fish and Wildlife Service has concluded that the present on-going schedule of minimum releases to the Tuolumne River at O'Shaughnessy Dam is inadequate for the protection of the downstream fishery, recreational and esthetic values. The Service believes that the new schedule of recommended minimum releases together with other pertinent recommendations in the Fish and Wildlife Service's report, will provide an acceptable level of protection for the natural values associated with the 12.1-mile reach of the river traversing lands within Yosemite National Park and Stanislaus National Forest.

Under terms of the authorized right-of-way amendment granted by the Department, the recommendations resulting from the Tuolumne River Flow Study would become a part of the conditions under which the Canyon Power Project would be operated, unless objections were filed within 30 days of this notification. Under this agreement, the San Francisco

DEPT. OF THE INTERIOR
DEC 17 1976

cc: Supervisor, FWS, Sacramento, California (ES)

Public Utilities Commission would be afforded a hearing before a special hearing officer who would render proposed findings of fact. The Secretary, after considering the proposed findings of fact and the record, would determine what flows would be required.

The Department of the Interior hereby acknowledges your appeal and request for a hearing. By this letter, I am advising you and Mr. Hennings of our intent to conduct a hearing. As soon as arrangements are made, I will provide you with information regarding the date, time, place, and other specifics of the hearing.

The Department appreciates the assistance extended the Fish and Wildlife Service and the cooperating agencies by the San Francisco Public Utilities Commission in carrying out the flow studies.

Sincerely yours,

(Sgd) Douglas P. Wheeler

Assistant Secretary for Fish and Wildlife and Parks

Mr. O. L. Moore
General Manager, Hetch-Hetchy
Water and Power
855 Harrison Street
San Francisco, California 94107

Enclosure

APPENDIX G

IN REPLY REFER TO

UNITED STATES
DEPARTMENT OF THE INTERIOR
OFFICE OF THE SOLICITOR
SAN FRANCISCO FIELD OFFICE
450 GOLDEN GATE AVENUE, BOX 36064
SAN FRANCISCO, CALIFORNIA 94102

March 4, 1977

Memorandum

To: Associate Solicitor, Conservation and Wildlife

From: Field Solicitor, San Francisco

Subject: City and County of San Francisco
Tuolumne River Flow Study

As you are aware, as a result of a Fish and Wildlife Service Report, known as the Tuolumne River Flow Study, the City of San Francisco and the Turlock and Modesto Irrigation Districts have objected to the study recommendations and have requested a hearing. The Administrative Law Judge has set March 18, 1977, for a pre-hearing conference and requested the parties to address the matters listed in his January 19, 1977, letter, attached.

In the meantime, counsel for the Districts made a Freedom of Information request on the Fish and Wildlife Service by letter of January 28, 1977, requesting a copy of the Environmental Impact Statement or documentation as to why one was not prepared in relation to the Study's recommendations. The Service's response is attached.

As a result, counsel for the Districts indicated he will file the attached joint pre-hearing statement with the Administrative Law Judge requesting a stay of the commencement of the hearings on the matter until an Environmental Impact Statement has been prepared. I am advised that the City of San Francisco concurs and will join in the statement.

Whether the Judge can and will honor the request or not remains to be seen. However, it is likely the Judge may seek Interior's position on the matter through this office

or he may go to the Secretary to seek guidance on what the scope of the hearing is and/or whether a statement is needed and/or going to be prepared. I would appreciate information as to the Department's and the Service's position on this issue as soon as possible but in any event before the scheduled pre-hearing conference. Should the position concur with the City and Districts, it would be unnecessary for the Judge to travel to San Francisco to hold the conference.

In view of the foregoing, I might offer my views on the question for consideration. I am of the opinion that an environmental assessment has to be made and then either an Environmental Impact Statement or at least a negative declaration must be prepared prior to the Secretary making a decision on the matter. Although an argument may be made that since the stipulation occurred in 1961, the change of right of way made in 1965, the project constructed about 1965-1967, and the field study in 1968 and 1970, and therefore it was "grandfathered" in under the NEPA, it is not persuasive. The court decisions overwhelmingly indicate that if the implementation of a project takes place after January 1970, NEPA requirements must be met.

Assuming a negative declaration or an EIS is determined to be necessary, a related issue for consideration is whether the document is needed before or at the hearing on the matter or only when the Judge's findings are presented to the Secretary for his decision. While it may be argued that the Secretary's decision is what must be supported by NEPA considerations, it can also be argued that the Judge should have the benefit of all alternatives, including some that may not have been considered so far, so that his findings and recommendations to the Secretary will have the benefit and perhaps take into account the NEPA considerations.

As to how to comply with NEPA, i.e. EIS or negative declaration, the effect of the increased flows recommended by the report will enhance the environment of the River and thus a negative declaration would seem appropriate. However, the result of increased flows apparently will diminish the amount of hydroelectric power generated at the City's Kirkwood Power Plant, which power is sold to the

Irrigation Districts presumably at cost. The result is that the Districts would have to find another source at high rates. As to the additional water released, the City asserts, and which is disputed, that it cannot be used for domestic consumption in San Francisco. In any event, the entire matter is controversial to say the least, such that careful consideration should be given as to whether to prepare an Environmental Impact Statement. I might note that the City and the Districts feels so strongly about the need for an EIS, that they have indicated informally that if the Administrative Law Judge does not suspend the proceedings pending an EIS, they will petition the Secretary and, if necessary, take the matter to the U.S. District Court.

Hence a determination should be made soon as to whether an EIS or negative declaration is necessary and, if so, when. If the answer is in the affirmative, because there are several Federal agencies involved, Fish and Wildlife Service, Forest Service, Park Service and Bureau of Land Management, a determination must be made as to who will be the "lead agency".

Ralph G Mihan

Ralph G. Mihan
Field Solicitor
San Francisco

Enclosure

cc:
Regional Director, Fish and Wildlife Service, Portland
✓Division of Ecological Studies, Fish and Wildlife Service, Sacramento
Russell Mays, Regional Counsel's Office, Agriculture

APPENDIX H

Estimate of Catchable-Size Trout by Reach by Length/Reach 1/

River Reach	Rainbow 1970	Rainbow 1977	Brown 1970	Brown 1977	Total 1970	Total 1977	Net % Change 1977 vs. 1970
1-O'Sh. Dam to Poopenaut Valley	168	373	828	1,332	996	1,705	+71%
2-Poopenaut Valley	221	194	546	673	767	867	+13%
3-Tuolumne Gorge	780	390	625	845	2,405	1,235	-49%
4-Tuolumne Gorge to Preston Falls	634	384	892	458	1,526	842	-45%
5-Preston Falls to Early Intake	1,333	932	1,067	532	4,200	1,464	-39%
Total	3,136	2,273	4,958	3,840	8,094	6,113	-24%

1/ Assumes sample sites representative of population distribution in reach. Expands sample site data to reaches on a length/length basis.

APPENDIX I

Estimate of Sub-Catchable Size Trout by Reach by Area/Reach 1/

River Reach	Rainbow 1970	Rainbow 1977	Brown 1970	Brown 1977	Total 1970	Total 1977	Net % Change 1977 vs. 1970
1-O'Sh. Dam to Poopenaut Valley	29	3,722	4,180	830	4,209	4,552	+ 7%
2-Poopenaut Valley	1,829	2,751	7,275	2,943	9,104	5,694	-37%
3-Tuolumne Gorge	4,685	10,076	8,666	7,007	13,351	17,083	+28%
4-Tuolumne Gorge to Preston Falls	5,400	7,650	7,915	5,532	13,315	13,182	- 1%
5-Preston Falls to Early Intake	7,776	3,931	7,691	3,418	15,467	7,349	-52%
Total	19,719	28,130	35,727	19,730	55,446	47,860	-14%

1/ Assumes sample site data representative of reach. Expands data from sample sites to reaches on an area/area basis.

APPENDIX J

COPY

STIPULATIONS FOR AMENDMENT OF RIGHTS-OF-WAY
FOR CANYON POWER PROJECT APPROVED BY
SECRETARY OF THE INTERIOR ON MAY 26, 1961
TO ADD ADDITIONAL AREA FOR EARLY INTAKE
RESERVOIR BYPASS
MAP C-3148 FILED MAY 26, 1964 IN UNITED STATES
LAND OFFICE AT SACRAMENTO, CALIFORNIA

(Amended Sacramento Serial No. 010130)

Pursuant to the act of December 19, 1913 (38 Stat. 242), and in consideration of the granting to it by the United States of amended rights-of-way applied for, the City and County of San Francisco, a municipal corporation of the State of California, hereinafter referred to as Applicant, does hereby stipulate and agree and does hereby bind itself, it successors and assigns, as follows:

1. The amendment applied for is subject to the set of stipulations executed by Applicant on May 23, 1961 relative to application for amendment of necessary rights-of-way for its Canyon Power Project. (Amended Sacramento Serial No. 010130).

2. Construction will not start until plans for disposal of tunnel spoil and stabilization of same in place are submitted by Applicant and approved by the United States Forest Service.

3. The amendment applied for is also subject to provision that water diversions by Applicant below Early Intake Dam do not decrease the magnitude of water releases from O'Shaughnessy Dam for fish, and provided these releases in addition to accretional runoff be permitted to enter and continue in the Tuolumne River below Early Intake.

COPY

IN WITNESS WHEREOF, the said City and County of San Francisco has caused this instrument to be executed in the City of San Francisco, California, this 26th day of January, 1965.

CITY AND COUNTY OF SAN FRANCISCO

/s/ John F. Shelley
Mayor

ATTEST:

/s/ Robert J. Dolan
Clerk of the Board of Supervisors
of the City and County of San Francisco
State of California

/s/ James J. Finn
Acting General Manager of Public Utilities
City and County of San Francisco

FORM APPROVED:

Subscribed and sworn to before me this 26th day of Jan., 1965

/s/ Thomas M. O'Connor
City Attorney
City and County of San Francisco

/s/ Martin Mongan
County Clerk
in and for the City and County of
San Francisco, State of California

By /s/ William F. Bourne
Public Utilities Counsel

APPENDIX K

PUBLIC UTILITIES COMMISSION
CITY AND COUNTY OF SAN FRANCISCO

HETCH HETCHY WATER AND POWER

BUREAU OF LIGHT, HEAT AND POWER

855 HARRISON STREET
SAN FRANCISCO, CALIFORNIA 94107
558-3821

January 23, 1973

Subject: Hetch Hetchy Releases for Fish Enhancement and Environmental Aesthetics

Mr. Felix Smith
Field Supervisor
U. S. Department of the Interior
Bureau of Sports Fisheries and Wildlife
Division of River Basin Studies
2800 Cottage Way, Room E-2727
Sacramento, California 95825

Attention: Mr. Jody Hoffman

Dear Mr. Smith:

Based on our informal review of your preliminary report, transmitted herewith are twelve copies of "Tentative Schedule for River Releases for Fish Enhancement and Environmental Aesthetics Below O'Shaughnessy Dam". Copies are enclosed for your distribution to the various interested agencies for their review.

This tentative schedule is for your consideration as an alternative proposal to Volume II of the Summary Report prepared for the City by Bechtel and sent to the various agencies last November 30.

We believe this schedule is fair as it is based upon the actual amount of water available from the watershed as indicated by precipitation and runoff. The apportionment is commensurate with available waters during wet years through relatively dry years.

Under columns "C" and "D", the City would be receptive, as permitted by the Californi Department of Public Health, to recapture the river release at Early Intake by diversion into Mountain Tunnel.

Based upon historical data, calculations indicate that Schedule "A" would be applicable 44% of the time; Schedule "A" or "B" would be applicable 63% of the time; Schedule "A" "B" or "C" would be applicable 89% of the time.

We would be happy to meet with your group at your convenience to discuss this tentative schedule. If you have any questions or comments regarding this schedule, or the river release matter in general, feel free to contact Mr. C. T. Beggs (415-558-5924) of this office.

Very truly yours,

O. L. MOORE
General Manager

Enc.

TENTATIVE SCHEDULE

River Releases For Fish Enhancement & Environmental Aesthetics
Below O'Shaughnessy Dam
(Releases Varying With Precipitation or Runoff as Applicable)

PERIOD	A	B	C	D
	Indicator / Released Flow in cfs			
Jan. 1 — Jan. 31	14.50 / 75	10.00 / 50	6.00 / 35	< 6.00 / 25
Feb. 1 — Feb. 28	19.00 / 75	15.00 / 50	10.00 / 35	<10.00 / 25
Mar. 1 — Mar. 31	25.50 / 75	18.70 / 60	14.25 / 50	<14.25 / 25
Apr. 1 — Apr. 15	29.50 / 75	23.00 / 60	18.50 / 50	<18.50 / 25
Apr. 16 — Apr. 30	↓ / 110	↓ / 100	↓ / 50	↓ / 25
May 1 — May 15	31.00 / 150	26.00 / 125	21.00 / 75	<21.00 / 50
May 16 — May 31	↓ / 200	↓ / 125	↓ / 100	↓ / 75
June 1 — June 30	32.35 / 200	27.00 / 125	21.75 / 100	<21.75 / 75
July 1 — July 31	680,000 / 150	545,000 / 125	415,000 / 100	<415,000 / 75
Aug. 1 — Aug. 31	720,000 / 150	580,000 / 125	440,000 / 100	<440,000 / 75
Sept. 1 — Sept. 15	↓ / 150	↓ / 125	↓ / 100	↓ / 75
Sept. 16 — Sept. 30	↓ / 110	↓ / 100	↓ / 75	↓ / 50
Oct. 1 — Oct. 31	↓ / 75	↓ / 60	↓ / 50	↓ / 35
Nov. 1 — Nov. 30	↓ / 75	↓ / 50	↓ / 35	↓ / 25
Dec. 1 — Dec. 31	↓ / 75	↓ / 50	↓ / 35	↓ / 25
Total in Acre-feet	81,472	61,231	46,314	32,400

1. — Indicators from Jan. 1 to June 1 to be the precipitation measured at O'Shaughnessy since Oct. 1
From July 1 to Jan. 1, indicators are to be measured inflow into Hetch Hetchy Res'r since Oct. 1
2. — All measurements as of the first of the period.

APPENDIX L

January 22, 1979 (1978)

TO: Wm. R. Gianelli
Oral Moore (2)
George Sears (2)
Warren Gant (2)
Roger K. Masuda (2)
Wm. Royce
Milo Bell
Richard Ridenhour

The enclosed copy of the 1978 Tuolumne River Flow Study Report is being sent to those listed above as suggested by Bill Gianelli.

You will note four blank spaces in the last paragraph on page 3 concerning the flows of the South Fork Tuolumne. As soon as the flow data is received from USGS they will be sent to you for addition to the report.

It is noted that some of the flows shown in Table 1 are estimates. Some of these figures may be changed when the South Fork Tuolumne data is received.

Sincerely,

Robert C. Lewis
Fishery Consultant
509 Del Sol Avenue
Pleasanton, CA 94566

Enc as noted above

TUOLUMNE RIVER FLOW STUDY REPORT - 1978*

This report summarizes the field work accomplished during the summer and fall of 1978. It includes temperature and flow data, use counts on the river made by helicopter, and creel censuses of fishing activity. The area studied was from Hetch Hetchy to Wards Ferry. This includes the area of the Canyon Power Project which was studied and reported on in the Tuolumne River Flow Study report by Fish and Wildlife Service, and also includes the lower river area which is the proposed Clavey-Wards Ferry Project.

The precipitation in the winter of 1977-78 was above normal making it an exceptionally wet year compared to the previous year which was exceptionally dry. This made it possible to study the area in a very dry year previously reported in 1977 and a very wet year in 1978.

The City of San Francisco rented 12 thermographs which were installed August 8 - 12, 1978. Installation was delayed due to the heavy runoff. They were removed September 19 - 22, 1978. It was unfortunate that all thermographs became inoperative prior to removal. Except for the two that did not operate at all, the information obtained from the others was good even though it was for a short period. The thermographs were installed during the hottest period of the summer and high temperatures were recorded at that time. The water became cooler after the first week and high temperatures were not reached again.

Figure 1 shows the location of the thermographs in the drainage. Table 1 gives the dates the thermographs were installed and removed and the dates they ceased to operate. It also shows the approximate flow of water on those dates as well as temperatures taken with a pocket thermometer.

Table 2 illustrates the high and low temperatures recorded by the thermographs, the maximum, minimum and average daily fluctuatation of temperatures as well as the average hours of the day that high and low temperatures were recorded. The high temperatures were recorded the first week the thermographs operated due to the hot weather. The high daily temperatures were generally from 1600 - 1800 hours, and the low temperatures were generally from 0800 - 1000 hours with exceptions noted in Table 2.

The air temperatures at Early Intake and the maximum and minimum daily water temperatures recorded by the thermograph located at the gaging station below O'Shaughnessy Dam and at the gaging station above Early Intake are shown

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*By Robert C. Lewis
Fishery Consultant
January 16, 1979

graphically in Figure 2. The water flows at the gaging station above Early Intake are also shown in Figure 2. There was a mechanical problem with the gage below O'Shaughnessy Dam and above Early Intake which caused some questionable flow readings. The flows used here are those adjusted and submitted by U.S.G.S. Water spilled over O'Shaughnessy Dam from July 21 to August 14 which provided more than the required fish water release of 75 cfs which comes from a low level in the dam. The spill water over O'Shaughnessy Dam was 70.7° F at 0920 hours and the fish water release was 50° F. This combined flow downstream at the gaging station below O'Shaughnessy was 69.8° F at 1010 hours on August 10, 1978. The temperature increase through the study area had been recorded at 77° F at the gage above Early Intake at 1500 hours with about 228 cfs on August 9, 1978. On August 10, 1978 it was recorded at 74° F. Colder water (50° F) was released from Kirkwood Power House at Early Intake and a large flow of cold water (52° F) from the Holm Power House on Cherry Creek so the temperatures dropped to 54.5° F below the confluence with Cherry Creek at 1300 hours on August 9, 1978. The weather had been exceptionally warm for several days which partially accounts for the high surface water temperature on Hetch Hetchy Reservoir. With this situation, the water temperatures in the study area from O'Shaughnessy Dam to Early Intake will be high regardless of the amount of water released as long as it is spilled over the top of O'Shaughnessy Dam. This is shown graphically in Figure 2. It shows that the water flow and air temperature dropped rapidly until August 14 causing the water temperature above Early Intake and below O'Shaughnessy Dam to drop also. The air temperature increased during the period August 14 - 17 to 89° F and the water flow accidently dropped to between 40 and 35 cfs. This caused the water temperature above Early Intake to rise to 74° F due undoubtedly to low flow and high air temperatures as the maximum water temperatures below O'Shaughnessy did not increase. All of this water came from the low level fish water release valve. When the water flow above Early Intake increased to approximately 90 cfs, the water temperatures above Early Intake and below O'Shaughnessy continued to drop though the air temperature again reached 90° F on August 20. The water spilled from the surface of Hetch Hetchy Reservoir caused the water temperature above Early Intake to exceed the maximum of 68° F proposed by Fish and Wildlife Service "for the well being of trout".

Figure 3 shows graphically the recorded water temperatures of the Tuolumne River above Hetch Hetchy Reservoir, South Fork Tuolumne, Tuolumne below the South Fork confluence at Lumsden, Tuolumne below the Cherry confluence, Tuolumne above the Cherry confluence, and Cherry Creek below Cherry Dam. If the thermograph in Cherry Creek above the confluence with the Tuolumne and the instrument in the Tuolumne above the Cherry confluence had operated properly the information would have been more meaningful. Nevertheless, it shows that the cold water from the Cherry (Holm PH) mixed with the water from the Tuolumne made a high temperature of 49° F to 55° F which would be a good temperature for a fish water release below the proposed Jawbone Dam. It is interesting that the temperatures at the lower end of the Lumsden campground were basically 54° F to 55° F with a few peaks up to 59° and 60° F. These peaks are seven days apart and were caused by shutting down one unit at the Holm PH on Sundays, cutting the supply of cold water from the Cherry by about 50 percent. The temperatures at Lumsden include the warmer water from the S.F. Tuolumne. In Table 2, the average high temperatures below the Cherry confluence occurred from 2400 - 0600 hours because one unit of the Holm PH was shut down during that period on some of the days. The air temperatures shown in Figure 2 has a definite bearing on water temperatures demonstrated by relating it to water temperatures plotted in Figure 3.

Table 1 shows the water temperature of the South Fork Tuolumne to be 75° F on August 8, 1978 just above its confluence with the Tuolumne. The flow was cfs which is the total of the Middle Fork and the South Fork measured at the gages about two miles upstream near the Oakland Recreation Camp. The weather became cooler and the water temperature dropped to 52° F on September 20, 1978 with a flow of cfs. Figure 3 shows the temperatures recorded on the thermograph. The flow decreased to cfs on The flows then increased due to 3.59 inches of rain recorded at Early Intake between September 5 and 10. The flows recorded at the above stations in 1977 totaled 0.5 cfs on August 8, 1977 and 1.2 cfs on September 20, 1977 having reached a low of 0.45 cfs although the South Fork was dry at its confluence with the Tuolumne. With the proposed Clavey-Wards Ferry Project this water would be added to the fish water release below Jawbone Dam. Additional temperature and flow data should be obtained as the above is an example of a very dry year and a very wet year.

Table 1 shows a water temperature of 70° F on the Clavey River with a flow of 33 cfs at the gage at the lower bridge about eight miles upstream from its confluence with the Tuolumne on August 9, 1978. The thermograph installed here did not operate. The water temperature was 52° F and the flow was 35 cfs on September 21, 1978. If the weather had not cooled after August 9, 1978, it is possible that the water temperature would have continued at a high level because the flow decreased to 17 cfs on September 3. The flows then increased due to 3.59 inches of rain between September 5 and 10, recorded at Early Intake. Additional information should be obtained because the flows at that station were 1.8 cfs on August 9, 1977 and 5.1 cfs on September 21, 1977. A low of 1.2 cfs was recorded on September 10, 1977. This compares an exceptionally wet year with an exceptionally dry year.

A Fish and Wildlife thermograph located in the Clavey River above its confluence with the Tuolumne showed a temperature of 81.5° F on August 2 and 3, 1977. This is shown in Figure 3 of my 1977 report dated January 19, 1978. It is estimated that the flow was less than 2 cfs at that time. This information can be valuable in discussing the Clavey River Wild Trout Management Plan proposed by Department of Fish and Game and a fish water release in the Clavey River below the proposed Clavey Reservoir.

The fish water release below O'Shaughnessy Dam is taken directly from the Kirkwood Powerhouse tunnel. On August 10, 1976 the temperature of this water was 50° F. A few hours later the temperature was checked to be 50° F at the Kirkwood PH. The same type information was collected by comparing the temperatures from the thermograph installed below Cherry Dam with temperatures at the Holm PH. No change in water temperature occurred in the tunnels. This indicates that there would probably be no change in water temperature in the proposed tunnel between Jawbone Dam and Clavey Reservoir. Much colder water could probably be released in the 5.9 miles of the Clavey River below Hunter Point Dam than is now available and also in the Tuolumne River below the Clavey PH.

The thermograph located below Early Intake Dam served little purpose because of the variable flow of cold water released from Kirkwood PH. It was intended to show the increase in temperature between Early Intake Dam and the confluence with Cherry Creek at a flow of 75 cfs provided in the upper river which is considered

inadequate in the Flow Study Report by Fish and Wildlife Service. This involves approximately 2.3 miles of stream and should be studied in a normal water year. With the proposed Clavey-Wards Ferry Project this stream length above Jawbone Reservoir would be reduced to about 1 to 1.4 miles and average about 1.2 miles with a normal operating pool.

Use counts were made on the Tuolumne River by helicopter between O'Shaughnessy Dam and Wards Ferry. Flights were made on August 24, a weekday; on August 26, a weekend day; and on September 3, the middle of a 3-day weekend. Table 3 gives the data obtained. Figure 4 shows the location of the sections of stream tabulated in Table 3. Only persons using the stream were counted. Ground surveys showed that there were at least three or more people in every camp and that there were more camps than could be seen from the air. The table shows there is a marked increase in fishermen and campers on a 3-day weekend over a normal weekend;that fishing and camping use is light on weekdays; for example, no recreationists were seen when the thermographs were removed on September 20 and 21. The reverse is true of rafters - there was more activity on the weekday and normal weekend day. The camp use shown in the section between Wards Ferry Bridge and the confluence with the Clavey was rafters who had spent the night and were not on the river when the count was made. There are three major campgrounds in the Lumsden area where the river parallels a road for about 1½ miles. The heavy camp use in the Lumsden area were fishermen or campers, but no rafters. Most of the fishermen upstream and downstream from this campground were within 1/4 mile of a road. The use in the section from Early Intake to O'Shaughnessy Dam was very light.

Creel censuses were made in conjunction with the helicopter use counts to determine fishing success. No census was made on August 24 as only three fishermen were sighted from the helicopter. Following the flight on Saturday, August 26 a census was made in the Lumsden campground area. On August 27 a census was done at and upstream from Early Intake and below O'Shaughnessy Dam. On Saturday, September 2, a census was taken in the Lumsden area. Sunday, September 3, the count was made from the helicopter followed by a census upstream about 5 miles from Early Intake to Preston Flat. The following day, Monday, a census was conducted downstream from O'Shaughnessy Dam.

An information form (Table 4) was completed after interviewing one or more fishermen in a party. Most of the fishermen were in camps, having fished earlier in the day. The interview information is summarized in Tables 5 and 6.

In the Lumsden area (Table 5) the fishing success was .49 fish per angler hour and all of the fish were caught by 32 percent of the fishermen which is quite typical.

In the O'Shaughnessy to Early Intake area (Table 6) the fishing success was .26 fish per angler hour and the fish were caught by 35 percent of the fisherman.

The information in the tables is self-explanatory but it should be emphasized that most fishermen commented that the flow of 650 - 750 cfs in the Lumsden area was too much water for fishing. The question on the form relating to the size stream fishermen liked was intended only for the area of Early Intake to O'Shaughnessy and was therefore not recorded in many cases in the Lumsden area.

Fishing in Early Intake Reservoir and the river area near the road bridge downstream from Early Intake Dam was dependent on the catchable trout planted periodically by Fish and Game. Some of the fish caught were observed and they were definitely planted trout. Many people fished in these areas but few were contacted as it was decided not to include this type data in the study because it would bias the success rate of naturally produced trout. The success rate of a catchable trout fishery is regulated by the number of fish stocked and the frequency of the plants.

As noted in Table 3 the rafting activity from Lumsden to Wards Ferry is important. The leaders of three private rafting parties were interviewed at Lumsden. Of the 26 persons in the three groups only one was a fisherman. One of the guides had a party of 24 the previous week and no one fished. This gives a total of 50 persons with only one fisherman. The fisherman said that fishing was good at the overnight campsites. He caught a fish every 5 or 10 minutes. It appears that rafters generally are not fishermen or at least do not fish on rafting expeditions.

The spawning gravels were observed during the helicopter flights. There was a noticeable increase in the amount of spawning areas from a point about two miles downstream from the confluence with Cherry Creek to Wards Ferry. They were much better downstream than upstream from Lumsden. It appeared that the gravels would be good with lower flows although a smaller area would be inundated.

Observations were made for spawning rainbow trout below Early Intake Dam on March 10 and 29, 1978 to see if there was indication of an upstream spawning migration blocked by the dam. No fish were seen. On September 20, and October 19, 1978 observations were again made for a spawning migration of brown trout in the same area. One fish was observed below the dam on October 19, and three 16-inch rainbow containing eggs had been caught below the dam on October 18. Telephone inquiries indicate that no large fish were caught below the dam during the balance of the season. Early Intake Dam has apparently not blocked a spawning migration during 1978. Some of the local people said there were a lot of fish accumulated below the dam a few years ago which would agree with the contention of Jody Hoffman of the Fish and Wildlife Service.

Moccasin Creek State Fish Hatchery planted catchable size rainbow five or six times during the summer in the area of the bridge below Early Intake Dam, and in the reservoir above the dam as far as Kirkwood PH. They produce fall-spawned and mid-winter spawned rainbow as well as spring-spawned rainbow. This could account for the rainbow with eggs caught on October 18. No information could be obtained on the stage of development of these eggs so it is possible the fish would not have spawned until spring. Catchable size eastern brook were planted in Don Pedro Reservoir at Moccasin Point and at Wards Ferry Bridge.

Silver salmon have been planted in Don Pedro Reservoir the past several years. The size is about 8 fish per pound or approximately 5 - 7 inches in length when planted. There has been concern that the proposed Wards Ferry Dam would block a spawning migration of the silver salmon. This species has been planted in several freshwater inland reservoirs in California and produced a good fishery. It has been found that they will not propagate naturally when landlocked in fresh water. Eggs taken artificially from silver salmon landlocked in fresh water have not developed properly to produce fish. Apparently this silver salmon program in California is a put-and-take program in fresh water reservoirs with catchable size fish. It can therefore be assumed that the proposed dam at Wards Ferry will not be a problem for the silver salmon program. It could be a problem for rainbow and brown trout found in Don Pedro Reservoir.

A thermograph tape was received from Fish and Wildlife Service recording water temperatures at the gaging station above Early Intake 5/26 - 9/29/72 when

the flow was 75 cfs. The 1972 water year was about two-thirds of normal. The data showed temperatures over the 68° F criteria set by Fish and Wildlife Service on 65 days with a maximum of 74° F. Fish and Wildlife Service state that these temperatures are not suitable for the well being of trout, but when they chemically treated this section of river in 1977 there were good numbers of fish. The final report on this fish sampling has not been received.

SUMMARY

1. The study for 1978 included collection of temperature and flow data, use counts made by helicopter, and creel censuses of fishing activity in the area from O'Shaughnessy Dam to Wards Ferry.
2. The 1978 year was an exceptionally wet year compared to studies made in 1977 which was an exceptionally dry year.
3. Thermographs were installed in various locations (see Figure 1 and Table 1) but failed to operate for the full period.
4. Table 2 summarized the temperature data recorded. The thermographs were installed during the hottest weather of the summer. The highest water temperatures were recorded in the first week of operation, generally between 1600 - 1800 hours.
5. O'Shaughnessy Dam was spilling water when the thermographs were installed on August 10. The spill water, temperature 70.7° F, mixed with 50° F water from the low level fish water release was 69.8° F downstream at the gaging station below O'Shaughnessy Dam. The water temperature reached 74° F at the gaging station above Early Intake. The previous day the water temperature was 77° F at the gaging station above Early Intake. The graph in Figure 2 shows that the water temperatures dropped rapidly as the air temperatures declined, and as the spill decreased at O'Shaughnessy. These temperatures exceeded the 68° F criteria set by Fish and Wildlife Service during the spill period.
6. The cold water added to the river from the Kirkwood Powerhouse at Early Intake and from Holm Powerhouse on the Cherry provided cooler water (50° - 55° F) below the Cherry confluence. Information in Figure 3 . Water temperatures at Lumsden reflect a warming change when one unit at Holm PH is shut down for one day.

7. The South Fork Tuolumne contributed warmer water to the Tuolumne at Lumsden which must be evaluated when added to a fish water release from Jawbone Dam in the proposed Clavey-Wards Ferry Project. It was dry at the confluence in 1977.

8. The lower 8 miles of the Clavey River (below the lower bridge) becomes warm and should be evaluated in relation to the Clavey River Wild Trout Management Plan proposed by Department of Fish and Game, and in relation to the proposed Clavey-Wards Ferry Project.

9. Water passing through the tunnels (O'Shaughnessy Dam to Kirkwood PH, and Cherry Dam to Holm PH) did not increase in temperature. This indicates that water in the proposed tunnel from Jawbone Dam to Clavey Reservoir would probably not increase in temperature, thereby providing reasonably cold water to release in the Clavey River below Hunters Point Dam and in the Tuolumne below Clavey PH.

10. Use counts were made by helicopter on the Tuolumne River between O'Shaughnessy Dam and Wards Ferry on a weekday, a weekend day, and on a 3-day weekend day. The river was divided into sections as shown in Figure 4 and the results are tabulated in Table 3. The number of fishermen and campers is much heavier on a 3-day weekend than on a normal weekend and there are very few on a weekday. The greatest use was in the Lumsden campground area, and a short distance upstream and downstream. Very few fishermen were more than 1/4 mile from a road. The use in the section from Early Intake to O'Shaughnessy Dam was very light.

11. Creel censuses were made in conjunction with the helicopter use counts to determine fishing success. Fishing in the Lumsden area (Table 5) was rather typical with success at .49 fish per angler hour and 32 percent of the fishermen catching fish. In the section from O'Shaughnessy to Early Intake (Table 6) fishing was not so good. The success rate was .26 fish per angler hour and 35 percent of the fishermen caught fish. This was a very small sample.

12. Most fishermen indicated they disliked the large flows of 650 - 750 cfs and preferred a stream of about 75 cfs.

13. Creel censuses were not made in the Early Intake Reservoir or the river in the area of the bridge below Early Intake Dam because these areas are planted with catchable trout and the fishing success rate is dependent on the number of fish stocked and frequency of plants and not on natural reproduction.

14. Rafting is an important activity (Table 3) between Lumsden and Wards Ferry. Rafters are generally not fishermen. Interviews with leaders of 50 rafters indicated only one fished at an overnight camp and reported fishing good in the area.

15. Observations from the helicopter indicated spawning gravels to be excellent between Lumsden and Wards Ferry.

16. Ground observations were made below Early Intake Dam to determine whether any upstream spawning migration of rainbow in the spring or brown trout in the fall were blocked by the dam. No spawning migration was blocked by the dam in 1978.

17. There is a good silver salmon fishery in Don Pedro Reservoir. Information is available that silver salmon landlocked in a freshwater reservoir do not spawn successfully. This is apparently a put-and-take fishery. It can therefore be assumed that the proposed Wards Ferry Dam would not harm this fishery. Possibly rainbow and brown trout migrate upstream from Don Pedro Reservoir for spawning.

18. The study in 1977 provided information in a very dry year. This report of the 1978 study gives information in a very wet year. It is essential that similar information be gathered on a more nearly normal water year. Additional water temperatures are needed in a normal year in all sections of the river to resolve problems of fish water releases.

19. Water temperature data was received and tabulated from a Fish and Wildlife Service thermograph operated at the gaging station above Early Intake 5/26 - 9/29/72 when the flow was 75 cfs. The data shows temperatures over 68° F on 65 days with a maximum of 74° F.

20. Data on angler use and success should be expanded, especially between O'Shaughnessy Dam and Early Intake.

RECOMMENDATIONS FOR FIELD WORK IN 1979

1. Rent eleven thermographs for use June 25 - September 28, 1979 installed in the Tuolumne River as follows:

   (1) Above Hetch Hetchy Reservoir
   (2) Below O'Shaughnessy Dam
   (3) Above Early Intake
   (4) Below Early Intake
   (5) Above Cherry confluence
   (6) Cherry Creek above Tuolumne confluence
   (7) Below Cherry confluence
   (8) South Fork Tuolumne above Tuolumne confluence
   (9) Below South Fork Tuolumne confluence - Lumsden
   (10) Wards Ferry
   (11) Clavey River - gage at lower bridge

2. Thermographs should be checked for proper operation after one week.
3. Hand thermometer readings should be made periodically during the period of thermograph operation.
4. Observe rainbow spawning migration below Early Intake Dam in March to determine whether the dam blocks a spawning run.
5. Observe brown trout spawning migration below Early Intake Dam in September to determine whether the dam blocks a spawning run.
6. Make a use count by helicopter between O'Shaughnessy Dam and Wards Ferry on a week day, a weekend day, and a 3-day weekend day.
7. Conduct a creel census in conjunction with the use counts and at any time that people are seen on the river to determine fishing pressure and success as related to other years, and obtain fishermen's opinions about the fishery and stream flows.
8. Conduct an opening weekend creel census on April 28 and 29 by stationing a man on the road below O'Shaughnessy Dam and at the trail head above Early Intake to contact all fishermen leaving these areas.
9. Tabulate and/or graph all water temperature data for all years thermographs were operated at the gaging station above Early Intake by Fish and Wildlife Service and City of San Francisco in relation to air temperatures and stream flows.

Estimated cost of 1979 studies:

Rental of 11 thermographs for 4 months	$1000.00
Three helicopter flights	1500.00
Participation in thermograph program and observations listed in recommendations and preparation of a report	7000.00

City of San Francisco employees' time involved is not included.

Robert C. Lewis
Fishery Consultant
509 Del Sol Avenue
Pleasanton, CA 94566

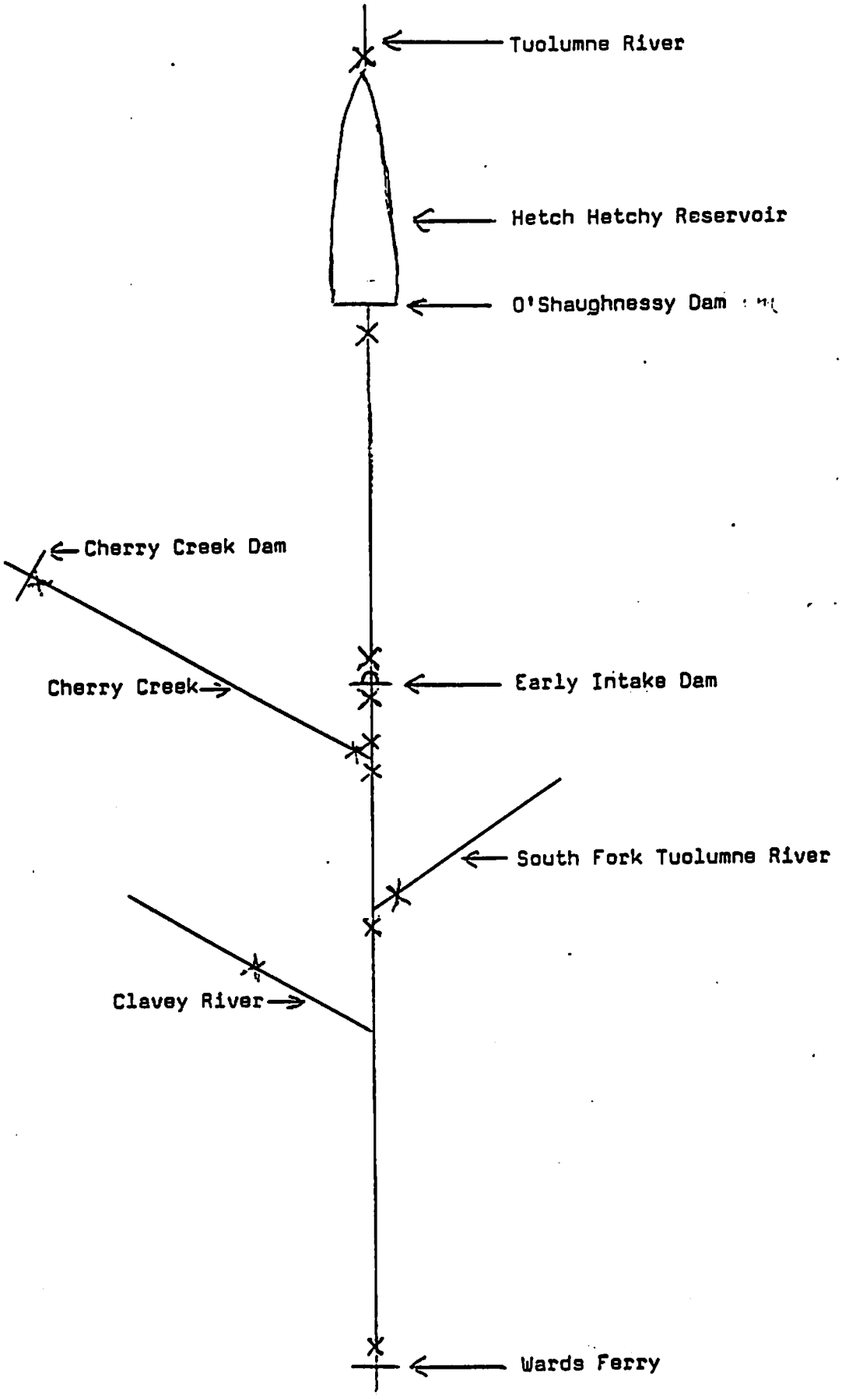
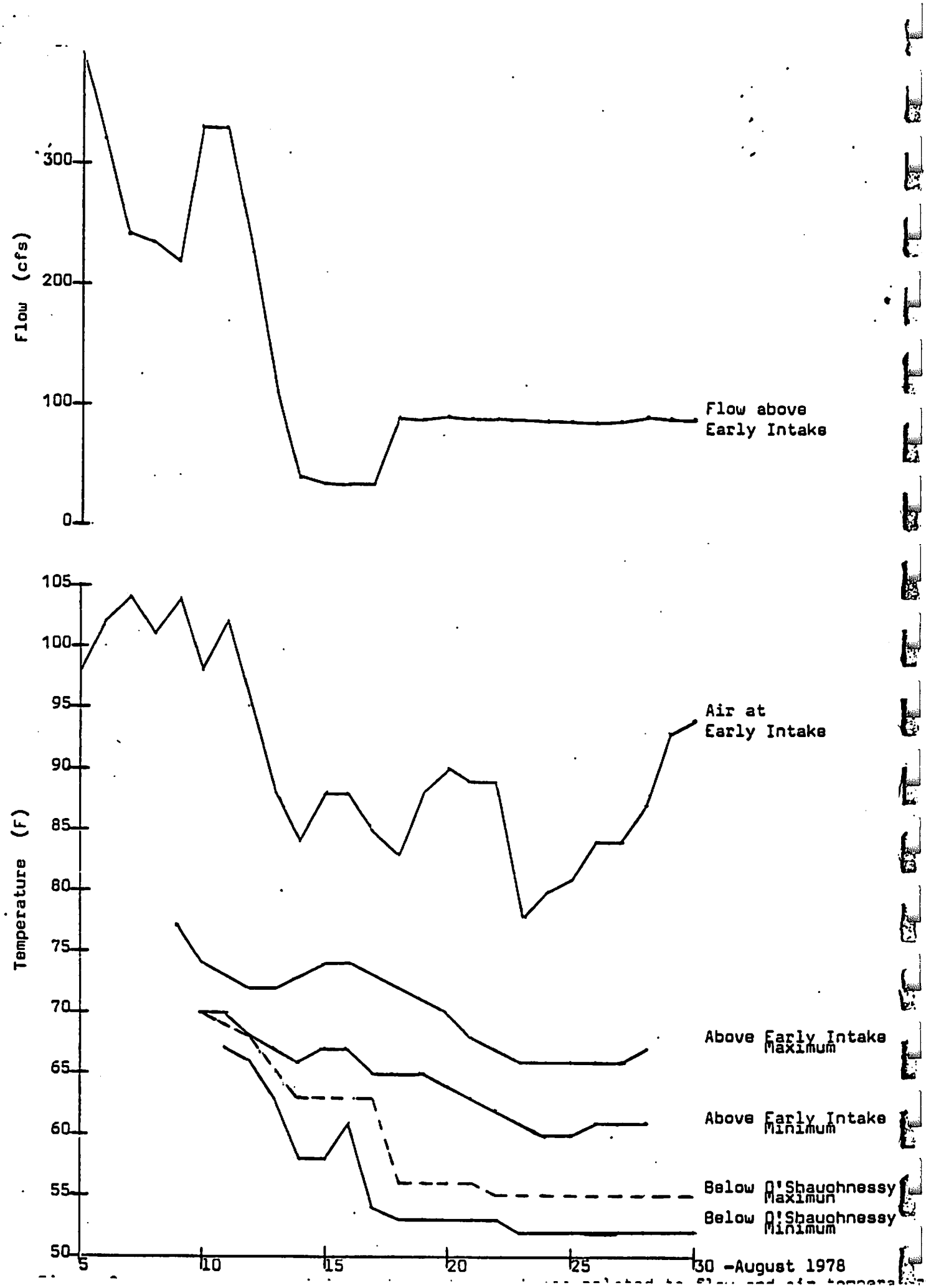


Figure 1. Sketch of Tuolumne River Drainage.
Thermograph locations indicated by x.


Flow (cfs)
300
200
100
0
Flow above Early Intake
Temperature (F)
105
100
95
90
85
80
75
70
65
60
55
50
Air at Early Intake
Above Early Intake Maximum
Above Early Intake Minimum
Below O'Shaughnessy Maximum
Below O'Shaughnessy Minimum
5
10
15
20
25
30 -August 1978

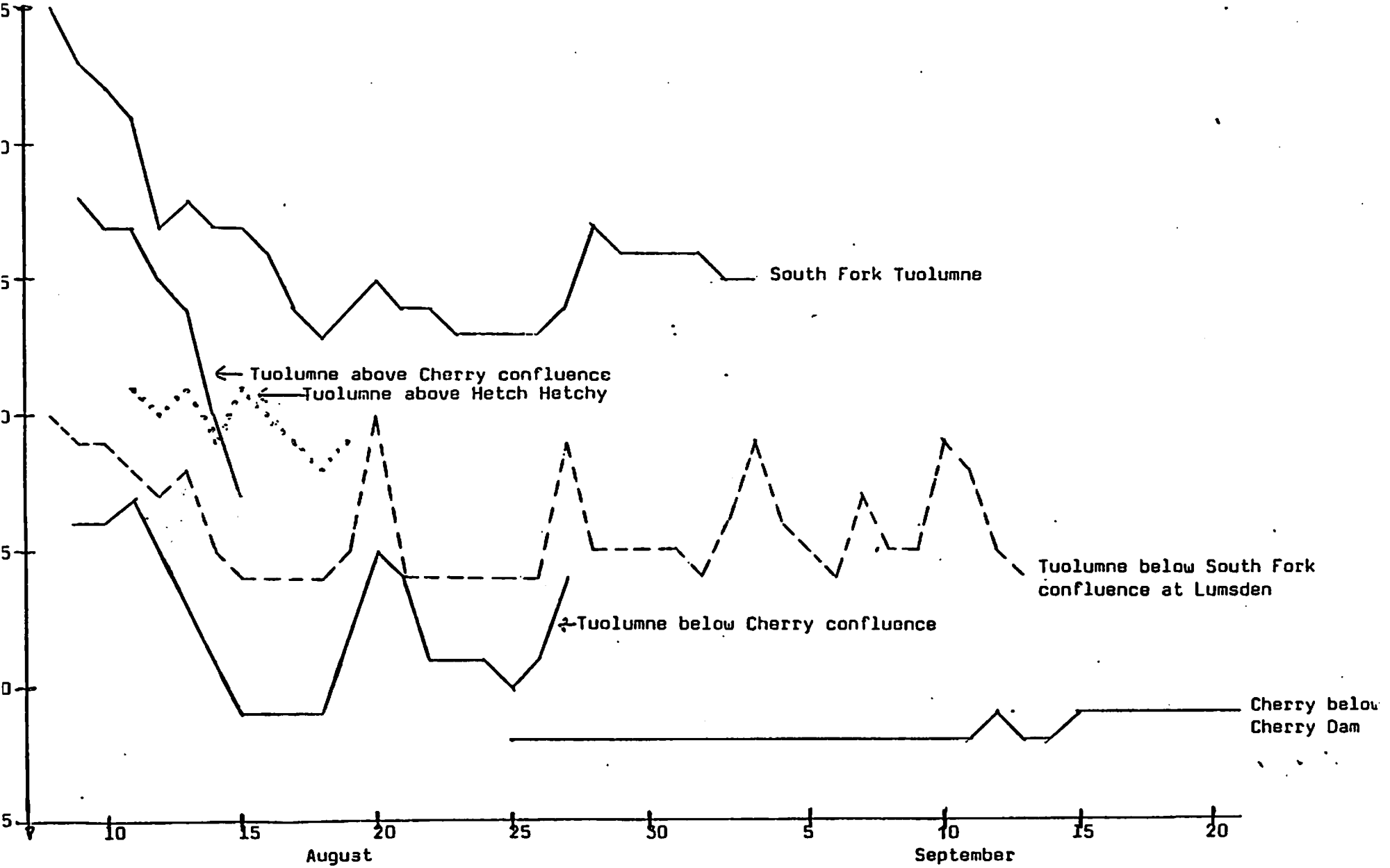


Figure 3. High stream flow temperatures at various locations - 1978.

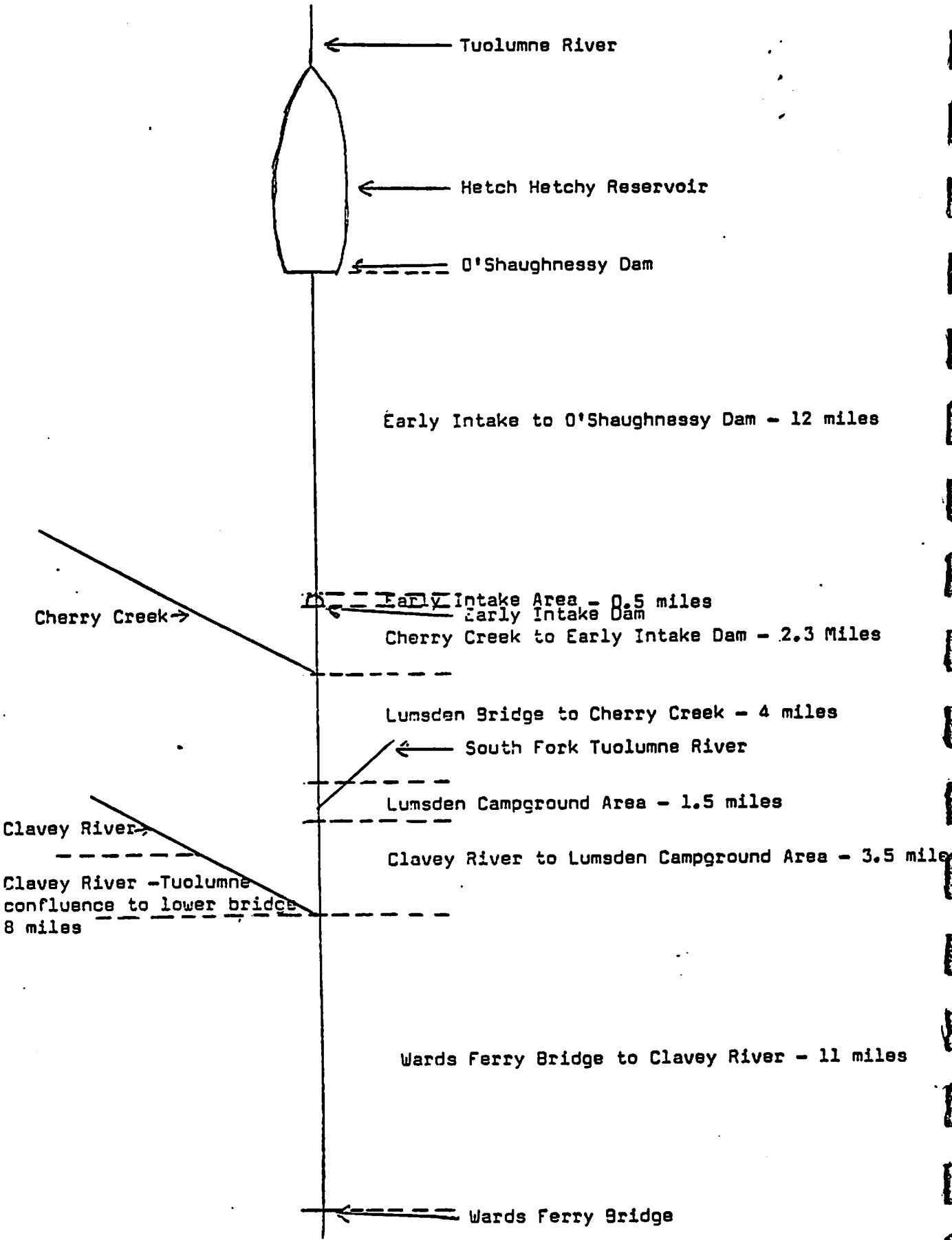


Figure 4. Sketch of Tuolumne River Drainage
Shows the sections listed in Table 3
in which use counts were made.

Location on Tuolumne River	Installed			Date ceased to operate	Removed		
	Date	Flow cfs	Temp. (F)		Date	Flow cfs	Temp. (F)
Air at Early Intake	8/9		104		9/20		72
Above Hetch Hetchy	8/11	1210**	59	8/19	9/19	400**	
Below O'Shaughnessy Dam	8/10	246	70	8/30	9/21	35	54
Above Early Intake	8/9	228	77	8/28	9/20	45	62
Below Early Intake	8/9	357	61	8/26	9/20	122	55
Above Cherry confluence	8/9	357	68	8/15	9/21	126	57
Cherry above Tuol. confluence	8/9	795	52	8/9	9/21	730	52
Below Cherry confluence	8/9	1152	55	8/28	9/21	856	52
S.F. Tuol. above Tuol. confluence	8/8	60**	75	9/4	9/20	60**	50
Below S.F. confluence - Lumsden	8/8	1250**	61	9/13	9/20	950**	52
Wards Ferry	8/12	1300**	64		8/20*		
Clavey - gage at lower bridge	8/9	33	70	8/9	9/20	37	52
Cherry below Cherry Dam	8/25	17	48		9/22	17	49

Table 1. Flow and water temperature data on dates thermographs were installed and removed and the date each ceased to operate due to malfunction.
* Removed by a fisherman.
** Estimate

Location on Tuolumne River	High temp. (F)	Low temp. (F)	Max. daily fluc-tuation (F)	Min. daily fluc-tuation (F)	Average daily fluc-tuation (F)	Average time of day high temp. was recorded	Average time of day low temp. was recorded
Above Hetch Hetchy	61	53	6	5	5	1600 - 1800	0800 - ———
Below O'Shaughnessy Dam	70	52	9	2	3	1600 - 1800	0600 - 1000
Above Early Intake	77	60	8	3	6	1500 - 1600	0800 - ———
Below Early Intake	64	53	5	1	2	1800 - 2000	1000 - ———
Above Charry confluence	68	54	4	2	3	1800 - ———	0800 - 1000
Cherry above Tuol. confluence *							
Below Cherry confluence	57	48	6	1	3	2400 - 0600	0600 - 2400
S.F. Tuol. above Tuol. confluence	74	63	9	4	6	1400 - 1600	0800 - 1000
Below S.F. confluence - Lumsden	60	49	9	1	4	1600 - 1800	0200 - 0600
Wards Ferry	63	54	6	3	5	1800 - 2000	0800 - 1000
Clavey - gage at lower bridge *							
Cherry below Cherry Dam	49	47	2	1	1	1200 - 1600	2200 - 0600

Table 2. Temperature data recorded on thermographs during period of operation (refer to Table 1).
* Failed to operate.

Stream Sections	Fishermen			Camps			Rafts			Rafters			Kayaks			Miners		
	8/24	8/26	9/3	8/24	8/26	9/3	8/24	8/26	9/3	8/24	8/26	9/3	8/24	8/25	9/3	8/24	8/26	9/3
Wards Ferry Bridge to confluence with Clavey			7	4	3	4	8	13	9	27	36	31		5		2	10	4
Clavey River upstream to lower bridge		2				3												
Confluence Clavey to Lumsden Campground area		3	9			2	3			6				1				
Lumsden Campground Area	3	4	21	7	16	50	7	10		13	14							
Lumsden Bridge to confluence Cherry Creek			22			4												
Cherry Creek to Early Intake Dam		2				1												
Early Intake Area			2															
Early Intake Reservoir to O'Shaughnessy Dam			7			5												
Total	3	11	68	11	19	69	18	23	9	46	50	31		6		2	10	4

Table 3. Use Counts Made By Helecopter *

* 8/24 was a weekday Flight time 0920 - 1110
8/26 was a weekend day Flight time 0820 - 1005
9/3 was a 3 day weekend day Flight time 0810 - 1000
There are 3 major camp grounds in the Lumsden area.
Each camp averaged 3 or more people.

INFORMATION TO BE COLLECTED FROM FISHERMEN ON TUOLUMNE RIVER

Start a friendly conversation showing interest in the person's activity. Much information can be obtained without asking specific questions and giving the impression of conducting a formal interview. Do not pursue the conversation if the person is reluctant to talk or appears hostile.
Fill out the form after leaving the fisherman so he will not feel it is a formal interview.

****

1. How is the fishing? _____ (good, fair, poor, etc.)
2. How long have you been fishing? _____(Number of hours)
3. Number of fish caught this trip. _____(Rainbow) _____(Brown)
4. Approximate size. _____(Inches)
5. Is this the first time fishing the Tuolumne? _____(yes or no)
   If not, how often have you fished the Tuolumne? _____(times per year)
6. How does the Tuolumne compare with other California streams you have fished? _____(better, same, worse)
7. Do you enjoy this size stream? _____(too large, too small, about right) Ask this question only for those fishing between O'Shaugnessy Dam and Early Intake.
8. Added Comments. _____
   _____

9. Date _____(month, day, hour)
10. Location on River _____
11. Number of fishermen in party _____
12. Number of non-fishermen in party _____
13. Activity of non-fishermen _____(hiking, swimming, camping)
14. Approximate flow of river if known _____(cfs)

_____
Name of Interviewer

Table 4. Census form.

Date	No. Fishermen	Hours fished	Total hours fished	No. Rainbow	No. Brown	Total fish	Fish caught per hour	Size (inches)	Fishing was			Flow was				First time to fish Tuolumne			Compare w/ other Calif. streams			No. non-fishermen in party
									Good	Fair	Poor	Flow cfs	Too large	Too small	About right	Yes	No	Times fished before	Better	Same	Worse	
8/8	0											1250										0
8/26	2	2	4	0	7	7	1.75	11 - 14	x			760	x				x	3		x		0
8/26	4	3	12	0	7	7	.58	11 - 13		x		760	x				x			x		0
8/26	4	2	8	0	0	0	0	-			x	760	x				x	2		x		0
8/26	3	2	6	0	0	0	0	-			x	760	x			x					x	0
8/26	4	2	8	1	1	2	.25	10 - 19		x		760				x				x		0
8/26	2	1	2	0	0	0	0	-			x	760				x					x	0
8/26	1	2	2	0	0	0	0	-			x	760				x				x		0
8/26	1	3	3	0	0	0	0	-			x	760				x					x	0
8/26	2	2	4	0	5	5	1.25	9 - 10	x			760				x			x			0
8/26	2	3	6	0	0	0	0	-			x	760				x					x	0
8/26	1	8	8	1	10	11	1.38	9 - 10	x			760					x	1	x			0
9/2	4	2	8	0	0	0	0	-			x	650	x			x				x		4
9/2	1	2	2	3	0	3	1.5	6 - 10		x		650	x				x	2		x		4
9/2	1	1	1	0	0	0	0	-			x	650	x				x	2	x			3
9/2	2	0	0	0	0	0	0	-				650	x				x	2	x			3
9/2	1	5	5	10	0	10	2.0	6 - 10	x			650	x				x	2	x			2
9/2	1	5	5	0	0	0	0	-			x	650				x				x		2
9/2	4	1	4	0	0	0	0	-			x	650				x					x	5
9/2	4	2	8	0	0	0	0	-			x	650				x					x	5
9/2	2	1	2	0	0	0	0	-			x	650				x					x	3
9/2	2	.5	1	0	0	0	0	-				650					x	1	x			0
9/2	1	3	3	1	1	2	.67	14	x			650			x	x			x			0
9/2	2	2	4	3	0	3	.75	12	x			650			x	x			x			0
9/2	1	4	4	4	0	4	1.	8 - 14	x			650			x		x	1	x			0
9/20	0											950										0
Total	52	56.5	110	23	31	54	.49	-	7	3	12	-	9		3	14	10	-	9	8	7	31

Table 5. Census - Tuolumne River - Lumsden Area.

Date	No. Fishermen	Hours fished	Total hours fished	No. Rainbow	No. Brown	Total fish	Fish caught per hour	Size (inches)	Fishing was			Flow was				First time to fish Tuolumne			Compare w/ other Calif. streams			No. non-fishermen in party
									Good	Fair	Poor	Flow cfs***	Too large	Too small	About right	Yes	No	Times fished before	Better	Same	Worse	
8/9	0											228										0
8/10	2	4	8	0	0	0	0	-			x	331	x			x						0
8/10	2	2	4	0	0	0	0	-		x		331	x				x	7*	x			0
8/27	2	2	4	0	0	0	0	-			x	89	x			x					x	0
8/27	2	6	12	0	0	0	0	-			x	89	x				x	1		x		0
8/29	0											90										0
9/3	2	1.5	3	4	1	5	1.6	8 - 12	x			90	-		x		x	15**		x		0
9/3	2	2	4	2	2	4	1.	6 - 8	x			90			x		x	7*	x			1
9/3	0											90										2
9/3	0											90										1
9/3	0											90										4
9/4	2	2-	4	0	1	1	.25	6			x	92		x			x	2		x		2
9/20	0											45										0
Total	14	19.5	39	6	4	10	.26	-	2	1	4	-	4	1	2	2	5	-	2	3	1	10

Table 6. Census - Tuolumne River - O'Shaughnessy to Early Intake.

* For past seven years.
**Fished fifteen years ago.
***Flows measured above Early Intake

APPENDIX M

TUOLUMNE RIVER FLOW STUDY REPORT - 1980*

INTRODUCTION

This report summarizes the field work accomplished during the summer and fall of 1979. It includes stream temperatures in relation to air temperatures and flow data. Use counts were made by helicopter and creel censuses were made periodically. The area of concern was primarily from Hetch Hetchy to Wards Ferry. The area between Hetch Hetchy and Early Intake concerns the Canyon Power Project which was studied and reported on by Fish and Wildlife Service in their Tuolumne River Flow Study report. The section of the river between Early Intake and Wards Ferry is the area included in the proposed Clavey-Wards Ferry Project.

Studies were made in 1977 following an exceptionally dry winter and in 1978 after an exceptionally wet winter. The winter preceeding the 1979 study was close to normal precipitation. Studies have therefore been made on three different year types.

STREAM TEMPERATURES

The City of San Francisco rented 11 thermographs which were installed at various locations in the river drainage as shown in Figure 1. The thermographs were installed during July and were checked at approximate intervals of two weeks. Some of them did not operate properly so the period of operation was not as complete as anticipated. Table 1 shows the dates the thermographs were installed and removed, and dates on which some were inoperative. It also shows the estimated stream flow and the high water temperature on the day they were installed and removed.

Table 2 shows the high and low temperatures recorded by each thermograph during the period of operation; also the maximum, minimum, and average daily fluctuation of temperatures as well as the average hours of the day when high and low temperatures were recorded.

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*By Robert C. Lewis
Fishery Consultant
January 7, 1980

Canyon Power Project

A thermograph was installed at the gage station above Early Intake on July 10; one at the gage station below O'Shaughnessy Dam, and one in the river above Hetch Hetchy Reservoir on July 17. The thermograph below O'Shaughnessy was stolen in early October so no information is available except a water temperature of 55°F on July 17 when it was installed. Figure 2 graphically shows the maximum and minimum daily water temperatures at the gage above Early Intake and the water flow and air temperature for the same period. The water flow dropped to about 64 cfs which is below the required fish water release of 75 cfs, for about ten days after O'Shaughnessy stopped spilling on July 4. The high water temperature was recorded at 77°F. The graph shows a definite correlation between maximum and minimum air and water temperatures. The water temperatures exceeded 68°F for 30 days after the thermograph was installed on July 11. This is the maximum temperature the Fish and Wildlife Service have established "for the wellbeing of trout". The minimum water temperature exceeded 68°F on only three days when it reached 70°F. The average daily fluctuation in temperature was 5 degrees and up to 9 degrees on the warmer days which provides cooler water during a portion of the day. The air temperature at Early Intake became warm during mid-September and the water temperature was 68°F for several days. The water flow was reduced to 35 cfs as scheduled in mid-September and the water temperature dropped due to shorter days and colder nights.

The temperatures recorded on the thermograph in the river above Hetch Hetchy are shown graphically in Figure 4. The high and low temperatures relate to the air temperatures and the maximum water temperatures above Early Intake. The stream temperatures above Hetch Hetchy reached a high of 68°F on only three days in early August.

Clavey-Wards Ferry Project

The thermographs for this portion of the study were located in the Tuolumne River below Early Intake; above the Cherry confluence; Cherry Creek above the Tuolumne confluence; below the Cherry confluence; South Fork Tuolumne above the Tuolumne confluence; below the South Fork confluence; above Don Pedro Reservoir at Wards Ferry; and in the Clavey River at the lower bridge. These locations are shown in Figure 1. Some of the thermographs did not work properly

which was corrected by the frequent inspections. This was the reason for the late date of installation shown for the Clavey River and Wards Ferry. The high daily stream temperatures are shown in Figures 3 and 4. The data from the thermograph below Early Intake Dam was not put on the graph because it was within a degree or two of the data from the thermograph above the Cherry confluence. The purpose of these two was to determine any appreciable rise in temperature in this 2.3 miles of stream.

Varying amounts of water were released from the Kirkwood Power House. This water was 50°F and was mixed with the warmer water recorded at the station above Early Intake. It was stabilized in Early Intake Reservoir and was as much as 15 degrees cooler by the time it reached the confluence of Cherry Creek. This is shown in Figure 3 with the recordings from the thermograph above Early Intake and the one above Cherry confluence.

Holm Power House released up to 875 cfs of cold water (about 50°F) which was added to the 30+ cfs of fish water release in Cherry Creek. This volumne of cold water lowered the temperature of the Tuolumne River below the confluence of the Cherry as shown in Figure 3. The Holm PH reduced generation from 2300 hours to 600 hours which decreased the water release to 165 cfs for that period during July, then in August and September it was cut to zero for that period. This is reflected in Figure 3 as the temperatures shown are the high readings. The only water that reached the Tuolumne from Cherry Creek was the fish water release which was warmer. Generation was also reduced on Sundays so the release was 165 cfs from 0600 hours to 2300 hours. This reduced flow on Sundays caused an increase in water temperatures as shown in Figure 3 every seven days at the stations below the Cherry confluence, below the South Fork confluence, and at Wards Ferry. The rise in temperature did not show at Wards Ferry until Mondays because the flow was not increased at Holm PH until 0600 hours Monday which is about 20 miles upstream, although the intervals are 7 days apart.

Figure 5 shows how the water releases changed at Holm PH to meet the required power generation on Thurday, 9/6/79, a change from 0 at night to 875 cfs. It also shows the rise in temperatures downstream which was caused by the decreased flow. Figure 6 is similiar, but this was on Sunday, 8/5/79, when the flow was zero at night and increased to only 165 cfs during the day. The

Kirkwood PH released cold water into the Early Intake Reservoir. This release was smaller than at Holm PH, varying from month to month, but during the study period it ranged from zero on weekends and at night to 130 cfs in the afternoons.

The high daily stream temperatures recorded on the thermographs in the South Fork above the confluence with the Tuolumne and the one in the Clavey River at the lower bridge are shown in graph form in Figure 4. The temperature of the South Fork reached 76°F on four occasions and was above 68°F on 25 days in July and early August when the flow varied from 64 to 27 cfs. The Clavey reached 74°F twice, and exceeded 68°F 12 times in late July and early August, but the thermograph did not operate until July 28 so there could have been some high temperatures earlier in July. This thermograph was about 8 miles upstream from the confluence with the Tuolumne River. The lower 8 miles of this stream could normally become quite warm , but it could receive cold water with the Clavey-Wards Ferry Project.

USE COUNTS

Use counts were made on the Tuolumne River by helicopter between O'Shaughnessy Dam and Wards Ferry. Flights were made on July 11, a weekday; July 28, a weekend day; and September 2, the middle of a 3-day weekend. The stream was divided into sections which are shown in Figure 7 with the approximate mileage for each section. Table 3 shows the above sections with the dates and number of people seen using the river. Ground surveys on the same day showed that there were 3 or more persons in most of the camps, and that there were more camps than could be seen from the air. There are 3 major campgrounds in the Lumsden area. There were only 6 fishermen counted on a weekday, 35 on a weekend day, and 56 on the 3-day weekend day, for a total of 97. In 1978 the count totaled 82 with a smaller number on the weekend and a higher number on the 3-day weekend. It was interesting that in 1978 fishermen below Early Intake were within 1/4 mile of a road. In 1979 a larger number were counted in the sections between Lumsden and Wards Ferry where access is much more difficult. Some of these left their boats at the head of Don Pedro Reservoir and fished up the river. The count above Early Intake was about the same as in 1978.

The rafting use from Lumsden to Wards Ferry was about the same both years. This use was greater on a weekday and a Saturday of a weekend, and light on the

3-day weekend.

The river flow was low on Sundays and on Monday of the 3-day weekend. The rafters need about 500 cfs to navigate the river. The camps seen near the confluence of the Clavey and Tuolumne were rafters waiting for the river to rise.

CENSUS

Creel censuses were made on the opening day of trout season (April 28 & 29) between Early Intake and O'Shaughnessy Dam. All of the fishermen were interviewed at the trail head at the end of the road above Early Intake, and at the trail that leads to the river below O'Shaughnessy Dam. Only one fisherman was checked below the dam and 48 at the trail head above Early Intake.

A census form (Table 4) was completed after interviewing one or more fishermen in a party. The information is tabulated in Table 5. The results for each day individually are tabulated in Table 7. This shows that fishing success was 1.12 fish caught per angler hour on April 28, and .48 fish per angler hour on April 29. The total success rate for the two days was .84 fish per angler hour, and the fish were caught by 69 percent of the anglers. Many of the fishermen interviewed on the second day had hiked up the river four or five miles to the Preston Falls area and camped overnight. They enjoyed hiking and camping as well as fishing. It was interesting that some of the early fishermen on the first day did not catch a fish quickly and returned to fish below the Kirkwood PH where catchable trout had been planted.

The river flow on the two days was 105 and 92 cfs and most fishermen said it was about right. 35 percent of the fishermen had fished this area previously. The total catch consisted of 50 rainbow and 32 brown trout.

Fishing was reported excellent in Early Intake Reservoir during the month of May when O'Shaughnessy was spilling about 6000 cfs of water. It was estimated that 100 - 120 brown trout about 12 inches in length were taken. These fish were undoubtedly from natural propagation and migrated downstream during the high water.

Creel censuses were also made in the Lumsden area in conjunction with the helicopter flights. Most of the fishermen contacted were in camp after they had finished fishing. The census form (Table 4) was used and the information tabulated in Table 6. The censuses were made on 5 days and the summary for each day is shown in Table 8. The best success rate was .48 fish caught per hour on a

weekday. The poorest was a success rate of .05 fish caught per angler hour, and the average was a success rate of .22. The fish were caught by 36 percent of the anglers. Twenty-one percent of the fishermen had fished the Tuolumne before. The total catch in 1979 consisted of 54 rainbow and 3 brown trout while in 1978 the catch was 23 rainbow and 31 brown trout. Many of the fishermen interviewed were novices who rarely catch fish. Many of the weekend fishermen appeared to enjoy camping, hiking, swimming, with fishing a secondary sport. According to Table 8 it can be noted that 108 persons were interviewed as fishermen and there were 46 non-fishermen in the parties.

Two people who had been camping in the Lumsden campground for a week and not fishing said there were very few people in the campgrounds during the week and large numbers on the weekends. They had talked to a number of fishermen who said the fishing was poor.

Five fishermen were interviewed who had fished for 4 hours each in the area 3 miles downstream from Lumsden campground and caught only 2 fish. This is a very difficult area to fish as there are no roads and it is reportedly one of the places where fishing is outstanding according to statements by Fish and Wildlife Service and Department of Fish and Game.

No attempt was made to interview fishermen in Early Intake Reservoir and the river area near the bridge below Early Intake because this section is planted with catchable trout by Department of Fish and Game. Many people fished here and made good catches. The study being made concerned the rate of success from naturally propagated fish and would be biased if catchable trout catches were included. The success rate of a catchable trout fishery is regulated by the number of fish stocked and the frequency of the stocking.

FISH MIGRATION

Observations were made for spawning rainbow trout below Early Intake Dam on March 21 to see if there was any accumulation of fish migrating upstream that were blocked by Earl Intake Dam. No fish were seen.

Information was received by telephone with individuals who fished below the dam in September and October. A few fish were caught but there was no accumulation of brown trout below the dam.

Observations have been made for three years and there has been no evidence that Early Intake Dam blocks a spawning migration of rainbow or brown trout.

DISCUSSION

The water temperature above Early Intake was above 68°F for 30 days after the thermograph was installed. The temperature could have been higher prior to the installation and before the spill at O'Shaughnessy stopped. This information could be obtained by placing a thermograph above Early Intake in June before the spill at O'Shaughnessy stops. In 1978 it was shown that the water from the fish release valve at the bottom of the dam was consistently 50°F and the spill water was about 70°F. A thermograph should be installed below O'Shaughnessy for the same period as the one above Early Intake. Additional data would aid in the decision of adequate flows and/or temperatures in this section of stream. The flow schedule is 75 cfs from May 1 to September 15, and 35 cfs for the balance of the year. The data shows that the water temperature gets colder and is no problem after the middle of September even though the flow is decreased to 35 cfs. This is probably due to shorter days and colder nights.

The data indicates that the temperature of water drawn from the bottom of the proposed Jawbone Dam could be from 50 to 55 degrees F to provide a fish water release in the Tuolumne River. The temperature should remain cold enough that no temperature increases would occur downstream due to reduced releases from Holm PH at night and Sundays as happens now. Determination of an adequate flow with suitable temperatures for trout over a distance of about 9 miles from Jawbone Dam to the confluence of the Clavey River must include the warm temperature of the South Fork that enters the river at Lumsden. Temperature control downstream from the confluence of the Clavey to the head of the proposed Wards Ferry Reservoir could be with cold water from the proposed Clavey Powerhouse, or Clavey Reservoir. Data from the temperature studies between O'Shaughnessy Dam and Early Intake, and the low flow temperature data below the Cherry confluence, and below the confluence of the South Fork should be helpful in these determinations. Additional data would strengthen such determinations.

The use counts made by helicopter showed 97 fishermen using the river compared to 82 in 1978. More fishermen were using the inaccessible areas; i.e., Lumsden to Wards Ferry than was true in 1978. The ground count actually provided more information in the accessible areas, but no information in the inaccessible areas.

The census on opening weekend of fishing season above Early Intake gave much more information than was obtained with more effort in 1978. This work should be repeated next year and should yield information on whether the fishery is increasing or decreasing.

The census in the Lumsden area showed a decline from a success rate of .49 fish caught per angler hour in 1978 to a success rate of .22 in 1979. If this census is repeated next year it should help to show the status of the fishery in that area.

In 1979 the fishermen did not complain about the large flows as they did in 1978, but generally the flows were not as large. With the proposed Clavey-Wards Ferry Project there would likely be a constant flow in winter and summer except during the runoff periods when the flow cannot be controlled. A constant level flow should be desirable and appreciated by the fishermen, but it would be too small for rafting.

SUMMARY

1. The study in 1979 included collection ot temperature and flow data, use counts made by helicopter, and creel censuses offishing activity in the area from O'Shaughnessy Dam to Wards Ferry.
2. 1979 was a normal water year compared to 1978 which was an exceptionally wet year, while 1977 was an exceptionally dry year.
3. Thermographs were installed at various locations (see Figure 1 and Table 1).
4. Table 2 summarizes the temperature data recorded. The highest water temperatures were generally recorded between 1600 and 1900 hours except when cold water from powerhouse releases influenced the temperatures.
5. A thermograph was installed at the gage above Early Intake on July 11 with the high water temperature for the day of 72°F (Figure 2). The temperature reached a high of 77°F and exceeded 68°F for 30 days. The temperature could have been higher before the installation of the thermograph. Hetch Hetchy stopped spilling on July 4. The thermograph below O'Shaughnessy Dam was installed om July 17 when the temperature was 55°F. This thermograph was stolen about October 1 so no information is available to correlate with the one above Early Intake. The high temperatures exceeded the 68°F criteria set by the Fish and Wildlife Service. Additional data should be gathered at

these two stations.

6. The cold water added to the river from Kirkwood Powerhouse at Early Intake, and from the Holm Powerhouse on Cherry Creek provided colder water in the river below the Cherry confluence shown in Figures 3 and 4. The recordings from above Early Intake are shown in Figure 3 to indicate how the warm water became colder. All of the graphs plot maximum daily water temperatures which show an increase at seven day intervals on Sundays, due to Holm PH reducing power operation and water releases on Sundays. In August and September the Holm PH shut down entirely for seven hours during the night so temperatures are based on the 30 cfs fish water release in Cherry Creek. These operations are shown in Figures 5 and 6.

7. The South Fork Tuolumne contributed warmer water to the Tuolumne at Lumsden which must be considered when added to a fish water release from the proposed Jawbone Dam in the proposed Clavey-Wards Ferry Project. Temperatures plotted in Figure 4 show it reached 76°F on 4 occasions and exceeded 68°F on 25 days.

8. The Clavey River temperatures are shown in Figure 4. They reached 74°F and exceeded 68°F on 12 days. These temperatures were recorded at the lower bridge about 8 miles upstream from the confluence with the Tuolumne.

9. Use counts were made by helicopter on the Tuolumne between O'Shaughnessy Dam and Wards Ferry on a weekday, a weekend day, and on a 3-day weekend. The river was divided into sections shown in Figure 7 with the results tabulated in Table 3. There are more fishermen on a weekend than on a week day. In 1979 there were more fishermen seen in the inaccessible areas between Lumsden campground and the upper end of Don Pedro Reservoir at Wards Ferry.

10. A creel census was made at the trail head above Early Intake on the opening weekend of trout season (April 28 & 29) to check the fishing activity between O'Shaughnessy and Early Intake. The results are tabulated in Table 5 with a summary for each day shown in Table 7. Fishing success rate was .84 fish caught per angler hour.

11. A creel census was made in conjunction with the helicopter flights in the Lumsdem campground area. The results are tabulated in Table 6 and summaries for each day in Table 8. The success rate was .22 fish per

angler hour.

12. Creel censuses were not made in the Early Intake Reservoir or the river in the area of the bridge below Early Intake because these areas are planted with catchable trout and the success rate of that type fishery depends upon the number of fish stocked and the frequency of stocking.
13. It was reported that fishing for brown trout about 12 inches in length was good in Early Intake Reservoir during the month of May when the runoff flow is about 6000 cfs. These were probably fish from natural propagation migrating downstream with the larger flows.
14. Rafting is a popular activity as shown in Table 3. The number counted were about the same as in 1978.
15. It appears that no spawning migration of rainbow or brown trout is blocked by Early Intake Dam.
16. Additional temperature information would be helpful in determining adequate flow releases in the Canyon Power Project (O'Shaughnessy to Early Intake), and the proposed Clavey-Wards Ferry Project. Additional angler use and success rates should be expanded to show the status of the fishery and establish a trend showing its improvement or decline.

RECOMMENDATIONS FOR FIELD WORK IN 1980

1. Rent 9 thermographs for use June 23 – September 26, 1980 installed in the Tuolumne River as follows:
   (1) Below O'Shaughnessy Dam
   (2) Above Early Intake
   (3) Above Cherry confluence
   (4) Cherry Creek above Tuolumne confluence
   (5) Below Cherry confluence
   (6) South Fork Tuolumne above Tuolumne confluence
   (7) Below South Fork Tuolumne confluence – Lumsden
   (8) Wards Ferry above Don Pedro Reservoir
   (9) Clavey River – gage at lower bridge
2. Thermographs should be checked for proper operation at 2-week intervals.
3. Hand thermometer readings should be made periodically during the period of thermograph operation.
4. Check whether Early Intake Dam blocks a spawning migration.
5. Conduct an opening weekend creel census on May 3 and 4 by stationing a man on the road below O'Shaughnessy Dam and at the trail head above Early Intake to contact all fishermen leaving these areas.
6. Conduct a creel census 4 or 5 times in the Lumsden area to determine fishing pressure and success in relation to other years and obtain fishermen's opinions about the fishery and stream flows.
7. Make a use count by helicopter between O'Shaughnessy Dam and Wards Ferry on a weekday, a weekend day, and a 3-day weekend. (It is questionable whether this provides needed information – check Table 3).

Estimated cost of 1980 studies:

Rental of 9 thermographs for 4 months	$ 900.00
Participation in thermograph program and observations listed, and preparation of report	7000.00
3-helicopter flights (if thought beneficial)	1500.00

City of San Francisco employees' time involved is not included.

Robert C. Lewis
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509 Del Sol Avenue
Pleasanton, CA 94566

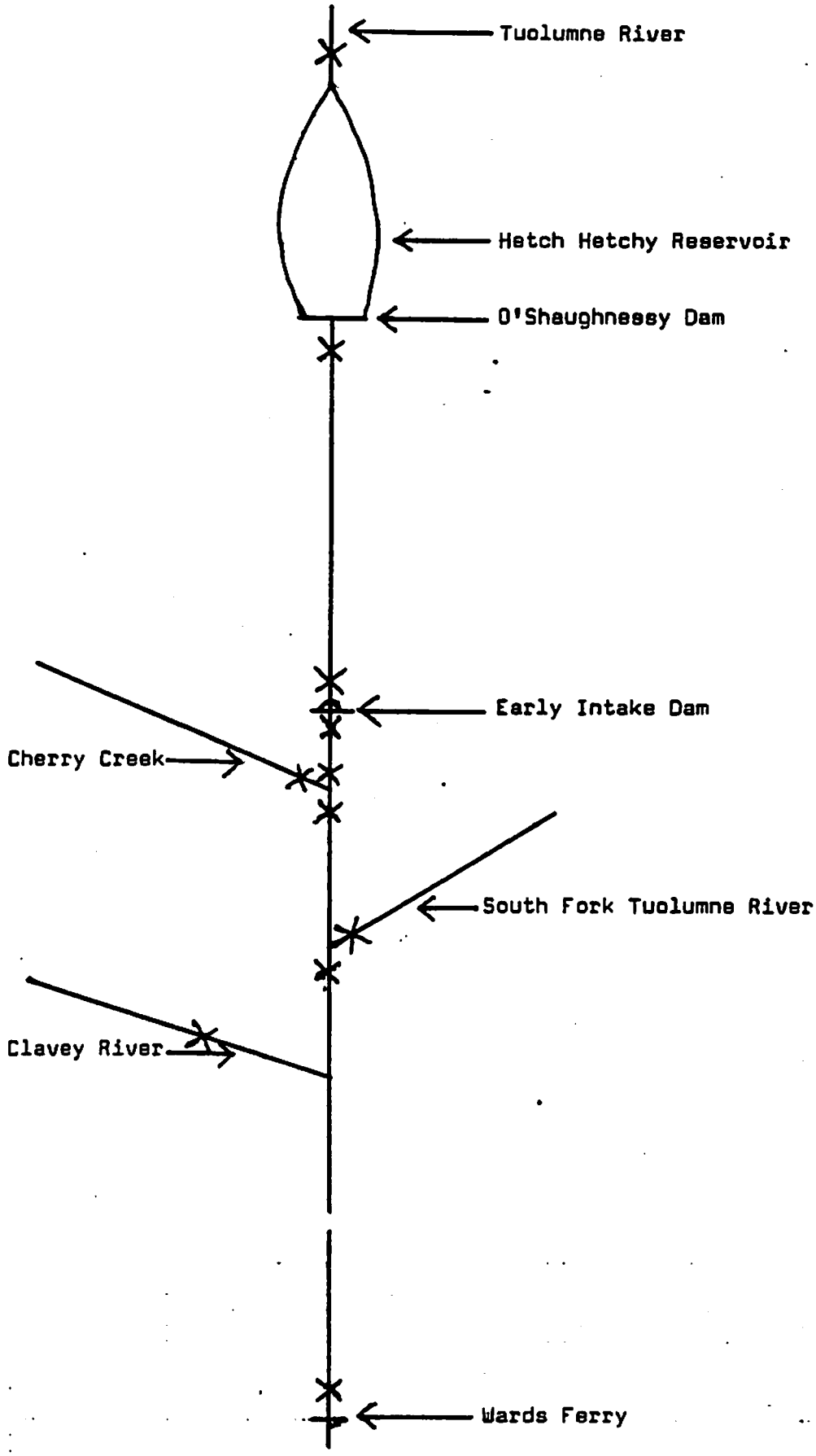
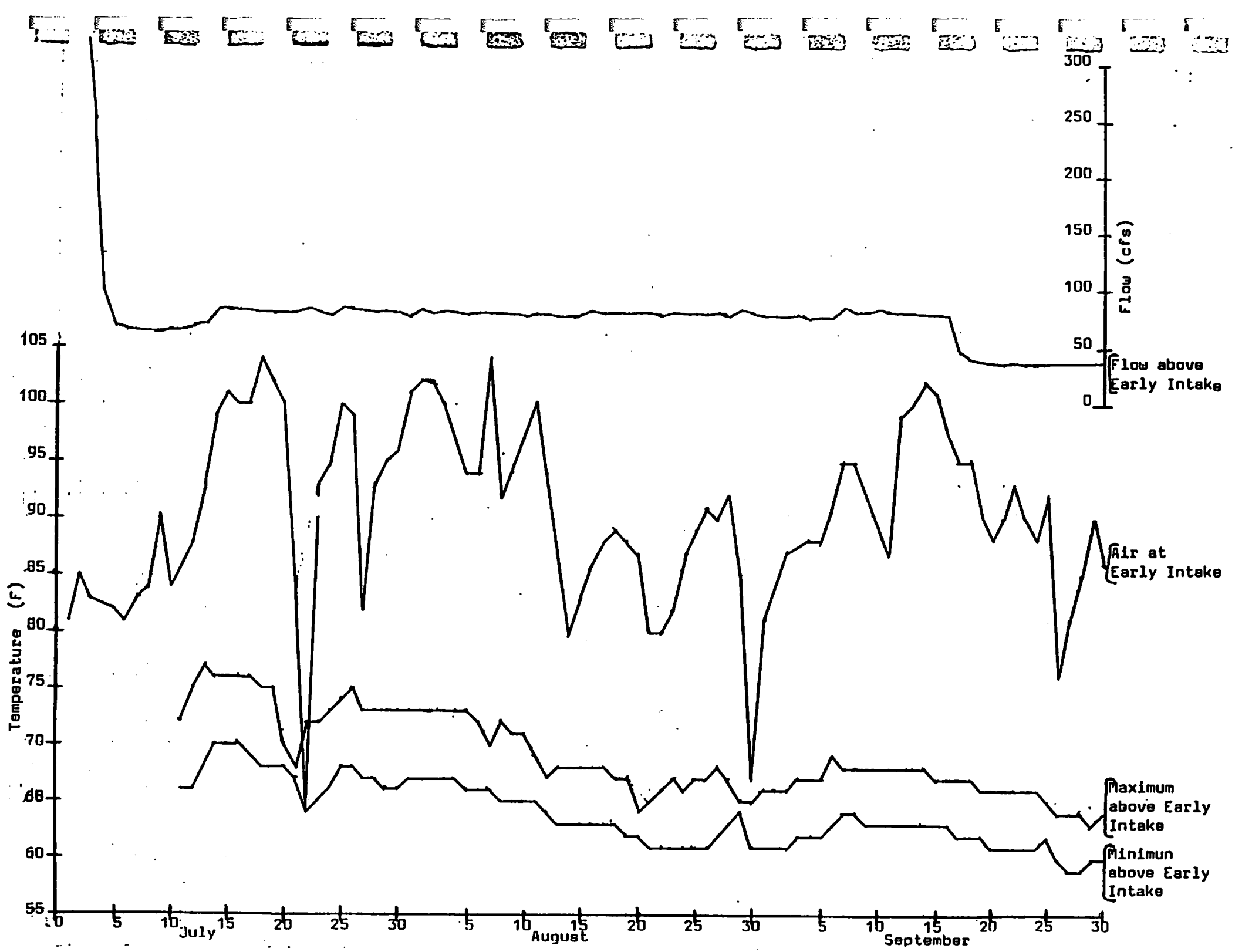


Figure 1. Sketch of Tuolumne River Drainage.
Thermograph locations indicated by ✕.


300
250
200
150
100
50
0
Flow (cfs)
Flow above Early Intake
105
100
95
90
85
80
75
70
65
60
55
Temperature (F)
Air at Early Intake
Maximum above Early Intake
Minimun above Early Intake
July
August
September

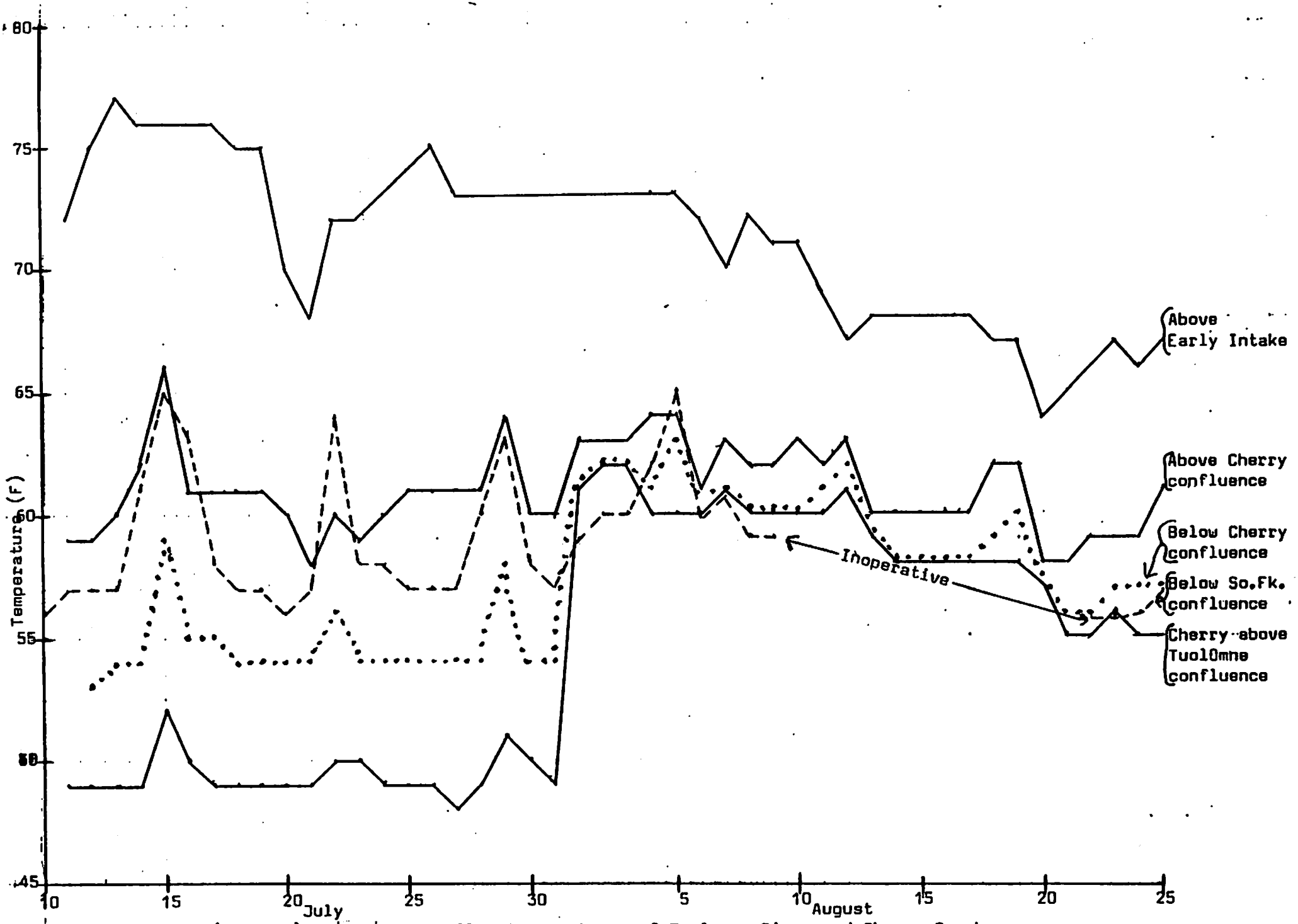


Figure 3. (2 pages) High stream flow temperatures of Tuolumne River and Cherry Creek at [illegible]

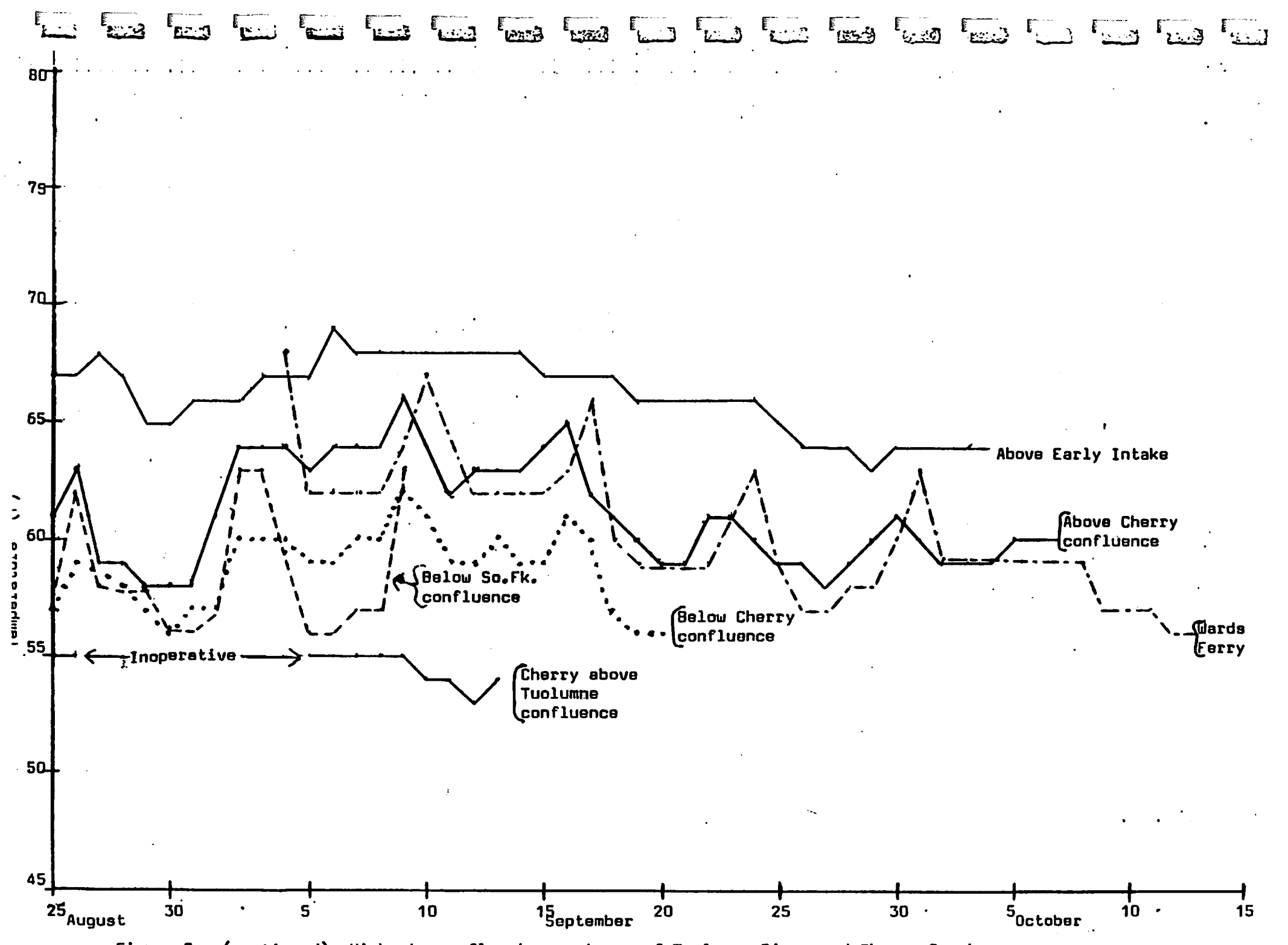


Figure 3. (continued) High stream flow temperatures of Tuolumne River and Cherry Creek at various locations - 1979

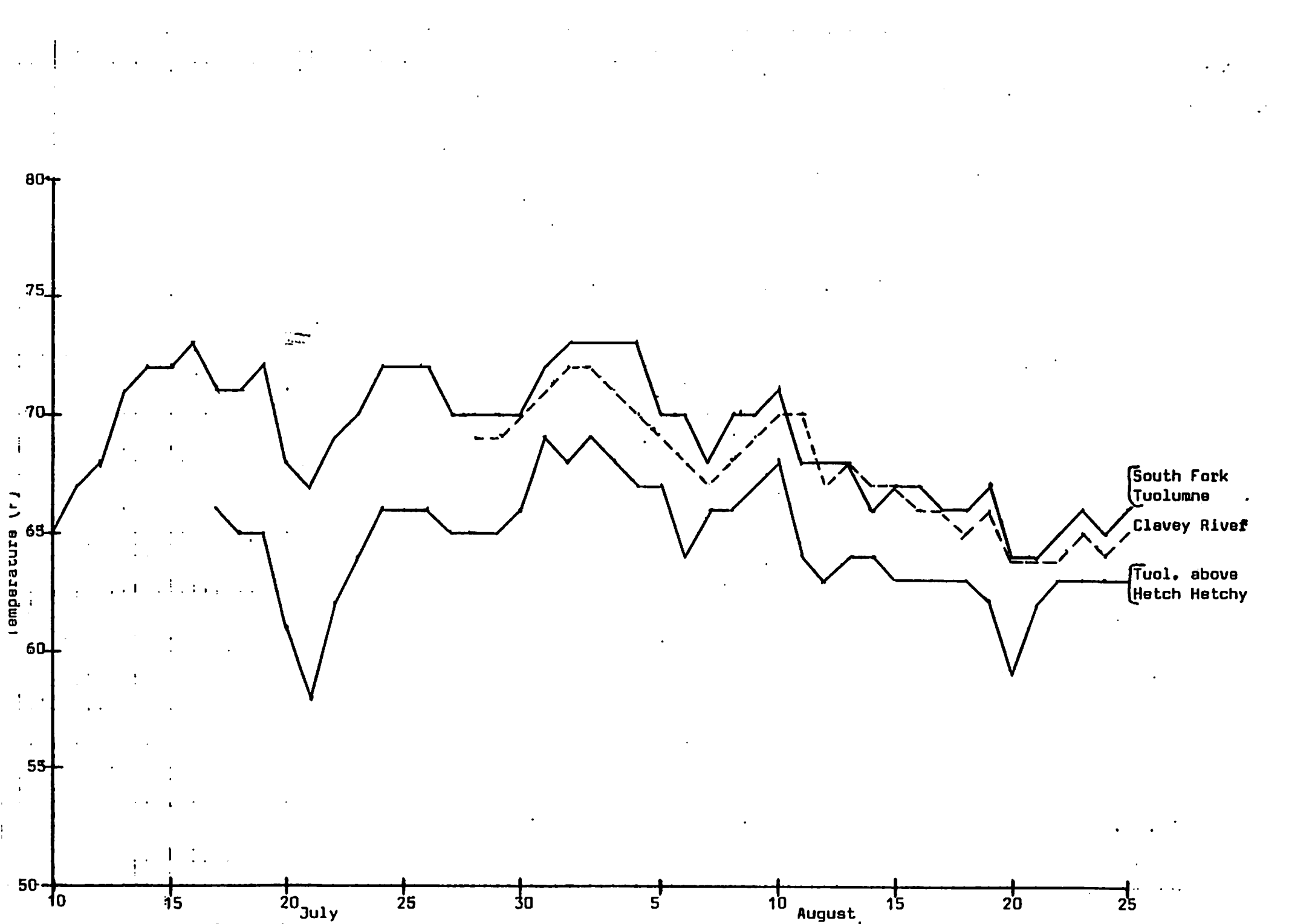


Figure 4. (2pages) High stream flow temperatures of Tuolumne and Clavey Rivers at various locations - 1979.

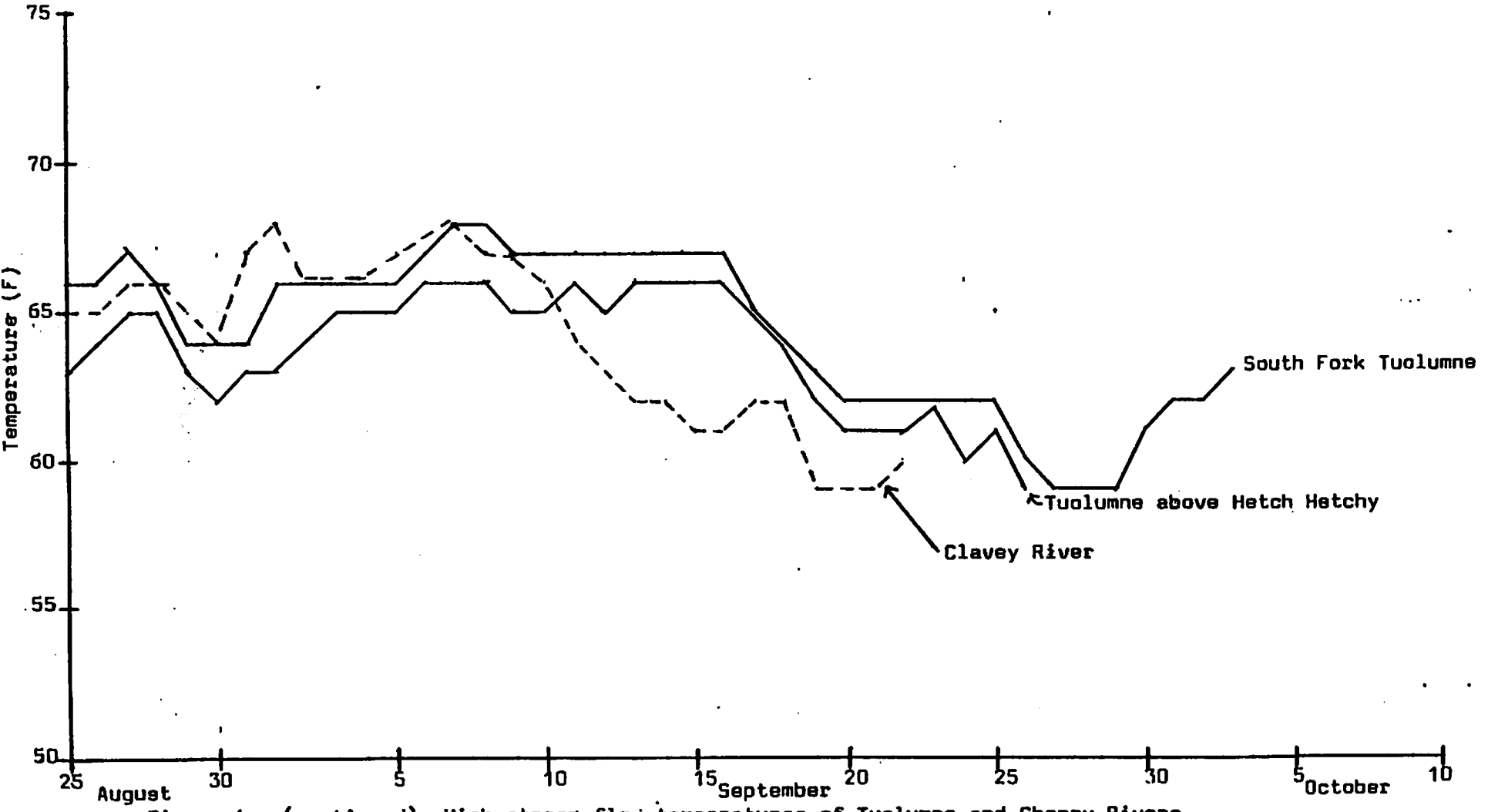


Figure 4. (continued) High stream flow temperatures of Tuolumne and Cherry Rivers at various locations - 1979.

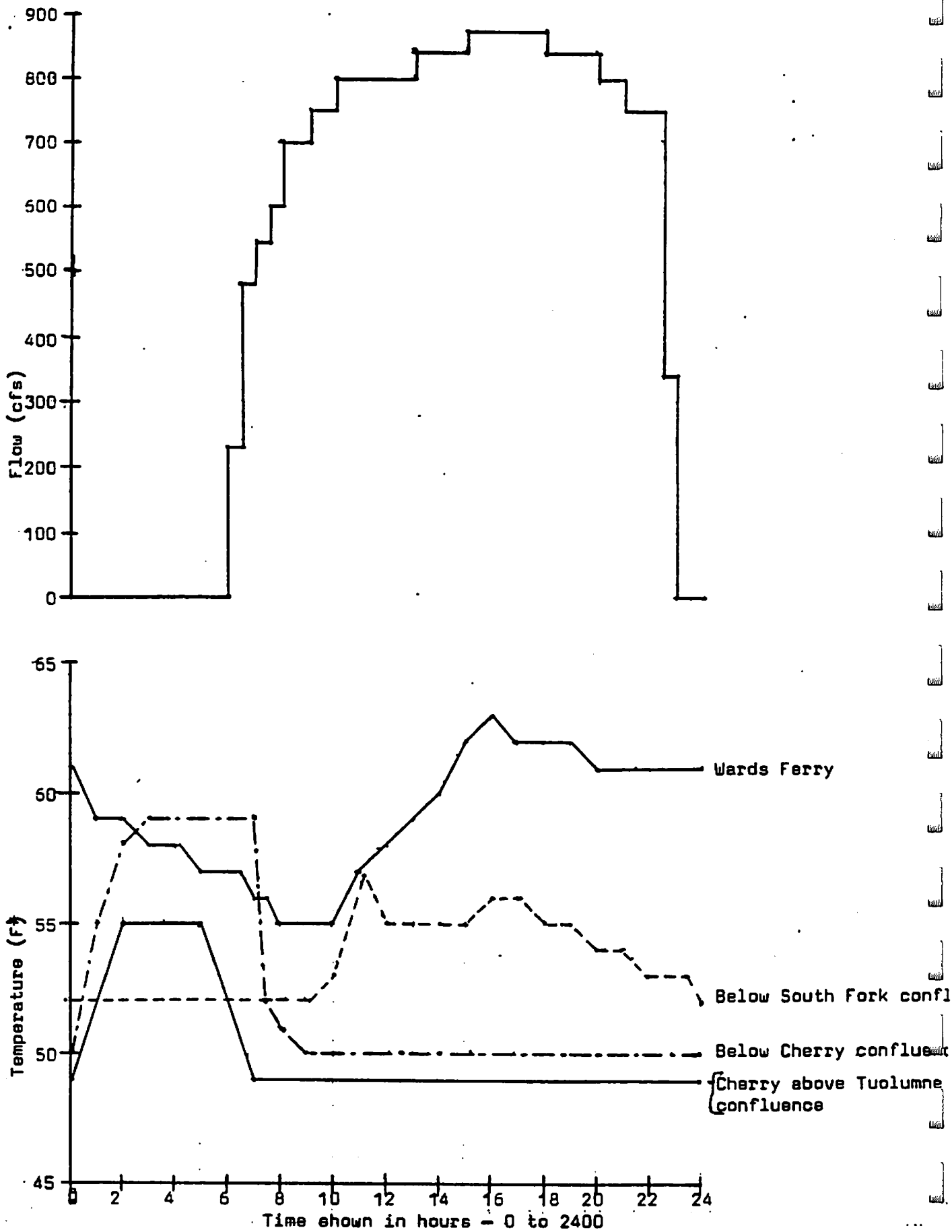


Figure 5. Shows flow releases from Holm Power House on Cherry Creek and their effect on stream temperatures at various locations downstream for each hour during the day, Thursday 9/6/79.

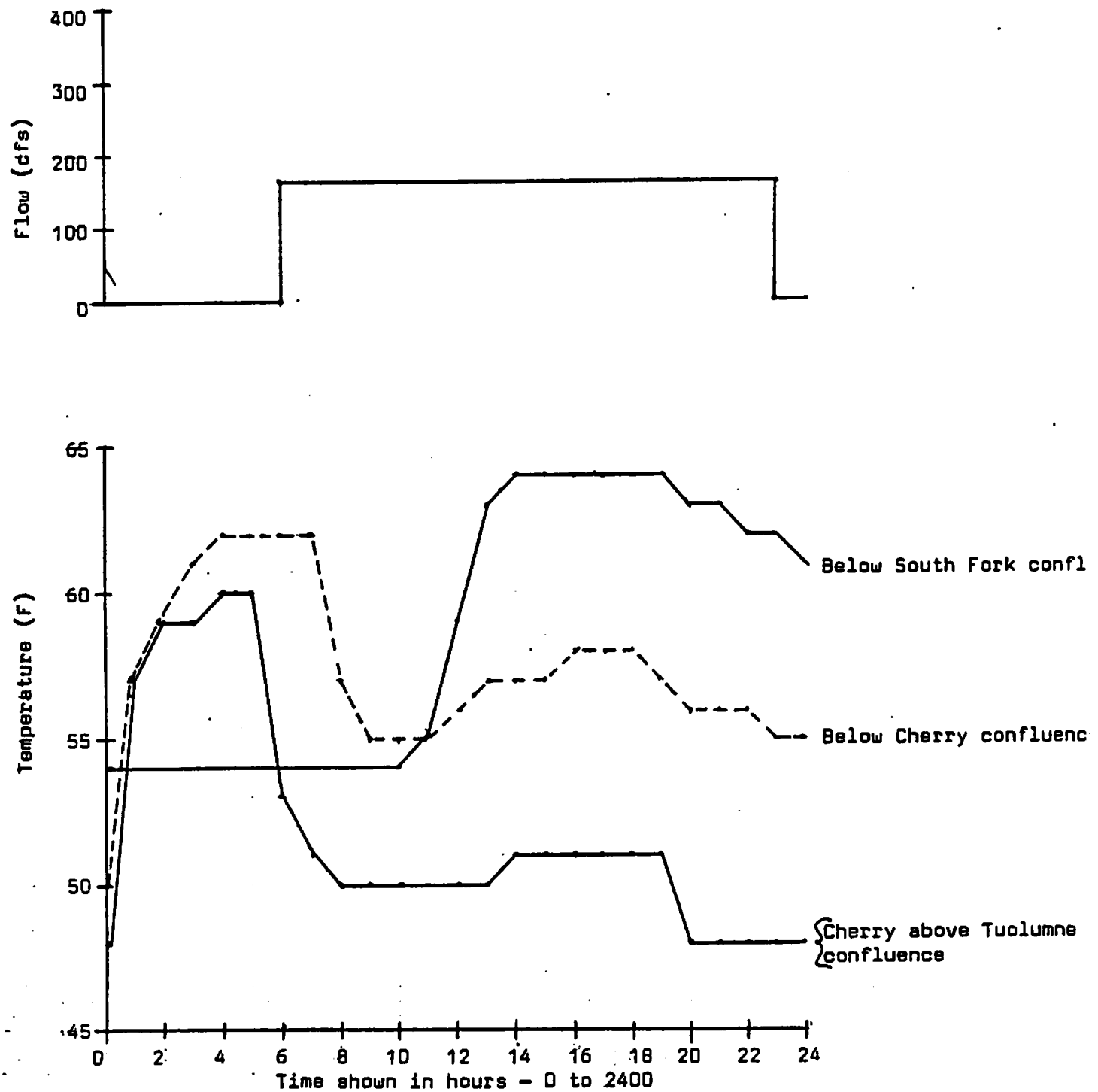


Figure 6. Shows flow releases from Holm Power House on Cherry Creek and their effect on stream temperatures at various locations downstream for each hour during the day, Sunday 8/5/79.

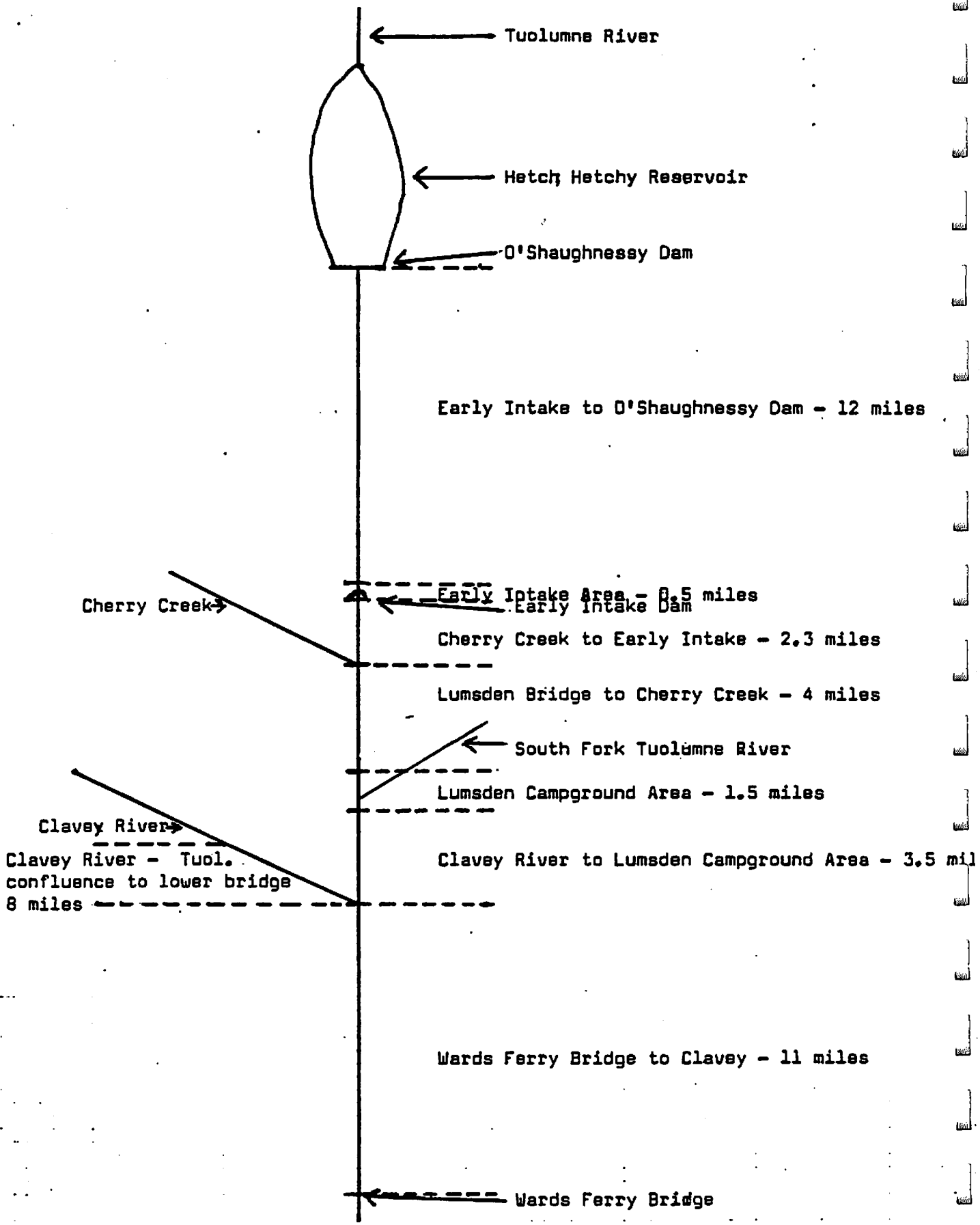


Figure 7. Sketch of Tuolumne River Drainage showing the sections listed in Table 3 in which use count were made.

Location on Tuolumne River	Installed			Dates inoperative	Removed		
	Date	Flow cfs	Temp. (F)		Date	Flow cfs	Temp. (F)
Air at Early Intake	7/10		84		10/7		86
Above Hetch Hetchy	7/17	550*	66		9/27	15*	59
Below O'Shaughnessy Dam	7/17	78	55	Stolen in Oct.			
Above Early Intake	7/10	64	72		10/5	37	64
Below Early Intake	7/10	196	58	8/26 - 9/6	9/8	89	64
Above Cherry confluence	7/11	196	59		10/8	89	60
Cherry above Tuol. confluence	7/11	790	49	8/27 - 9/5	9/13	800	54
Below Cherry confluence	7/11	990	53		9/20	920	56
S.F. Tuol. above Tuol. confluence	7/10	65	65		10/8	12	63
Below S.F. confluence - Lumsden	7/10	580*	56	8/10 - 8/22	9/10	410*	63
Wards Ferry	9/4	300*	68		10/14	300*	56
Clavey - gage at lower bridge	7/28	33	69		9/22	17	60

Table 1. Flow and high water temperature data on dates thermographs were installed and removed and the dates they were inoperative due to malfunction. - 1979

\+ Estimate

Location on Tuolumne River	High temp. (F)	Low temp. (F)	Max. daily flut-tuation (F)	Min. daily fluc-tuation (F)	Average daily fluc-tuation (F)	Average time of day high temp. was recorded	Average time of day low temp. was recorded
Above Hetch Hetchy	69	55	8	1	5	1700 - 1900	0800 - 1000
Below O'Shaughnessy Dam	thermograph stolen						
Above Early Intake	77	59	9	1	5	1700 - 1900	0800 - 0900
Below Early Intake	68	55	9	1	3.5	2200 - 0200	0800 - 1000
Above Cherry confluence	66	55	8	1	3	1600 - 1800	0800 - 1000
Cherry above Tuol. confluence	62	47	15	1	6	0100 - 0600	0700 - 2400
Below Cherry confluence	63	49	14	3	8	0300 - 0700	1000 - 2400
S.F. Tuol. above Tuol. confluence	73	55	9	1	6	1600 - 1800	0800 - 1000
Below S.F. confluence - Lumsden	65	51	11	4	7	1100 - 1700	2400 - 0300
Wards Ferry	68	53	7	2	5	1600 - 1800	0800 - 1000
Clavey - gage at lower bridge	72	50	6	1	3	1800 - 2200	0900 - 1100

Table 2. Temperature data recorded on thermographs during period of operation - 1979. Refer to Table 1.

Stream Sections	Fishermen			Camps			Rafts			Rafters		
	7/11	7/28	9/2	7/11	7/28	9/2	7/11	7/28	9/2	7/11	7/28	9/2
Wards Ferry Bridge to confluence with Clavey	4	6	12	2		3	10	11	6	38	26	16
Clavey River upstream to lower bridge		4	3		3	1						
Confluence Clavey to Lumsden Campground Area	2	4	10					7			24	
Lumsden Campground Area		12	18	9	16	30	5	3		12		
Lumsden Bridge to confluence Cherry Creek		5	4			1						
Cherry Creek to Early Intake Dam												
Early Intake area		2										
Early Intake Reservoir to O'Shaughnessy Dam		2	9		2	5						
Total	6	35	56	11	21	40	15	21	6	50	50	16

Table 3. Use counts made by helecopter *

* 7/11 was a weekday Flight time 0800 - 0930
7/20 was a weekend day Flight time 0750 - 0925
9/2 was a 3 day weekend day Flight time 0750 - 0930
There are three major camp grounds in the Lumsden area averaging 3 or more people per camp.

INFORMATION TO BE OBTAINED FROM FISHERMEN ON TUOLUMNE RIVER

START A FRIENDLY CONVERSATION SHOWING INTEREST IN THE PERSON'S ACTIVITY. EXPLAIN THAT INFORMATION IS BEING GATHERED TO DETERMINE THE STATUS OF THE TUOLUMNE RIVER FISHERY.

****

1. HOW IS FISHING? _____ (GOOD, FAIR, POOR, ETC.)
2. HOW LONG HAVE YOU BEEN FISHING TODAY? _____ (NUMBER OF HOURS)
3. NUMBER OF FISH CAUGHT THIS TRIP _____(Rainbow) _____ (Brown)
4. APPROXIMATE SIZE _____ (INCHES)
5. HOW OFTEN HAVE YOU FISHED THE TUOLUMNE? _____
6. HOW DOES THE TUOLUMNE COMPARE WITH OTHER CALIFORNIA STREAMS YOU HAVE FISHED? _____ (BETTER, SAME, WORSE)
7. DO YOU ENJOY THIS SIZE STREAM? _____ (TOO LARGE, TOO SMALL, ABOUT RIGHT)
8. ADDED COMMENTS _____

   _____

   _____
9. Date _____
   (month) (day) (time)
10. LOCATION ON RIVER _____
11. NUMBER OF FISHERMEN IN PARTY _____
12. NUMBER OF NON-FISHERMEN IN PARTY _____
13. ACTIVITY OF NON-FISHERMEN _____ (HIKING, SWIMMING, CAMPING)
14. APPROXIMATE FLOW OF RIVER IF KNOWN _____ (CFS)

_____
Signature of Interviewer

REVISED 3/79

Table 4. Census form.

Date	No. fishermen	Hours fished	Total hours fished	No. Rainbow	No. Brown	Total fish	Fish caught per hour	Size (inches)	Fishing was			Flow was				First time to fish Tuolumne			Compare w/ other Calif. Streams		
									Good	Fair	poor	Flow cfs**	Too large	Too small	About right	Yes	No	Times fished before	Better	Same	worse
4/28	2	1	2	0	1	1	.5	14.		x		105			x		x	A*		x	
4/28	2	2	4	0	1	1	.25	12		x		105			x		x	A		x	
4/28	1	1	1	0	0	0	0	-			x	105			x	x				x	
4/28	1	1.5	1.5	0	0	0	0	-			x	105			x	x				x	
4/28	2	1	2	0	0	0	0	-			x	105			x	x				x	
4/28	1	1.5	1.5	0	0	0	0	-			x	105			x		x	1		x	
4/28	2	1.5	3	0	0	0	0	-			x	105			x	x	x	1-A		x	
4/28	1	1.5	1.5	2	0	2	1.33	7		x		105			x		x	30		x	
4/28	1	1.5	1.5	0	2	2	1.33	7		x		105			x	x				x	
4/28	2	1.5	3	1	1	2	.67	10 - 11		x		105			x		x	A		x	
4/28	1	1.5	1.5	0	1	1	.67	7		x		105			x	x				x	
4/28	2	1.5	3	1	2	3	1.	10 - 14		x		105			x	x	x	1-A		x	
4/28	3	2	6	4	3	7	1.17	10 - 13	x			105			x		x	A		x	
4/28	2	1.5	3	6	6	12	4.	9 - 12	x			105			x		x	A		x	
4/28	2	2	4	0	4	4	1.	8 - 11	x			105			x		x	A		x	
4/28	2	2	4	8	2	10	2.5	8 - 10	x			105			x		x	A		x	
4/28	1	4	4	10	0	10	2.5	8	x			105			x	x				x	
4/28	2	2	4	3	1	4	1.	9 - 11	x			105			x	x				x	
4/28	2	2	4	1	1	2	.5	8 - 10		x		105			x	x				x	
4/29	3	3	9	0	3	3	.33	10 - 12			x	92			x		x	A		x	
4/29	3	3	9	0	0	0	0	-			x	92		x			x	A		x	
4/29	1	2	2	1	0	1	.5	8		x		92		x		x				x	
4/29	2	3	6	5	4	9	1.5	8 - 10	x			92			x	x	x	1-A		x	
4/29	2	3	6	4	0	4	.67	8 - 9		x		92			x		x	A		x	
4/29	2	2	4	1	0	1	.25	9			x	92			x		x	A		x	
4/29	2	2	4	2	0	2	.5	8		x		92	x			x				x	
4/29	1	2	2	1	0	1	.5	8		x		92			x		x	2		x	
4/29	1	1.5	1.5	0	0	0	0	-			x	92			x	x					x
Total	49	54	98	50	32	82	.84	-	7	12	9	-	1	2	25	14	17	-	0	27	1

Table 5. Census - Tuolumne River - O'Shaughnessy Dam to Early Intake - 1979.
*A - Annually
** - Flows measured above Early Intake.

Date	No. fishermen	Hours fished	Total hours fished	No. Rainbow	No. Brown	Total fish	Fish caught per hour	Size (inches)	Fishing was			Flow was				First time to fish Tuolumne			Compare w/ other Calif. Streams		
									Good	Fair	Poor	Flow cfs **	Too large	Too small	About right	Yes	No	Times fished before	Better	Same	Worse
7/10	4	2	8	7	0	7	.87	10 - 14	x			580			x		x	7	x		
7/10	3	2	6	2	1	3	.5	10 - 14	x			580			x		x	10	x		
7/10	3	2	6	1	0	1	.17	14	x			580			x	x			x		
7/10	3	1	3	0	0	0	0	-			x	580			x	x				x	
7/21	4	2	8	4	0	4	.5	8 - 10			x	460	x				x	2		x	
7/21	2	2	4	3	0	3	.75	8 - 13	x			460				x	x	16	x		
7/21	4	2	8	1	0	1	.13	9			x	460			x	x				x	
7/21	3	2	6	0	0	0	0	-			x	460			x		x	2		x	
7/21	2	.5	1	2	0	2	2.	11	x			460			x		x	7	x		
7/21	2	2	4	1	0	1	.25	15	x			460			x		x	A*		x	
7/21	2	1	2	0	0	0	0	-			x	460	x			x				x	
7/21	3	2	6	0	0	0	0	-			x	460	x			x				x	
7/21	2	2	4	0	0	0	0	-			x	460	x			x					x
7/21	2	2	4	0	0	0	0	-			x	460	x			x					x
7/28	2	5	10	0	0	0	0	-			x	600		x		x					x
7/28	0	0	0	0	0	0	0	-				600			x						
7/28	2	0	0	0	0	0	0	-				600			x		x	A	x		
7/28	2	5	10	3	0	3	.3	9 - 15	x			600			x	x				x	
7/28	2	4	8	0	0	0	0	-			x	600		x			x	A	x		
7/28	3	3	9	2	0	2	.22	8		x		600			x	x				x	
7/28	6	3	18	2	0	2	.11	9			x	600			x	x					x
7/28	0	0	0	0	0	0	0	-			x	600			x					x	
7/28	2	2	4	1	1	2	.5	15 - 20	x			600			x	x				x	
7/28	2	1	2	0	0	0	0	-			x	600	x			x					x
7/28	1	1	1	2	0	2	2.	9		x		600			x	x				x	
7/28	1	2	2	0	0	0	0	-			x	600			x		x	20		x	

Table 6. (2 pages) Census - Tuolumne River - Lumsden area - 1979.

Date	No. fisherman	Hours fished	Total hours fished	No. Rainbow	No. Brown	Total fish	Fish caught per hour	Size (inches)	Fishing was			Flow was				First time to fish Tuolumne			Compare w/ other Calif. Streams		
									Good	Fair	Poor	Flow cfs	Too large	Too small	About right	Yes	No	Times fished before	Better	Same	Worse
9/1	4	3	12	8	0	8	.67	8 - 14	x			700			x		x	A		x	
9/1	2	2	4	4	0	4	1.	8 - 12	x			700	x				x	A	x		
9/1	2	0	0	0	0	0	0	-				700	x				x	A		x	
9/1	1	3	3	1	0	1	.33	7			x	700	x				x	7		x	
9/1	2	3	6	3	0	3	.5	7 - 8		x		700	x				x	7		x	
9/1	0	0	0	0	0	0	0	-				700			x					x	
9/1	2	3	6	0	0	0	0	-			x	700			x		x	1		x	
9/1	3	4	12	2	1	3	.25	8		x		700			x		x	2	x		
9/1	2	.5	1	0	0	0	0	-			x	700	x			x					x
9/1***	5	4	20	2	0	2	.1	10			x	700	x				x	A		x	
9/2	2	4	8	0	0	0	0	-			x	300	x				x	A		x	
9/2	2	2	4	0	0	0	0	-			x	300	x				x	A		x	
9/2	2	4	8	2	0	2	.25	8			x	300	x			x					x
9/2	4	2	8	0	0	0	0	-			x	300	x				x	7		x	
9/2	2	2	4	0	0	0	0	-			x	300	x			x					x
9/2	2	5	10	1	0	1	.1	12			x	300			x		x	A		x	
9/2	4	2	8	0	0	0	0	-			x	300	x			x					x
9/2	4	2	8	0	0	0	0	-			x	300	x			x					x
9/2	1	2	2	0	0	0	0	-			x	300	x			x					x
Total	108	98	258	54	3	57	.22	-	10	4	27		20	2	23	20	22		9	24	11

Table 6. (continued) Census - Tuolumne River - Lumsden Area - 1979.

*A - Annually

++ - Flows estimated below confluence with South Fork Tuolumne.

*** - Fished 3 miles below Lumsden camp ground - no road in this area.

Date	No. fishermen	Hours fished	Total hours fished	No. Rainbow	No. Brown	Total fish	Fish caught per hour	Day of week	Fishing was			Flow was				First time to fish Tuolumne			Compare w/ other Calif. Streams		
									Good	Fair	Poor	Flow cfs	Too large	Too small	About right	Yes	No	Times fished before	Better	Same	Worse
4/28	32	32.5	54.5	36	25	61	1.12	Sat.	6	8	5	105	0	0	19	10	11		0	19	0
4/29	17	21.5	43.5	14	7	21	.48	Sun.	1	4	4	92	1	2	6	4	6		0	8	1
Total	49	54	98	50	32	82	.84		7	12	9		1	2	25	14	17		0	27	1

Table 7. Summary of census by days and flow - Tuolumne River - O'Shaughnessy Dam to Early Intake on the opening weekend of trout season - 1979.

Date	No. fishermen	Hours fished	Total hours fished	No. Rainbow	No. Brown	Total fish	Fish caught per hour	Day of week	Fishing was			Flow was				First time to fish Tuolumne			Compare w/ other Calif. Streams		
									Good	Fair	Poor	Flow cfs	Too large	Too small	About right	Yes	No	Times fished before	Better	Same	Worse
7/10	13	7	23	10	1	11	.48	Tues.	3	0	1	640	0	0	4	2	2		3	1	0
7/21	26	17.5	47	11	0	11	.23	Sat.	3	0	7	460	5	0	5	5	5		2	6	2
7/28	23	26	64	10	1	11	.17	Sat.	2	2	6	600	1	2	9	7	3		2	6	3
9/1	23	22.5	64	20	1	21	.33	Sat.	2	2	4	700	6	0	4	1	8		2	7	1
9/2	23	25	60	3	0	3	.05	Sun.	0	0	9	300	8	0	1	5	4		0	4	5
Total	108	98	258	54	3	57	.22		10	4	27		20	2	23	20	22		9	24	11

Table 8. Summary of census by days and flow - Tuolumne River in the Lumsden area - 1979.
September 1 and 2 was a 3 day weekend.

APPENDIX N

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
Stanislaus National Forest
175 South Fairview Lane
Sonora, California 95370

REPLY TO: 2350 Administration - Studies

November 7, 1972

SUBJECT: Canyon Power Project (Tuolumne River Flow Study)

TO: Mr. James D. Carson, Acting Field Supervisor
Bureau of Sport Fisheries and Wildlife
River Basin Studies
2800 Cottage Way, Room E2727
Sacramento, California 95838

Dear Mr. Carson:

Now that we have completed our assigned portions of the Tuolumne Flow Study, notably studies of recreation use and aesthetics, the Forest Service offers the following flow schedule recommendation:

January 1 - May 15	75 CFS
May 15 - September 15	150 CFS
September 15 - December 31	75 CFS

Since inception of the Canyon Power Project and the Tuolumne Flow Study, Congress enacted Public Law 90-542 (Wild and Scenic Rivers Act). The Tuolumne, although not included in the Act of October 2, 1968, has subsequently been declared a river to be studied for possible inclusion at some future time. Bearing this fact in mind, our recommendations with respect to recreation development will be to limit improvement to that necessary for "primitive" camping with access to Prestion Flat by foot or horseback only.

Horseback use will only be allowed on a day-use basis and no overnight stay for animals will be allowed. If daily use of stock conflicts with backpacking or forage begins to suffer, horseback use will be eliminated. No commercial packing will be allowed in the area.

The existing trail will remain and be maintained from Early Intake to Preston Flat. Construction is needed to improve the primitive path from Preston Flat to Camp Mather (a distance of four miles). Sanitation facilities are needed at Little Preston and Big Preston Flats as well as at the more popular swimming and fishing holes.

Overcrowding is not expected to be a problem for many years except on summer holidays. Winter recreation is practically non-existent. It is recommended that yearlong fishing be continued unless future fisheries studies indicate a decline in native populations. It is

our desire to avoid deterioration of the fishery to a point where a stocking program is necessary. Our management direction suggests trying for a self-sustaining fishery habitat on a wild and scenic river.

Our suggested flow schedule presented earlier was based on visual observations and photo comparisons made during flows ranging from 35 CFS to 1600 CFS. The rugged nature of the river and the possibility of its being classified as a Wild Scenic or Recreation River has influenced us to recommend slightly beyond what our original report on aesthetic recreation indicated. All possible measures should be taken to prevent winter flows exceeding 700 CFS. Flows of this magnitude overflow banks, scour spawning areas, and accelerate erosion. Since high flows restrict camping and fishing experiences, summer releases between May 20 and August 31 should not exceed 350 CFS at any time.

An estimated annual increase in visitor days of 8 percent per year is expected over the next twenty years. A major factor affecting the increase is the anticipated desirable conditions created by higher summer flows. Yearlong fishing which is now in its second season and gaining in popularity is also a factor. Our tabulated use projections are as follows:

Year	Actual Use	Estimated Use
	(In Daily Visits)	
1970	702	
1975		1,032
1980		1,516
1990		3,274

We hope the preceding information and attached reports will be beneficial to you in preparation of a joint agency recommendation statement. We are most appreciative for the excellent cooperation we have received during the flow study from all participating agencies.

If we can be of further service to you by clarifying questions you may have or by supplying additional copies of our report, please do not hesitate to contact us.

Sincerely,

W. J. FREDEKING
Deputy Forest Supervisor

Enclosures

APPENDIX O

United States Department of the Interior
NATIONAL PARK SERVICE
P.O. Box 577
Yosemite National Park, California 95389

IN REPLY REFER TO:
L7423
XC38

March 10, 1972

Mr. Norman R. Chupp, Field Supervisor
Bureau of Sport Fisheries and Wildlife
Division of River Basin Studies
2800 Cottage Way, Room E-2727
Sacramento, California 95825

Attention: Mr. Jodie Hoffman

Dear Mr. Chupp:

We feel Mr. Hoffman deserves encouragement on the effort and progress he has expended to date. After considering the Tuolumne River Study preliminary draft we would offer the following recommendations.

In lieu of the 1967 pre-existing flows, our suggestions are predicated on a reasonable maintenance of historic runoff patterns, realizing the dire requirements of the City and County of San Francisco and their commitments to downstream irrigation districts. Beyond aesthetic values, in this case the National Park Service is involved in salvaging an approximation of a dynamic natural feature, which was all but eradicated by construction of the Hetch Hetchy impoundment and Canyon Tunnel diversion. We are intent on securing flows that not only partially restore the existing fishery, recreational opportunity and scenic value, but will qualitatively duplicate the historical natural flow profiles of the pre-Hetch Hetchy regimes. In order to defend and practically maintain a viable river environment, the below recommendations constitute our sole recourse.

1. We suggest that the normal and wet year absolute minimum flow be established at 200 c.f.s. from May 1 to June 30, 150 c.f.s. from July 1 to September 30, and 75 c.f.s. from October 1, to April 30.

2. During unusually dry years when the April - July forecast runoff is 300,000 acre feet or less, we suggest the absolute minimum flow be established at 150 c.f.s. from May 1 to September 15, and 75 c.f.s. from September 16 to April 30.

Visitor use and safety is recognized as a management consideration, but it should not preempt or adversely influence the Park's limited aquatic restoration objectives.

We wholeheartedly endorse the regulatory provision as drafted, for changes in water release magnitude into the Tuolumne River from O'Shaughnessey Dam. We recommend that the City and County of San Francisco be advised to submit a monthly record of 24 hour flow regime to Yosemite National Park, Attention: Resources Management Division.

The incomplete O'Shaughnessey Dam hydroelectric plant specifications are for a 1200KW unit with a penstock operating range extending from 35 to 75 c.f.s. Planned power utilization should be restricted to the local domestic requirements of the Hetch Hetchy area.

The pending construction status is due to the excessive over-bids received during January - March 1966 and the Departmental outcome of the current Tuolumne River Fishery-Recreation-Aesthetic Study. We see no possibility of flow regime interference, providing Departmental negotiations consider the above minimum flow recommendations. Should further amended right-of-way applications be filed by San Francisco for an enlarged generator in the future, the present study criteria should be applied to the stipulations.

We trust our candid comments will support this joint undertaking successfully.

Sincerely yours,

ACTING
Superintendent

APPENDIX P

CITY AND COUNTY OF SAN FRANCISCO
PUBLIC UTILITIES COMMISSION

HETCH HETCHY WATER SUPPLY
POWER AND UTILITIES ENGINEERING BUREAU

425 MASON STREET
SAN FRANCISCO 1
PHONE PROSPECT 5-7000

December 30, 1953

Subject: Hetch Hetchy Water Supply
Application to the U. S. Department of the Interior for Amended Location of Tunnel Aqueduct, Steel Penstocks and Power Plant, Canyon Power Project, located in Sections 16, 17, 22 and 19, T. 1 N., R. 20 E., Sections 23, 24, 26 and 27, T. 1 N., R. 19 E., M.D.B.&M., within Yosemite National Park, California; and Sections 28, 31, 32 and 33, T. 1 N., R. 19 E., Section 6, T. 1 S., R. 19 E., Sections 35 and 36, T. 1 N., R. 18 E., Sections 1, 2, 11 and 12, T. 1 S., R. 18 E., M.D.B.& M., within Stanislaus National Forest, California.
Your File Designation:
U
USES-STANISLAUS
City and County of San Francisco
Hetch Hetchy Project - Acct. 0101.90

Mr. Charles A. Connaughton
Regional Forester
U. S. Department of Agriculture
Forest Service
California Region
630 Sansome Street
San Francisco 11, California

Attention: Mr. M. H. Barnum

Dear Sir:

Please refer to your letter to me, above subject, dated December 5, 1953 with which you submitted stipulations for review by this office for water releases from Hetch Hetchy Reservoir in connection with subject application, said releases being used for fish life and recreation.

The Canyon Power Project consists of the following structures, the rights of way for which were granted to the City by an act of Congress known as the Raker Act, approved December 19, 1913:

O'Shaughnessy Dam, capacity 360,000 acre-feet, Application Sacramento Serial No. 07186, approved by the Secretary of the Interior on June 9, 1914;

[illegible] aqueduct tunnel for the proposed Canyon Power Project [illegible] the canyon. It is estimated that this change in the location of the tunnel will result in a saving in construction costs of approximately $1,400,000.

In your letter to me, above subject, dated December 31, 1958, you mention the Fish and Wildlife Coordination Act of March 10, 1934 and the amendments thereto under Public Law 85-624 enacted by the 85th Congress on August 12, 1958. It is our position that the Canyon Power Project does not come under the scope of said Act because (1) said project was authorized by a specific Act of Congress known as the Baker Act, above referred to, and (2) the water rights for the project were obtained under the laws of the State of California and (3) the Canyon Power Project was approved by the Secretary of the Interior before the date of enactment of said Fish and Wildlife Coordination Act and (4) a major portion of the construction of the Canyon Power Project has already been completed as previously stated.

However, since the Fish and Wildlife Coordination Act has been referred to by your office as governing subject application, I believe it appropriate at this time to make the following quotations from the Congressional records concerning the Act.

The following is quoted from Report No. 2183 of House of Representatives Committee on Merchant Marine and Fisheries:

> "The purpose of the bill is to grant authority to construction agencies like the Bureau of Reclamation and the Corps of Engineers to cooperate with Fish and Wildlife Service in planning and constructing, as a part of Federal water-development projects, facilities necessary to protect fish and wildlife values. Construction of projects of the nature of Grand Coulee Dam and Bonneville Dam require considerable study and, in some cases, slight modification, to insure against the loss of a valuable fish or wildlife resource, in that case, the salmon.
>
> At present, there is no requirement that Fish and Wildlife Service be consulted, with the result that it has the [illegible] to secure information as to [illegible] an adverse effect on fish and wildlife values.

water (700 second-feet) required for the operation of the proposed Canyon Power Project. These rights were acquired by appropriations made by the City and County of San Francisco during the period 1901 to 1911 under the provisions of the laws of the State of California and are not encumbered by water release requirements for [illegible]. The City has complied with all of the provisions of said laws which do not include any requirements for the release of water for the development and enhancement of fish life.

It is the intention of the Early Act to protect the waters of the Tuolumne River between O'Shaughnessy Dam and Early Intake from pollution as long as said waters are used for domestic purposes. A portion of the waters released from O'Shaughnessy Dam as well as the waters discharged from the proposed Canyon Power Plant will always be impounded by Early Intake Reservoir and conveyed to the City and County of San Francisco for domestic use through the Mountain Division Aqueduct Tunnel. When the Hetch Hetchy Project reaches the stage of ultimate development all of the water passing through the Canyon Power Plant will be conveyed to San Francisco for domestic use. The use of the Tuolumne River watershed between O'Shaughnessy Dam and Early Intake for purposes of recreation, including fishing, conflicts with the intent of said Congressional Act.

As stated above, it is to be noted that the City already possesses an application approved by the Secretary of the Interior for the construction of the aqueduct tunnel on the south side of the Tuolumne River canyon. This approved application contains no stipulations for the release of waters from Hetch Hetchy Reservoir to develop and improve fish life in the Tuolumne River. The subject amended application, has been filed only for the purpose of obtaining an approval from the Secretary of the Interior to shift the location of the tunnel aqueduct from the south side to the north side of the canyon in order to effect a substantial saving in construction costs. Recent engineering studies have shown that it would be more

for the prevention of losses to fish and wildlife should be included to the extent justifiable in authorized projects."....

..... "The legislation would be a permissive law so far as it concerns relationship between water project construction agencies and fish and wildlife conservation agencies. The latter would not be given any veto power over any part of the water resource development program."....

From the foregoing quotation it would seem that the Fish and Wildlife Coordination Act intends to include fish and wildlife conservation features in a Federal water project only if they are compatible with the major purposes of the project and that said conservation features shall be included only to the extent justified. The quotation also indicates that the Act intends to be of a permissive nature and does not intend to convey veto power to fish and wildlife conservation agencies over any part of a water resource development project.

Reference is made to your copy of my letter, above subject, to Mr. Lawrence C. Merriam, Regional Director, Region 4, National Park Service, dated November 28, 1958. Attached to said copy was a tabulation showing the relation between the suggested fish releases and the natural flow of the Tuolumne River at O'Shaughnessy Dam for the period 1918 to 1957 inclusive. I have revised this chart to conform to the fish releases suggested in your letter to me, above subject, dated December 5, 1958 and am enclosing herewith copy of revised chart. The areas shown in red on the chart indicate the amounts of water by which the suggested fish releases exceed the natural flow of the Tuolumne River. It will, therefore, be necessary in order to obtain the suggested fish releases that space in Hetch Hetchy Reservoir be allocated for the storage necessary to accumulate the waters required for said releases. This will result in a considerable decrease in the amount of water available each year for the primary purposes of the project. It is our understanding that no reimbursement to the City by State or Federal fish and wildlife agencies will be made for the use of said storage space in Hetch Hetchy Reservoir required

by those conducted by the Service [illegible] project on fish and wildlife values require time. Adverse necessary to minimize the impact of such a project may entail changes in the overall plans. In the past, suggested changes with changes may have been made too late to permit of alterna- tion with resultant adverse effects on fish and wildlife. Under this bill, Fish and Wildlife Service must be consulted and its plan, whether accepted or rejected by the construct- ing agency, must be submitted to the Congress for its con- sideration as a part of the authorizing legislation for each project." ....

From this quotation it appears that the Fish and Wildlife Coordination Act is primarily intended to cover Federal water development projects in the plan- ning stage before approval by the Congress of the United States. *not true*

The following is quoted from Report No. 1981 of the Senate Committee on Interstate and Foreign Commerce:

"[This] amendment to the Coordination Act would grant authority to the agencies of Government engaged in construc- tion to consult with the Fish and Wildlife Service before and during the building of Federal water development projects.

"The Fish and Wildlife Service would make known to these construction agencies, such as the Corps of Engineers and the Bureau of Reclamation, the project necessary to protect fish and wildlife. Considerable study would be required in some cases, with suggested changes in construction plans to the great advantage to our wildlife resource. Under the bill suggestions regarding changes could be made previous to the commencement of construction. Such plans, or recommendations, whether accepted or rejected by the construction agency, would be submitted to the Congress at the time authorization legis- lation for the project was under consideration." ....

..... "H. R. 13128, as reported, is intended to provide more adequately for the conservation and preservation of fish and wildlife without unduly restricting needed development of our water resources to meet man's various requirements." ....

..... "The bill provides for the inclusion of fish and wildlife conservation features in these authorized projects so long as they are 'compatible with the purposes for which the pro- ject was authorized.' It is understood that some benefits from authorized project purposes may have to be diminished in some slight degree in order to obtain benefits from fish and wildlife conservation measures adopted to compensate for losses to these resources or to enhance and develop fish and wildlife.

A copy of the tabulation prepared in this study is enclosed.

Following is a description of the method of calculation used according to columns in the tabulation:

Column 1: Actual Releases from Hetch Hetchy Reservoir on a daily basis from 1938 to 1957, inclusive.

Column 2: Requested Fish Release (As described above)

Column 3: Flow in the Tuolumne River immediately below O'Shaughnessy Dam (Includes requested fish release).

Column 4: Flow through Canyon Powerhouse (After allowance for requested fish release is made)

Column 5: Reduction in flow through Canyon Powerhouse due to Requested Fish Release

Monthly totals of the power loss for each month based on second feet-days are obtained by totaling the amounts in Column 5. One cubic foot per second based on an average net head of 1175 feet at the Canyon Powerhouse and using an overall plant and transformer efficiency of 86% will generate 2055 KWH per day. Multiplying this figure by the total second feet-days of power loss in a month produces the net power loss for the month in KWH. Applying a current market value of $0.0064 per KWH produces the net cash value of the power lost for the month.

Operating the Canyon Power Project under the above conditions during the twenty-year period, 1938 to 1957, inclusive, would have resulted in a loss of power revenue to the City in the amount of $2,186,000 or an average of $109,300 per annum. Capitalizing the above loss in power revenue at 5% for 100 yrs yields a ~~[illegible]~~ (worth) ~~outlay~~ of ~~$[illegible],300~~. $3,454,000 – [illegible]

I have previously pointed out in this letter that the proposed change in the location of the aqueduct tunnel serving the proposed Canyon Powerhouse on the south side of the Tuolumne River canyon to the north side of the canyon would result in a saving in construction costs of approximately $1,400,000. It is

water for the suggested fish releases. I therefore feel that the City [illegible] to provide a flow in the Tuolumne River below O'Shaughnessy Dam in excess of the amount that would have flowed in the river under natural conditions.

The City has now completed a detailed study of the operation of the proposed Tuolumne River Project conforming to the requirements of the water releases for fish life suggested in your letter of December 5, 1958. For the purpose of this study the actual releases from Hetch Hetchy Reservoir for the period 1938-1955 inclusive were used since O'Shaughnessy Dam was raised to its present height in 1937 with a storage capacity of 340,000 acre-feet. Addition of drum gates to the spillway in 1949 increased the storage capacity to 360,000 acre-feet.

The amount of reduction in the City's planned power output of the Cherry Powerhouse was computed on a daily basis using the actual releases from Hetch Hetchy Reservoir during the above period and allowing for your suggested minimum releases for fish life. A summary of said suggested minimum releases follows:

Normal year (All years when State Department of Water Resources April 1 forecast on April 1 - July 31 runoff at Hetch Hetchy Reservoir exceeds 380,000 acre-feet)	
April 1 to End of spill period (For all years when Hetch Hetchy Reservoir fills and spills)	100 c.f.s.
End of spill period to November 30	100 c.f.s.
December 1 to March 31	50 c.f.s.
Dry year (All years when State Department of Water Resources April 1 forecast of April 1 - July 31 runoff at Hetch Hetchy Reservoir is 390,000 acre-feet or less)	
April 1 to Date of storage peak (For all years when Hetch Hetchy Reservoir does not spill)	50 c.f.s.
Date of storage peak to November 30:	
If storage peak is between 355,000 and 360,000 acre-feet	100 c.f.s.
" " " " 345,000 and 355,000 " "	90 c.f.s.
" " " " 335,000 and 345,000 " "	80 c.f.s.
" " " " 325,000 and 335,000 " "	70 c.f.s.
" " " " 315,000 and 325,000 " "	60 c.f.s.
" " " " 315,000 or less	50 c.f.s.
December 1 - March 31	One-half the above values

Cherry River Project within Stanislaus National Forest. Said amended applications included a tunnel diversion located in Stanislaus National Forest [illegible] National Park connecting Cherry and Lake Eleanor Reservoirs.

The following is quoted from the stipulations accompanying the foregoing applications:

> "g. There shall be discharged into the stream channel of Eleanor Creek a continuous flow of water of not less than 5 cubic feet per second during the period October 1 to June 30 and of not less than 15-1/2 cubic feet per second during the period July 1 to September 30 of each year, or such lesser amount as may be designated by the Superintendent, Yosemite National Park, all to be measured at an existing gauging station on the right bank of the stream 0.6 miles downstream from Eleanor Dam and 1.1 miles upstream from the mouth of Eleanor Creek."

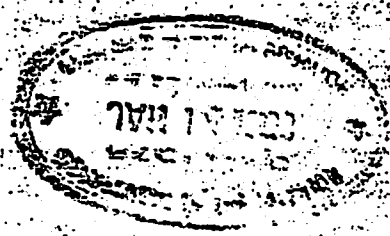
We believe that high releases and in excess of those quoted in the foregoing suggested stipulations would be compatible with the purposes for which the Cherry River Project was designed.

Very truly yours,

H. E. LLOYD
Manager and Chief Engineer

Enc.

cc: Mr. Lawrence Merriam
Regional Director
Region 4
National Park Service
U. S. Department of the Interior
180 New Montgomery Street
San Francisco 5, California



therefore obvious that if the aqueduct tunnel were located on the north side of the river that the reduction of power benefits caused by the suggested fish releases on a capitalized basis would exceed by $2,245,000 the estimated additional cost of constructing the aqueduct tunnel on the south side of the river under an application already approved by the Secretary of the Interior, which application includes no stipulation for fish releases.

From the foregoing detailed study we conclude that the operation of the Cherry Power Project in accordance with the fish releases suggested by your office is not justifiable. It is our position that the suggested fish releases would unduly restrict the needed power development of the Tuolumne River watershed to meet the ever-increasing demands of the people of the State of California.

On February 26, 1951 the Secretary of the Interior approved Application Sacramento Serial No. 042211 amending the location of Cherry Valley Reservoir within the boundaries of Stanislaus National Forest.

The following is quoted from the stipulations accompanying said approval:

> "3. For the protection and maintenance of fish, wild life and recreation in the Cherry River below the Dam, there shall be discharged into the stream channel a continuous flow of water of not less than 5 cubic feet per second during the period October 1 to June 30 and of not less than 15 cubic feet per second during the period July 1 to September 30 of each year, or such lesser minimum amounts as may be designated by the Regional Forester, all as measured at a gauging station to be located on the Cherry River approximately 4500 feet downstream from the Cherry Valley Dam."

On April 27, 1956 the Bureau of Land Management of the U. S. Department of the Interior approved amended Application Nos. 013246 and 013247 amending the location of tunnel aqueduct, steel penstock and power plant sites of the

APPENDIX Q

DION R. HOLM, City Attorney
THOMAS M. O'CONNOR
Public Utilities Counsel
McMORRIS M. DOW
Deputy City Attorney

206 City Hall
San Francisco 2, California
HEmlock 1-1322

UNITED STATES DEPARTMENT OF THE INTERIOR

DIRECTOR OF THE BUREAU OF LAND MANAGEMENT

In re

CITY AND COUNTY OF SAN FRANCISCO, a municipal corporation,

Petitioner.

Sacramento Serial No. 0 1 0 1 3 0

PETITIONER'S REPLY BRIEF

This brief is filed in reply to the Answer of the United States Department of Agriculture, Forest Service, and the California State Department of Fish and Game, as well as the material filed with a memorandum by the United States Department of the Interior, National Park Service.

The City and County of San Francisco desires to participate in the preservation of fishing and wild life values on the Tuolumne River, both economic and recreational, to the fullest extent practicable, and does not intend to "dry up" the Tuolumne River between O'Shaughnessy Dam and Early Intake as has recently been stated several times in the press and by recreational interests. Currently, the City is obtaining independent professional advice as to the amounts of water necessary to be released to maintain the fishery. Testimony along this line will be available at the hearing of this appeal

DION R. HOLM
CITY ATTORNEY
ROOM 206 CITY HALL
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HEMLOCK 1-1322

or can be submitted in writing if the Director so desires.

In view of the City's desire to cooperate in maintaining fishing and recreational benefits, the legal questions raised in the Application and Answers of the California State Department of Fish and Game, United States Department of the Interior, National Park Service, and United States Department of Agriculture, Forest Service, assume a secondary importance at this stage. However, certain statements have been made in the Answers, both legal and technical, which merit comment.

I. Brief of California Department of Fish and Game.

In response to the Brief for the California State Department of Fish and Game as Amicus Curiae, the statement that the State of California considers the protection and preservation of the State's fisheries to be of great importance hardly presents an issue, since none of the sections cited in the brief purports to interfere with vested rights

California Water Code Section 13000.1 has been taken out of context and when read with the balance of Chapter 1299, Statutes of 1959, by which said section was enacted into law, clearly relates to regulation of the disposal of waste matter into surface and underground waters of the State.

California Water Code Section 1243, which recognizes as a beneficial use of water its use for preservation and enhancement of fish and wild life resources, by its own terms operates prospectively, and obviously can have no effect on water rights, such as San Francisco's, which are presently vested and not dependent on the granting of a permit by the California State Water Rights Board.

As to California Fish and Game Code Section 5937, its

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language is a manifestation of the language formerly contained in Section 1410 of the California Civil Code, as adopted in 1911, which provided:

> "All water or the use of water within the state of California is the property of the people of the state of California."

The Supreme Court of California has construed the former Civil Code Section 1410, vestiges of which are presently found in Water Code Section 106, and it is submitted that the following language of the Supreme Court is equally applicable to the requirement of release of water in Fish and Game Code Section 5937:

> "Taken literally, this would include all water in the state privately owned and that pertaining to lands of the United States, as well as that owned by the state. It should not require discussion or authority to demonstrate that the state cannot in this manner take private property for public use. (See Palmer v. Railroad Commission, 167 Cal. 175, [138 Pac. 997].) The Constitution expressly forbids it. (Art. I, sec. 14.) The water that pertained to or was contained in the lands of the state was already the property of the people when this amendment was adopted. The statute was without effect on any other property."

San Bernardino v. Riverside, (1921) 186 Cal. 7, 29-30.

The case of Cole v. Rush, 45 Cal. 2d) 345, (page 4, Brief of California Department of Fish and Game), is not in point. The rule of that case is based on the presumption that the Legislature has knowledge of existing domestic judicial decisions and to have enacted and amended statutes in the

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light of such decisions as have a direct bearing upon them. Therefore, a necessary element - a judicial decision - before the rule of construction contended for can be applied is lacking with respect to Fish and Game Code Section 5937. In any event, Fish and Game Code Section 5937 can only operate prospectively, and not so as to impair vested rights. At page 4, the brief refers to the principle that water required to maintain fishlife is reserved from appropriations until it has served such beneficial purpose. The word "reserved" can only apply prospectively, and cannot operate to defeat vested appropriative rights.

San Bernardino v. Riverside, supra.

The California Attorney General, while he now says that his opinion in 18 Ops. Cal. Atty. Gen., 31 was inextricably rooted in the Friant Dam development, was at the time of writing that Opinion, resolving a dispute between the California Division of Fish and Game and the Division of Water Resources. The following language, taken from that opinion, at page 37, contains no startling new concept of California water law, but states long-standing principles and completely supports the position of San Francisco in the instant proceeding

> "It has been urged in behalf of the Division of Fish and Game that Fish and Game Code section 525 has the effect of reserving from any other uses the water necessary to propagate fish. As stated in a memorandum on behalf of the Division of Water Resources expressing opposition to this contention, this would in effect be a declaration by the section of a 'legislative intent under no circumstances ever to render dry any portion of a stream channel" below a dam. The contention of the Division of Fish and Game would indeed appear to require such an intent. This, however, would

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"contravene fundamental principles of the law of waters. The right of water users to take the whole stream under some circumstances has long been recognized. For example, riparian proprietors may sometimes take the whole stream if necessary for 'natural uses' (Hutchins, Selected Problems in the Law of Water Rights in the West 40-41 (1942); 1 Weil, Water Rights in the Western States 795 (3d ed. 1911)). Similarly, an appropriator may be entitled to all the water in a stream to satisfy his appropriation (Hutchins, supra, 66, 327, 416; 1 Weil, supra, 311)."

The Attorney General's statement that an appropriator may be entitled to all the water in a stream to satisfy his appropriation, is supported by the following decisions:

Brown v. Mullins (1884),
65 Cal. 89;
Alhambra Addition W. Co. v.
Mayberry (1891),
88 Cal. 68;
Baxter v. Gilbert (1899),
125 Cal. 580;
Huffner v. Sawday (1908),
153 Cal. 86;
Larsen v. Apollonio (1936),
5 Cal. (2d) 440;
Thorne v. McKinley Brothers (1936),
5 Cal. (2d) 704.

Without so stating, the Brief of the Attorney General attempts to equate a beneficial use with a water right. The law, however, is clear. Whether a water right was acquired

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under the Civil Code, or by initiating a proceeding before the State Water Rights Board and the issuance of a Permit, a beneficial use is essential to a water right, but does not in itself create a water right.

II. Memorandum of National Park Service.

San Francisco's water rights on the Tuolumne River are fully vested and are not subject to the application, permit, and licensing procedures before the State Water Rights Board, because said rights antedate the State Water Commission Act of 1913. This point is covered in the Appeal on page 3, lines 23 to 29, and on page 9, line 24, to page 10, line 14. The brief of the Attorney General of California for the Department of Fish and Game does not dispute this point. In addition, Report No. 41 of the House of Representatives, 63d Congress, 1st Session, dated August 5, 1913, contains the following statement, at page 16:

> "The city and county of San Francisco, under the laws of the State of California, has taken and performed all necessary acts to acquire, appropriate, and use the waters of the Tuolumne River, which has been done in strict compliance with the laws regulating the appropriation and use of waters in the State

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HEMLOCK 1-1322

"of California, and now has and holds a valid water right by virtue of its acts performed under the laws of said State."

Exhibit "C" to the subject Memorandum contains figures from which it reaches the conclusion that the demanded releases amount to approximately 5% of the total stream flow, averaged over an eleven-year period. This comparison is absolutely meaningless because it includes the complete stream flow, including flood waters, which are far beyond the capacity of O'Shaughnessy Dam to catch and store. Maintenance of the demanded stream flow necessarily will result in an invasion of City's proprietary stored water (Appeal, page 9, line 31, to page 10, line 13). The consequences of the invasion of storage have been previously stated in the Appeal (page 6, line 30, to page 7, line 14).

On page 5 of Exhibit "C" of the subject Memorandum reference is made to possible assistance by the Attorney General on certain legal points. Such legal points as have been raised by the Attorney General have already been answered in this brief.

A careful reading of Exhibit "D" reveals nothing that militates against the adequacy of a release of 30 cfs for the contemplated uses.

That the demanded releases are excessive and necessarily result in an invasion of City's water storage and its right to store a portion of the natural flow is conclusively demonstrated by Exhibit "F". On page 2 of that exhibit, a study of the natural flow over a twelve-year period indicates that on 2,711 days the demanded releases would have resulted in flows equal to or greater than the natural flow. On only 1,611 days the demanded releases would have resulted in a less than natural flow. The National Park Service, the Forest

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Service, and the California Department of Fish and Game obviously want San Francisto to supply, without charge, not only excessive amounts of water, but also want the benefits of stream regulation supplied by the storage facilities of O'Shaughnessy Dam.

Exhibit "G" is a series of spot measurements of flow on five creeks flowing into Hetch Hetchy Reservoir. The method employed is not standard engineering practice for measuring inflow into a reservoir. Measurements taken immediately after the first rain of a season are of no significance. The standard and accepted method of measuring inflow is to compute it from changes in elevation of the water surfac and the draft from the reservoir, subject to evaporation correction. The method employed on the Hetch Hetcy project is a method approved by the Secretary of the Interior under provisions of the Raker Act. Appellant has a complete record of daily inflow from construction of Hetch Hetchy Dam to date. If deemed to be significant, San Francisco is willing to supply it.

With respect to Exhibit "I", the alternative suggested of a release of the natural flow up to 150 cfs would be much more damaging to San Francisco, if adopted, than the demanded 80:40:25 cfs. This requirement would mean that City could not store any of the natural flow until it exceeded 150 cfs, and would mean that not only would San Francisco be unable to exercise its vested water rights, but that City's actual municipal and domestic needs could not be met. As stated previou O'Shaughnessy Dam was not designed to provide San Francisco with amounts of water to which it has vested rights subject to a release of the first 150 cfs of natural flow. Considerably more storage would have to be provided to satisfy both.

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III. Brief for the United States Department of Agriculture (Forest Service).

A simple answer to the last paragraph on page 5, extending over to page 6, is that design capacity is not the same as maximum capacity, and had the aqueduct of the Canyon Power Project as presently approved (south side of Tuolumne Rivert) been built with 620 cfs design capacity, its maximum capacity would have been approximately the same as the maximum capacity of the Early Intake-Moccasin Power Hous e aqueduct due to the similarity of the two tunnels.

As to the first complete paragraph on page 6, it is argued that any saving in construction costs available to San Francisco's taxpayers by relocating the proposed Canyon Power Project from the south side of the Tuolumne River to the north side should be spent to improve fishing conditions. While fishing and recreational uses are deemed to be a beneficial use of water, we have previously pointed out that beneficial use alone does not create a water right nor can it be used to impair vested rights.

On page 7, it is stated: "The proposal means only that some of the water will be withheld from power production and applied instead to recreational purposes." The fact that this water is stored water to which San Francisco holds vested water rights is ignored. Also ignored is the fact that this tremendous asset to the economy of Northern California, O'Shaughnessy Dam, was built at great cost to a specific capacity to meet specific needs. As pointed out in the Appeal, O'Shaughnessy Dam is a part of the Canyon Power Project. To impose at this late date an additional excessive demand on that capacity without payment is a taking of property without

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just compensation. Any release of water for the preservation of fish and wildlife and for recreation purposes must be compatible with the primary purposes of the project.

The final paragraph on page 9, running over to page 10, repeats material that appears in the Park Service Memorandum. We repeat that any comparisons to natural stream flow are irrelevant because the natural stream flow is far in excess of the capacity of O'Shaughnessy Dam to capture.

Turning now to the legal aspects of the subject Brief, it is in error where it states (page 4) that the source of the immunity of City's water right from interference by the Secretary of Agriculture is unstated. The powers of the Secretary of Agriculture with respect to the Stanislaus National Forest are no greater than the powers of the Secretary of the Interior with respect to Yosemite National Park, as far as the instant Appeal is concerned. Section 11 of the Raker Act, referred to in the Appeal, clearly leaves the question of control, appropriation, use or distribution of wate to the laws of the State of California.

In attacking the existence of any right in City to its appropriations of Tuolumne River water, it is clear that the Brief overlooks Article XIV, section 3, of the California Constitution, adopted by amendment in 1928. The right of the riparian owner to the use of the water as against an appropria tor is now limited to reasonable beneficial use, present and prospective.

Peabody v. Vallejo,
2 Cal. (2d) 351;
Meridian v. City and County of
San Francisco,
13 Cal. (2d) 424.

The rule of Miller & Lux v. Haggin, and Palmer v.

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California Railroad Commission, (page 4, subject Brief), without the qualifications and limitations imposed by the constitutional amendment, can no longer be said to be the law of California. Without conceding that any riparian right is vested in the United States, the proposed release by San Francisco of thirty cfs will more than supply present and prospective uses on lands adjoining the Tuolumne River between O'Shaughnessy Dam and Early Intake.

While no judicial decision squarely on the point has been located, a riparian right, being for the benefit of land riparian to the stream, cannot exist for the preservation and protection of fish. This would appear to be a correct statement of the law, for in one reported decision riparian landowners were held not to be proper parties to compel a release of stored waters for the preservation and protection of fish life.

Rank v. Krug,
(U.S.C.D., S.D., Calif., N.D.-1950),
90 F. Supp. 773.

IV. Conclusion.

San Francisco is a responsible municipal corporation with an interest in the Tuolumne River not only for its power and water potential, but also in its recreation potentitial. San Francisco operates Camp Mather, a successful and heavily patronized recreation facility in the Tuolumne area, collaborates with the Forest Service by permitting recreational use of Cherry Reservoir, and has furnished a fish hatchery site with 20 cfs of water at Mocassin. The Briefs we have discussed herein contain many references to population projections

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and the pressures on recreation areas in the years to come. The same population increases that will put heavy burdens on recreation facilities will cause correspondingly heavy demands on the power and water potential of California. Being faced both with a responsibility to participate in supplying recreation facilities and water and power in the years to come, San Francisco is perhaps in a better position to balance these uses into a compatible whole than are others concerned with only one phase of the problem.

San Francisco concurs that the Tuolumne River should be used for all beneficial uses, but on a compatible basis consistent with vested rights and all the needs of the people.

Dated: March 31, 1960.

Respectfully submitted,

Dion R. Holm
City Attorney

Thomas M. O'Connor
Public Utilities Counsel

Mc Morris M. Doss
Deputy City Attorney

Attorneys for Petitioner

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APPENDIX R

PUBLIC UTILITIES COMMISSION
CITY AND COUNTY OF SAN FRANCISCO

HETCH HETCHY WATER AND POWER

BUREAU OF LIGHT, HEAT AND POWER

855 HARRISON STREET
SAN FRANCISCO, CALIFORNIA 94107
558-3821

May 15, 1979

Subject: Kirkwood Powerhouse Draft

Mr. Will Ging
U.S. Fish and Wildlife Service
2800 Cottage Way, Room E-2727
Sacramento, California 95825

Dear Mr. Ging:

Attached is a sheet showing the Kirkwood Powerhouse Draft since 1967 based on USGS stream gage readings. The larger figure for each month is the draft in acre-feet; the smaller figure is the daily average draft for the month in cubic feet per second.

Very truly yours,

O.L. McDaniel
General Manager

Enc.

HETCH HETCHY WATER AND POWER

MONTHLY DRAFT THROUGH KIRKWOOD POWER PLANT

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1967	—	8,650	44,281	42,879	44,426	43,276	44,803	44,713	43,317	44,884	43,507	44,547	449,233
		727	720	721	723	726	729	727	728	730	731	724	726
1968	44,709	41,820	44,797	43,317	44,787	43,500	44,773	43,265	43,287	43,202	36,456	37,444	511,357
	727	727	729	728	728	731	728	704	727	703	613	609	704
1969	38,106	35,326	32,811	40,413	31,160	33,574	34,211	35,294	38,396	39,628	39,346	39,892	438,157
	620	636	534	679	507	564	556	574	645	644	661	649	605
1970	40,637	11,161	40,395	34,254	43,299	42,109	42,853	42,730	39,280	41,054	40,415	41,258	459,445
	661	201	657	576	704	708	697	695	660	668	679	671	635
1971	41,498	37,545	29,136	40,274	41,000	39,102	40,709	40,508	38,955	40,203	31,617	39,600	460,147
	675	676	474	677	667	657	662	659	655	654	531	644	636
1972	42,182	39,169	41,763	41,375	41,871	39,792	41,342	41,492	40,088	39,364	39,782	39,929	487,649
	686	681	679	695	680	669	672	675	674	640	660	649	672
1973	41,369	44,911	50,561	48,246	50,539	34,547	44,633	42,337	42,366	43,377	43,484	49,571	535,941
	673	809	822	811	822	581	726	689	712	705	731	806	740
1974	29,418	29,841	50,846	48,629	45,350	35,933	47,506	45,989	42,860	47,179	45,415	45,766	514,726
	478	537	827	817	738	604	773	759	720	767	763	744	711
1975	44,788	45,456	51,506	47,361	53,117	43,676	49,394	45,474	43,355	43,987	48,735	49,279	566,128
	728	818	838	796	864	734	803	740	729	715	819	801	782
1976	44,955	29,852	31,452	1,908	29,790	27,701	27,994	27,755	28,211	29,237	20,531	19,829	319,215
	731	519	512	240	653	466	455	451	474	475	345	322	485
1977	20,979	7,647	8,601	7,987	8,214	12,195	12,317	12,617	14,919	12,544	15,438	15,220	148,678
	341	138	140	134	134	205	200	205	251	204	259	248	205
1978	41,000	50,027	56,693	52,344	44,243	40,655	56,536	47,770	44,512	50,184	49,608	50,338	583,910
	667	901	922	880	720	683	919	777	748	816	834	819	807
1979	50,545	45,604	51,887										
	822	821	844										
1980													
1981													
1982													
1983													

APPENDIX S

Upper Tuolumne River Operations Logic and Assumptions

The upper Tuolumne River system was modeled in an attempt to operate the facilities owned by the city of San Francisco and look at the impact of various releases from the reservoirs for fish. The reservoirs looked at were Hetch Hetchy Reservoir with a capacity of 360,360 acre-feet, Lake Eleanor with a capacity of 27,100 acre-feet, Lake Lloyd (Cherry Lake) with a capacity of 268,000 acre-feet and New Don Pedro Reservoir with a capacity of 2,030,000 acre-feet. In addition five powerplants were evaluated. These are Robert C. Kirkwood, Dion R. Holm, Moccasin, Don Pedro, and a proposed plant at the outlet at Hetch Hetchy Reservoir.

The priorities of water supply were to meet the fish demand first, then the domestic water supply to the city of San Francisco, and finally power generation. In all cases the existing rights under the Raker Act were adhered to and the water-bank account in New Don Pedro Reservoir provided for in an agreement between the city of San Francisco, Turlock Irrigation District and Modesto Irrigation was also maintained.

The maximum capacities of the power tunnels were 875 ft^3/s for Canyon Power Tunnel (Kirkwood Powerhouse), 680 ft^3/s for Mountain Power Tunnel (Moccasin Powerhouse) and 900 ft^3/s for Cherry Power Tunnel (Dion Holm Powerhouse). The maximum diversion capacity of Eleanor-Cherry Diversion Tunnel was considered to be 760 ft^3/s.

The diversions to the city of San Francisco were a constant 400 Mgal/d for ultimate development and 200 Mgal/d for present (1980) level of development. Turlock Irrigation District furnished data for theirs and Modesto Irrigation District diversions from New Don Pedro of 818,00 acre-feet per year on a varying monthly pattern.

Inflow and precipitation data was furnished by the city of San Francisco. Form P166 has been completed by the city since 1918 and has the inflow to Hetch Hetchy, inflow from Lake Eleanor-Cherry Watershed and the accretions between Hetch Hetchy and Early Intake, as well as accretions below Eleanor-Cherry to the Lower Cherry Aqueduct. The inflow to Cherry and Eleanor was split on a proportion of the area of the two watersheds. The inflow to Don Pedro is also on this form (computed as Tuolumne River at La Grange).

A discussion of the operational model follows. After fish releases requested in the various schedules were made, water was diverted thru Canyon Power Tunnel for Kirkwood Powerhouse and on to Mountain Tunnel for Moccasin Powerhouse and then to the city of San Francisco up to the maximum capacity of the conveyance facilities or, in the case of present level of development, up to the current diversion rate. Any additional water available was diverted thru the various powerhouses to generate power. The diversions to the city were checked against the Raker Act and reduced if necessary so as not to violate prior rights. And of course if sufficient water wasn't available to meet demands, the

diversions were cut back. During dry and critical years[1/] water was brought over from the Cherry Watershed via Lower Cherry Aqueduct which has a maximum capacity of 200 ft^3/s but only up to the requirements for the domestic supply for San Francisco.

In order to gain maximum power, water was diverted from Lake Eleanor to Lake Lloyd. This was done whenever the water surface elevation in Lake Lloyd was below 4,660 feet. For purposes of calculating the head on the tunnel elevation, 4,621 was considered to be minimum elevation. If Lake Lloyd was below 4,621 it could still receive water but only in a free-fall condition. The minimum capacity on Lake Eleanor at which water can still get thru the tunnel and still have enough water to meet evaporation and fish releases is 5,400 acre-feet.

The actual operation can be followed in the columnar explanation for the study.

[1/] Dry years based on the 10 percentile and critical years 1 percentile of inflow to Hetch Hetchy Reservoir.

Columnar explanation of Tuolumne program (TUOLP)

SECTION 1 (Hetch Hetchy Watershed)

1 Date

2 Hetch Hetchy Inflow - Calculated Natural flow Hetch Hetchy Watershed from column 23 (P166)[1/]

3 Canyon Power Tunnel Diversion - The quantities shown in this column were adjusted down from a maximum capacity of 875 ft^3/s (53,800 acre-feet/month) to a level at which there was just enough storage capacity in Hetch Hetchy Reservoir to be able to get through the critical period without shorting fish releases. In dry and critical years a deficiency was taken. The dry years are 1924, 1931, 1934, 1961, and 1976. 1977 is considered to be a critical year. Also, anytime Hetch Hetchy Reservoir capacity would be reduced below 45,000 acre-feet, the release to Canyon Power Tunnel was reduced to the city's domestic requirement in an attempt to conserve water in Hetch Hetchy Reservoir.

4 Release to Tuolumne Below Hetch Hetchy - Release to the Tuolumne River below Hetch Hetchy Reservoir equal to fish releases plus spills.

[1/] Note: P166 is the form furnished by city of San Francisco. Column numbers attributed to this form are for the form as laid out for the years 1975-1978.

5 Evaporation - Evaporation from Hetch Hetchy Reservoir. The rates come from P-174 by the city of San Francisco. The rates given on form P-174 when applied to the reservoir area in acres produced cubic feet per second flow. Therefore these factors were multiplied by 60 to arrive at the factor to produce acre-feet per month. The factors were used in a table look-up subroutine that provides the reservoir area from the capacity.

6 End of Month Storage Hetch Hetchy - Equal to previous EOM storage plus inflow minus Canyon Lower Tunnel diversion minus release minus evaporation.

7 Accretion Hetch Hetchy to Early Int. - Accretions between Hetch Hetchy Reservoir and Early Intake. From column 26 (P166).

8 Mountain Tunnel Diversion - Maximum capacity 680 ft^3/s (41,800 acre-feet/month). This was reduced whenever sufficient supplies were not available. Water for Mountain Tunnel could come from Canyon Power Tunnel plus accretions between Hetch Hetchy Reservoir and Early Intake and diversions from Lower Cherry Aqueduct plus any excess water which had been released from Hetch Hetchy for fish and not needed below Early Intake.

9 Release to Tuolumne Below Early Int. - Fish release plus excess water from Canyon Power Tunnel over capacity of Mountain Tunnel.

10 Diversion to San Francisco - Maximum 400 Mgal/d (200 Mgal/d present level). Supply limited to that available from Mountain Tunnel.

11 Diversion from Lwr. Cherry Aqueduct - Water diverted from Cherry Creek Watershed to just above Early Intake. Used to supplement Hetch Hetchy water when needed for domestic supplies. Maximum capacity of Lower Cherry Aqueduct is 200 ft^3/s.

Section 2 (Cherry Creek Watershed)

1 Date

2 Lake Eleanor Inflow - Calculated natural flow of Eleanor Creek into Lake Eleanor from column 24 (P166) and further proportioned by watershed area of Lake Eleanor and Cherry Lake.

3 Eleanor to Cherry Diversion - Whenever Lake Eleanor was higher than Cherry Lake and also above mouth of Eleanor-Cherry Tunnel water was diverted to Cherry Lake to maximize power generation at Dion Holm Powerhouse.

4 Release to Eleanor Creek - Fish release and spills and water released for Lower Cherry aqueduct diversions when needed.

5 Evaporation - Evaporation from Lake Eleanor. See discussion of EVAP under section 1.

6 EOM Storage Lake Eleanor - End-of-month storage in Lake Eleanor equal to the previous EOM plus Lake Eleanor inflow minus diversions to Cherry Lake minus release to Eleanor Creek minus evaporation.

7 Cherry Lake Inflow - Calculated natural flow of Cherry Creek into Cherry Lake from column 24 (P166) and further proportioned by watershed area of Cherry Lake and Lake Eleanor.

8 Cherry Power Tunnel Diversion - Maximum capacity 900 ft^3/s limited to the supply available from Cherry Lake. During critical and dry years when water was needed for diversion to Lower Cherry Aqueduct and onto city of San Francisco Cherry Power diversion was stopped. However schedules 8 and 12 required a minimum diversion of 90 ft^3/s. In addition, some water was diverted thru the powerhouse when needed to keep the San Francisco bank account at Don Pedro from going broke.

9 Release to Cherry Creek - Fish release plus spills plus release for diversion thru Lower Cherry Aqueduct to Early Intake.

10 Evaporation - Evaporation from Cherry Lake. See discussion of evaporation under Section 1 above.

11 EOM Storage Cherry Lake - End-of-month storage in Cherry Lake equal to previous EOM plus Cherry Lake inflow plus diversion from Lake Eleanor minus diversion for power to Dion Holm Powerhouse minus release to Cherry Creek minus evaporation.

Section 3 (Don Pedro Reservoir operations)

1 Date

2 Flow Tuolumne below confluence - Flow of Tuolumne River below its confluence with Cherry Creek (actually below return flow from Dion Holm Powerhouse). Equal to release to Tuolumne below Early Intake (Col. 9 section 1) plus release to Eleanor Creek (Col. 4 section 2) plus release to Cherry Creek (Col. 9 section 2) minus diversion from Lower Cherry Aqueduct (Col. 11 section 1) plus Cherry Power Tunnel diversion (Col. 8 section 2).

3 San Francisco Watershed unimpaired flow - Calculated natural flow from San Francisco Watershed (Col. 27, P166).

4 Modific. due to San Francisco Operation - Modification due to the operation of Hetch Hetchy Reservoir, Cherry Lake, Lake Eleanor, Canyon Power Tunnel, Mountain Tunnel, Cherry Power Tunnel, and diversion to city of San Francisco. It is equal to San Francisco Watershed unimpaired flow (Col. 3) minus flow Tuolumne below confluence (Col.2).

5 Don Pedro Unimpaired Inflow - Calculated natural flow of Tuolumne River at La Grange from Col. 28 (P166).

6 Modified Inflow to Don Pedro - Inflow due to the operation of the city of San Francisco equal to the unimpaired inflow to Don Pedro (Col. 5) minus the modification due to San Francisco operation (Col. 4).

7 Diversion from Don Pedro - Diversions by Turlock and Modesto Irrigation Districts. Data furnished by T.I.D.

8 Release from Don Pedro - Release data furnished by T.I.D. and includes spills from Don Pedro Reservoir.

9 Evaporation - Evaporation from Don Pedro Reservoir, see discussion of evaporation under section 1 above.

10 End-of-Month Storage Don Pedro - Equal to previous end-of-month storage plus modified inflow to Don Pedro (Col. 6) minus diversion (Col. 7) minus release (Col. 8) minus evaporation (Col. 9).

11 Don Pedro Flood Control storage

12 San Francisco Water Balance - Balance in bank account at Don Pedro for city of San Francisco equal to the previous month's balance plus the modified Don Pedro inflow (Col. 6) minus the Don Pedro unimpaired inflow (Col. 5) or the Raker Act entitlement if the unimpaired inflow is greater than the Raker Act entitlement. Furthermore the bank account balance is limited to 570,000 acre-feet.

Tuolumne Program Parameters (TUOLP)

ACCINF - 24 month accumulated unimpaired inflow to Hetch Hetchy Res.

ACINF - 6 month accumulated unimpaired inflow to Hetch Hetchy Res. for period April-July.

ACINF1, ACINF2, etc. - Accumulated unimpaired inflow to Hetch Hetchy Res. for the period Oct. 1 to time of decision (Oct. 1 of previous year for making decision Oct.-Dec.) with 1 being October & 2 being November, etc.

ACPRCP4, etc. - is accumulated precipitation at Hetch Hetchy from Oct. 1 to time of decision with 4 being January, etc.

CCFL - Flow of Cherry Creek below confluence of Cherry & Eleanor Creeks as a result of operation.

CITBANK - San Francisco's balance in bank at Don Pedro.

CITCRED - Credit (positive or negative) to CITBANK.

CLDIND - Indicator to determine whether power diversions from Cherry Lake are to be made.

CLDIV & CLDIVS - Diversions for power purposes from Cherry Lake.

CLDIVR - Max. diversion capable of being made for power purposes from Cherry Lake.

CLINFL - Unimpaired inflow to Cherry Lake.

CLREL - Release from Cherry Lake for fish.

CLRL - Release from Cherry Lake including fish, spills and water for Lower Cherry diversions.

CPRCP - Accumulated precipitation at Hetch Hetchy Res. for July 1 to date (used with San Francisco's rule curves).

DPDIV, DPDIVR, DPDIVS, DPINFL, DPREL, DPRL - Same definitions as CL but applies to Don Pedro.

EIACCR - Accretions between Hetch Hetchy & Early Intake.

EIFISHR - Fish release required at Early Intake.

EIREL - Release at Early Intake, includes fish releases, excess from Canyon Power that can't get thru Mountain Tunnel & accretions.

FISHA - FISHE & FISHREL - Required fish release from Hetch Hetchy.

FLTUOL - Flow of Tuolumne River below confluence of Cherry Creek & Tuolumne River.

HEAD - Difference in elevation between Lake Eleanor and invert of tunnel between Lake Eleanor & Cherry Lake.

HHDIV, HHDIVR, HHDIVS, HHINFL, HHREL, HHRL - Same definitions as CL but applies to Hetch Hetchy.

HHPRECP - Precipitation at Hetch Hetchy.

IDFISH - Schedule of fish releases.

LCACCR - Accretions on Lower Cherry Creek.

LCCDIV - Diversions thru Lower Cherry Aqueduct.

LCCDIVC - Release from Cherry Lake for diversion thru Lower Cherry Aqueduct plus fish releases from Cherry.

LCCDIVE - Release from Lake Eleanor for diversion thru Lower Cherry Aqueduct plus fish releases.

LEDIVR, LEREL, LERL, LEINFL - Same definitions as CL but applies to Lake Eleanor.

LEVEL - 2020 is ultimate, 1980 is present level of development.

MDPINFL - Modified inflow to Don Pedro due to operation of San Francisco reservoirs.

MODSFOP - Modification due to San Francisco operation and is applied to DPINFL to get MDPINFL.

MTDIV - Diversion thru Mountain Tunnel.

MTDIVR - Max. diversion capable thru Mountain Tunnel.

MTDNEED - Water needed from Lower Cherry Aqueduct.

RAKER - Raker Act entitlement.

SFDIV - Diversion to City of San Francisco.

SFDIVR - Max. diversion required by City of San Francisco.

SPEVAPR - Evaporation rate from San Francisco reservoirs watershed.

SFUIMFL - Unimpaired flow of San Francisco watershed from form, P166 furnished by City of San Francisco.

THHEOM - Target Hetch Hetchy Reservoir end-of-month storage from rule curves furnished by City of San Francisco.

APPENDIX T

United States Department of the Interior
WATER AND POWER RESOURCES SERVICE

MID-PACIFIC REGIONAL OFFICE
2800 COTTAGE WAY
SACRAMENTO, CALIFORNIA 95825

IN REPLY
REFER TO: MP-760
123.4

OCT 7 1980

To: Area Manager, Fish and Wildlife Service,
Room E-2740, 2800 Cottage Way, Sacramento, CA

From: Acting Assistant
Regional Director, Sacramento, CA

Subject: Tuolumne River Operation Study

To aid you in determining the instream flow requirements for the Tuolumne River below Hetch-Hetchy Reservoir, your office requested that we prepare power operation studies of the Tuolumne River Basin.

Attached is a copy of the Power Analysis for the Tuolumne River Operation Studies, recently completed by my staff. Analysis includes evaluations of the effects of alternative flow schedules on the operation of the major existing hydroelectric powerplants in the basin. A proposed 4,000-kW powerplant was assumed to be installed on the downstream outlet of Hetch-Hetchy Reservoir for all flow schedules which include increased fishery releases. The effects on power generation under each flow schedule are summarized and long-term economic effects are indicated. The impact on power sales revenue was not evaluated.

The criteria used in making our evaluation are outlined in the attachment.

Darrell D. Mack

Attachment

UNITED STATES DEPARTMENT OF THE INTERIOR

WATER AND POWER RESOURCES SERVICE

MID-PACIFIC REGION, SACRAMENTO, CALIFORNIA

POWER ANALYSIS FOR THE TUOLUMNE RIVER OPERATION STUDIES

SEPTEMBER 1980

PREPARED BY DIVISION OF PLANNING, ENERGY RESOURCES BRANCH

POWER ANALYSIS FOR THE TUOLUMNE RIVER OPERATION STUDIES

The Tuolumne River Operation Studies include an evaluation of the effects of alternative flow schedules on the operation of the major existing hydroelectric powerplants in the basin. The name, owner, installed capacity, and expected average annual generation are shown in table 1 for each powerplant. A proposed 4,000-kW powerplant was assumed to be installed on the downstream outlet of Hetch-Hetchy Reservoir for all flow schedules which include increased downstream fishery releases.

A summary of the effects on power generation under each flow schedule is shown in table 2. Long term economic effects are shown in table 4. The impact on power sales revenue was not evaluated.

Powerplant characteristics used to determine plant output of Kirkwood, Moccasin, and Dion Holm Powerplants were based on plant performance curves prepared by Hetch-Hetchy Water and Power and supplied by the Fish and Wildlife Service (FWS). Powerplant characteristics of Don Pedro Powerplant and the proposed Hetch-Hetchy Powerplant were developed by Water and Power Resources Service (Service) personnel.

Power accomplishments of the Tuolumne River Basin power system (System)[1/] were measured by determining average annual generation (AAG) and system dependable capacity (SDC) for each flow schedule.

1/ The existing powerplants are assumed to be operated as a single system for the purposes of this evaluation.

AAG for the System is the amount of electrical energy that could be generated by System powerplants on a yearly basis over a long term period using historical hydrological data.

The SDC of the hydroelectric system is the capacity which, under the most adverse flow conditions of record, can be relied upon to carry system load and meet firm power obligations. SDC was determined for two adverse flow periods, water years 1929 through 1932 and water years 1976 through 1977. The latter period was determined to be the most adverse and was used in our evaluation of SDC under the different flow schedules.

The estimation of SDC under the base condition (schedule 2u) was primarily based on energy production during the 1976 through 1977 adverse period. Kirkwood, Moccasin, and Dion Holm Powerplants divert water from their respective forebays through long power tunnels where the major portion of their power head is developed. The powerplant capacities available at these plants, therefore, are contingent upon the amount of water available for power releases, which, in turn, is proportional to the amount of energy produced. It was assumed that System powerplants would be operated at a 50 percent Annual Capacity Factor (4,380 kWh/kW per year) during the adverse period. SDC for the adverse flow period was estimated by dividing average yearly generation during that period by the factor 4,380 kWh/kW. These computed plant dependable capacities were then compared to plant capacities available in August 1977 at a 50 percent Annual Capacity Factor, minimum value controlled.

Don Pedro Powerplant's dependable capacity was evaluated differently due to the fact that the forebay develops the power head. Don Pedro Powerplant's dependable capacity was based on the plant capability available in August of 1977. This capability was then compared to a computed plant capacity that was based on the assumption that the plant would operate at a 50 percent Annual Capacity Factor (372 kWh/kW) in August. Capacity was computed by dividing the monthly energy output by the factor 372 kWh/kW, minimum value controlled.

Once SDC was estimated for the base condition, loss of SDC compared to the base condition was estimated for other flow schedules by computing the difference in adverse flow period average generation and dividing by 4,380 kWh/kW.

System AAG and SDC for each flow schedule were then compared to the base condition (schedule 2u) to determine net effects on AAG and SDC. Table 2 summarizes the impacts of the alternative schedules studied.

The economic cost to California of decreasing the System AAG and SDC can be estimated by assuming that a new source of energy and capacity would be built. A nuclear thermal powerplant was selected as a measure of the cost of a new source. However, the lead time required for a nuclear plant to become operational is over ten years. This long lead time is due to scaracity of suitable and acceptable plant sites, environmental studies, regulatory approval, financial constraints, and skilled labor shortages. Therefore, in the interim period between the reduction of hydroelectric generation and the addition of new generation, there

would be an increased usage of existing oil fired powerplants to replace the loss of energy and capacity. Table 3 summarizes these short-term effects.

The January 1980 price level costs of constructing and operating a nuclear powerplant operating at a 50 percent plant factor were 6.15 miles per kWh for energy and $220.00 per kW-year for capacity. The loss in AAG, SDC, and estimated economic cost for each alternative schedule are shown on table 4.

Table 1. Existing Major Hydroelectric Powerplants in Tuolumne River Basin

Powerplant Name	Owner	Installed Capacity (MW)	Average Annual Generation (MWh)
R. Kirkwood	Hetch-Hetchy Water and Power	67.5	622,000
Moccasin Creek	Hetch-Hetchy Water and Power	90.0	548,000
D. R. Holm	Hetch-Hetchy Water and Power	135.0	772,000
Don Pedro	Turlock and Modesto Irrigation Districts	136.5	598,400

Source: "Hydroelectric Power Resources of the United States"; FPC, 1976

Note to reader from Fish and Wildlife Service -

In Tables 2, 3, and 4:

Schedule 2 = Alternative 3
Schedule 3 = Alternative 1
Schedule 4 = Alternative 4
Schedule 6 = Alternative 7
Schedule 11 = Alternative 5
Schedule 12 = Alternative 6

Table 2. Impacts of Alternative Flow Schedules

Schedule	Powerplant Average Annual Generation					Total Generation (MWh)	Loss of Generation (MWh)	Dependable Capacity (MW)	Loss of Dependable Capacity (MW)
	Kirkwood (MWh)	Moccasin (MWh)	Dion Holm (MWh)	Don Pedro (MWh)	Proposed Hetch-Hetchy (MWh)				
2u	597,517	540,192	780,883	497,906		2,416,498	Base	371	Base
3u	542,999	525,918	770,232	500,020	16,357	2,355,526	60,972	333	38
4u	471,238	492,070	721,692	512,748	26,359	2,224,107	192,391	285	86
5u	542,999	527,543	772,641	497,304	16,357	2,356,844	59,654	341	30
6u	598,467	538,543	768,868	498,183	11,617	2,415,678	820	337	34
7u	572,182	538,967	771,217	499,777	14,047	2,396,190	20,308	338	33
8u	592,776	534,570	776,690	506,047	11,693	2,421,776	(-5,278)	350	21
11u	592,994	536,513	767,621	502,049	12,425	2,411,602	4,896	336	35
12u	595,080	536,966	759,325	501,412	11,819	2,404,602	11,896	338	35

Table 3. Short-term Economic Cost

Schedule (Ultimate Development)	Loss of Generation (MWh)	Fuel Replacement Cost ($1,000) [a/] [b/]	Oil Equivalent (1,000 bbl)	Residences Served (1,000)
2	Base	Base	Base	Base
3	60,972	3,297	94.0	10.0
4	192,391	9,112	295.0	30.0
5	59,654	3,240	92.0	10.0
6	820	637	2.0	.2
7	20,308	1,498	31.0	3.0
8	(-5,278)	367	8.0	1.0
11	4,896	817	8.0	1.0
12	11,896	1,127	19.0	2.0

[a/] Includes a $600,000/yr cost for construction, operation, and maintenance of a 4,000-kW powerplant at the downstream outlet of Hetch-Hetchy.

[b/] Fuel replacement cost for burning oil at existing PG&E plants on short-term basis. January 1980 price level.

Table 4. Long-term Economic Cost

Schedule (Ultimate Development)	Loss of Generation (MWh)	Loss of Dependable Capacity (MW)	Replacement Cost in Jan 1980 ($1,000) [a/ b/]	Residences Served (1,000)
2	Base	Base	Base	Base
3	60,972	38	9,336	10.0
4	192,391	86	20,704	30.0
5	59,654	30	7,568	10.0
6	820	34	8,084	.2
7	20,308	33	7,984	3.0
8	(-5,278)	21	5,188	1.0
11	4,896	35	8,331	1.0
12	11,896	35	8,373	2.0

a/ Includes a $600,000/yr cost for construction, operation and maintenance of a 4,000-kW powerplant at the downstream outlet of Hetch-Hetchy.

b/ Based on replacement power from nuclear powerplant to be built in the future. January 1980 price level.