

CASE STUDY REPORT #27
HELL HOLE RESERVOIR
RUBICON RIVER

I. Project Description

The Middle Fork American River project includes French Meadow Reservoir on the Middle Fork American River (Case Study #26) which impounds the Middle Fork, receives diverted water from Duncan Creek, and then is diverted through a tunnel and French Meadow powerhouse into Hell Hole Reservoir. Hell Hole Dam on the Rubicon River impounds Hell Hole Reservoir (gross capacity of 208,400 acre-feet) which reuses the discharge through French Meadows powerhouse and impounds the natural flow of the Rubicon River. From Hell Hole, water is either conveyed through a 10-mile tunnel to a powerhouse on the Middle Fork American River, or released through the dam. Figures 1 and 2 illustrate the complexity of this project.

There are two major impoundments above Hell Hole Reservoir (Rubicon and Buck Island Reservoirs) that influence flows in the Rubicon River and into Hell Hole. Both were completed in 1963 and have a combined storage capacity of 2,520 acre-feet.

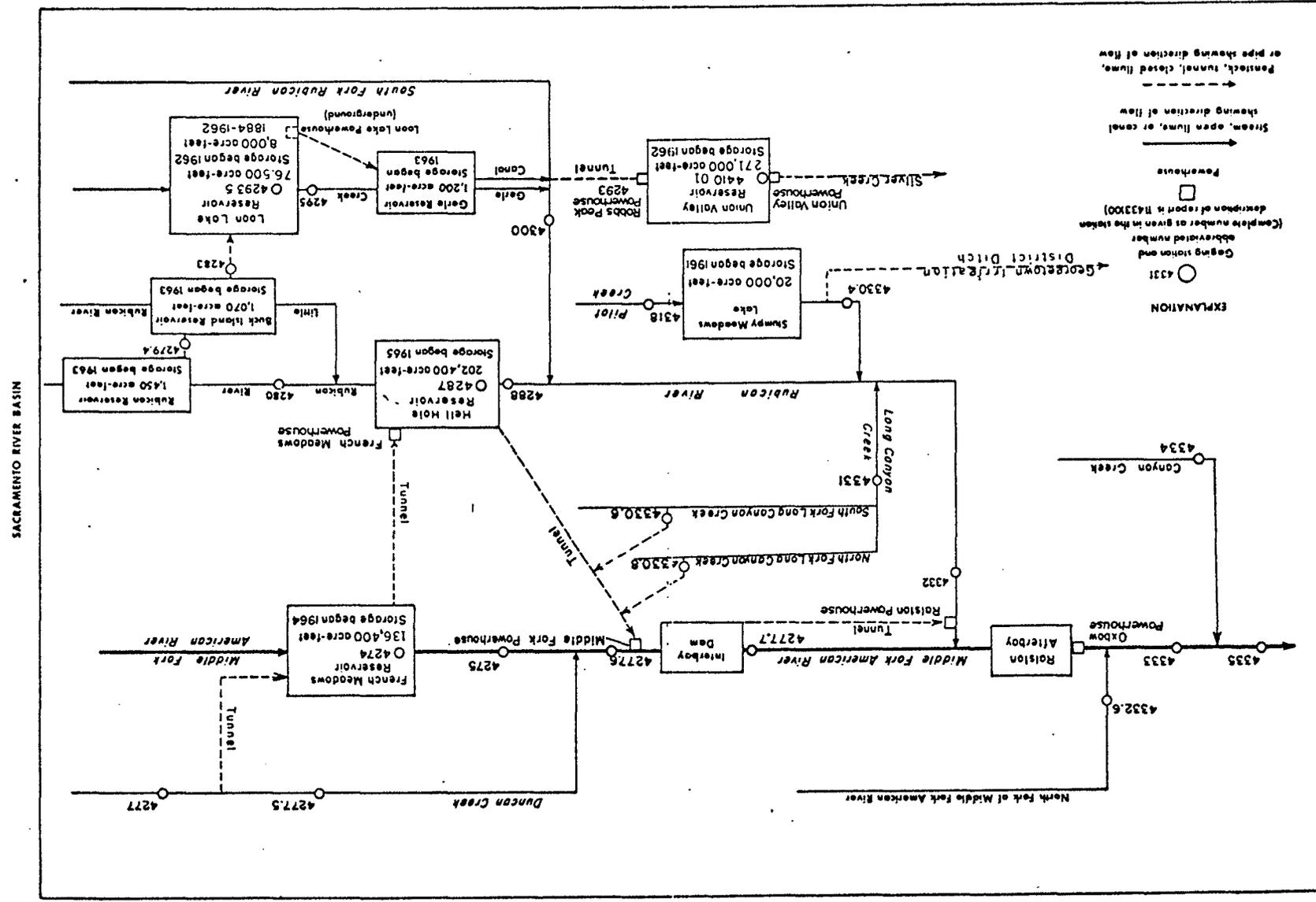
II. Pre-Project Conditions

Stream flow in the Rubicon River at Hell Hole prior to the construction of upstream impoundments responded to annual precipitation. The mean discharge pattern shown in Figure 3 illustrates a response to early winter rainfall and

Source: U. S. Geological Survey, 1973, water resources data for California.

Figure 1

Schematic diagram showing diversions and storage in Middle Fork American and Rubicon river basins.



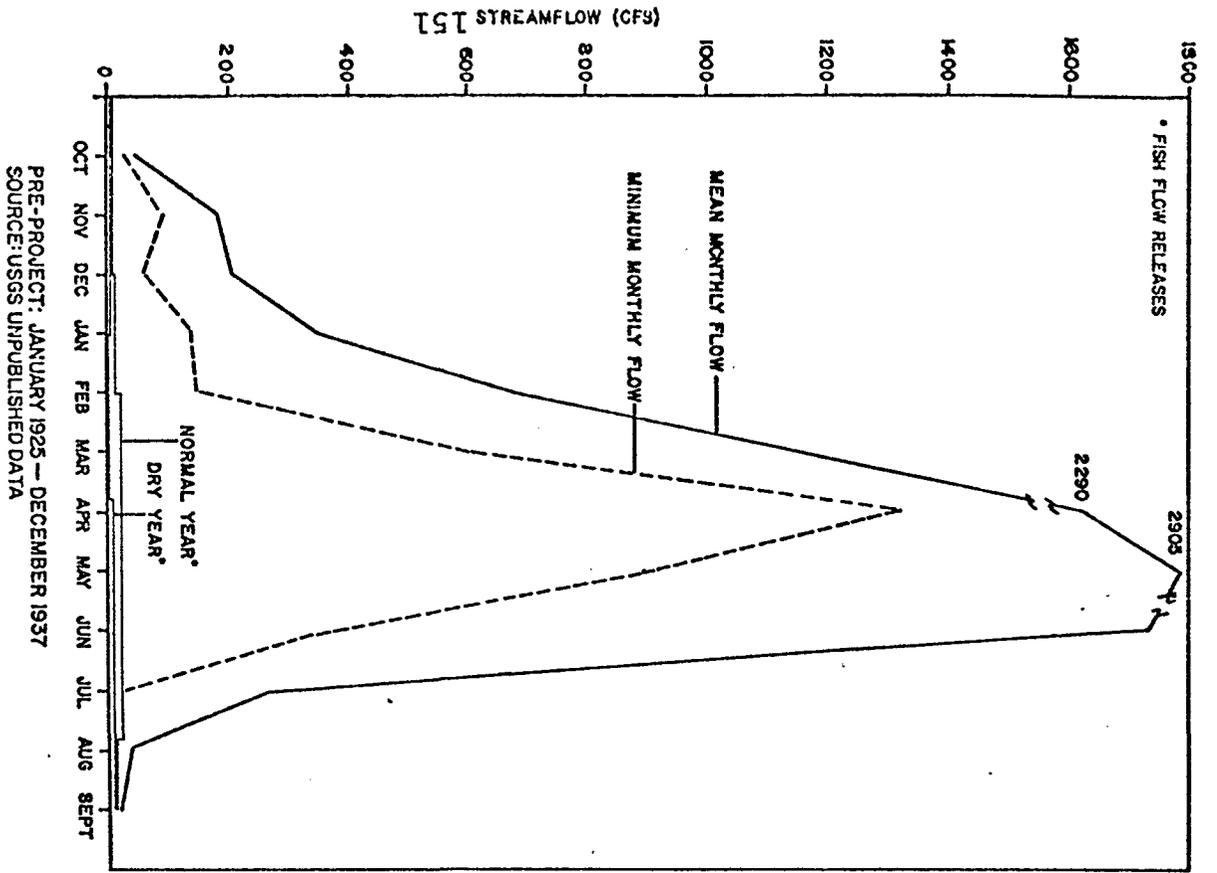
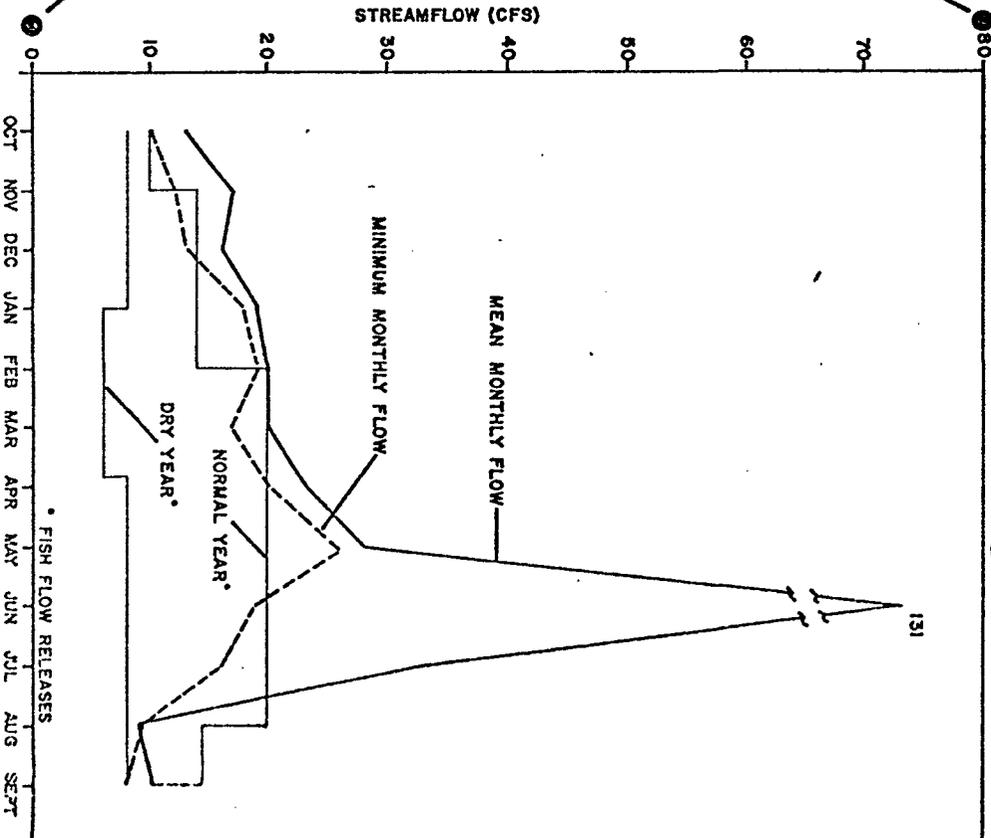
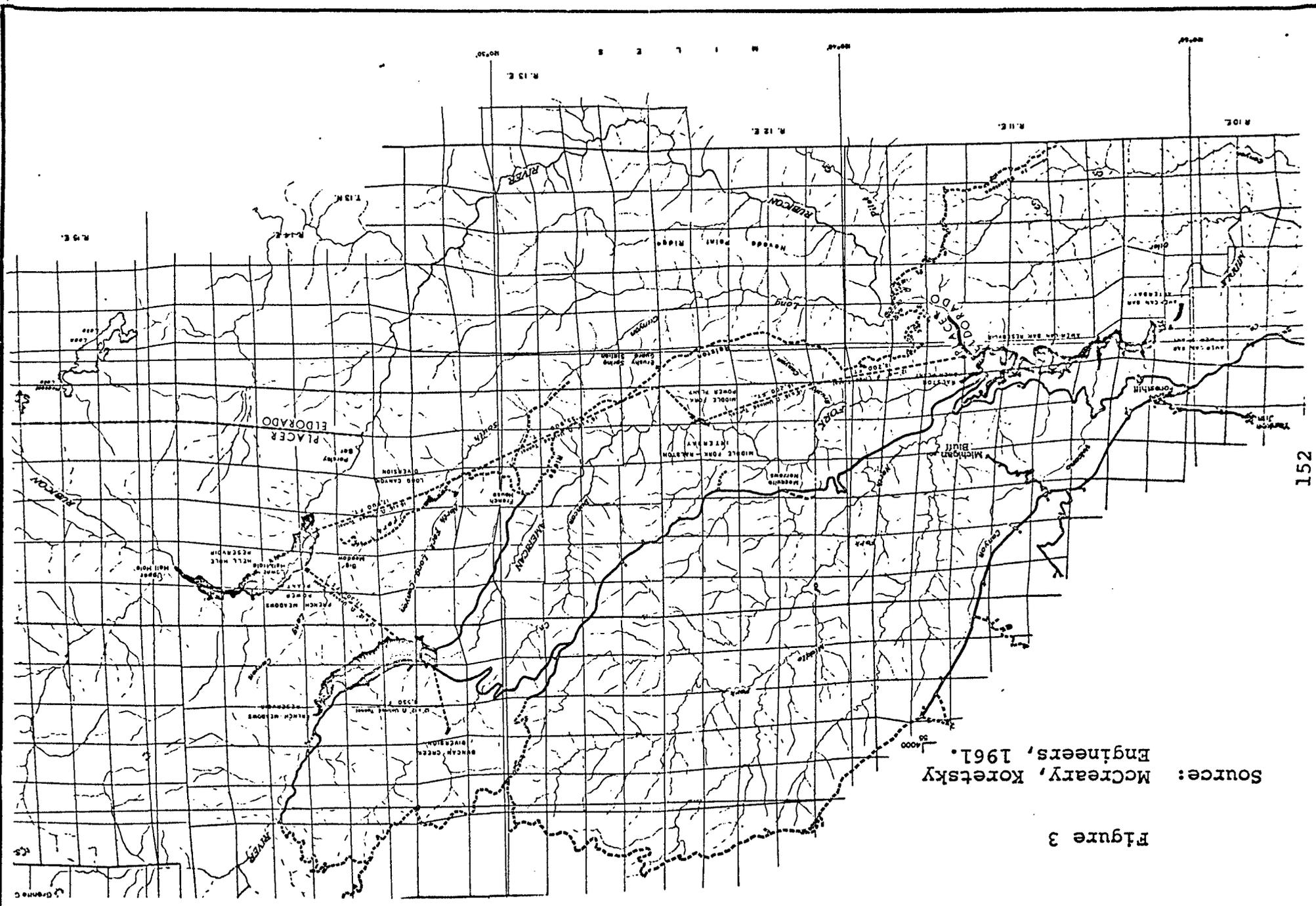


FIGURE 2
STREAMFLOW CONDITIONS, RUBICON RIVER
BEFORE AND AFTER CONSTRUCTION OF
HELL HOLE RESERVOIR



C-064136



Source: McCreary, Koretsky
Engineers, 1961.

Figure 3

snowmelt, freezing conditions between January and March and peak snowmelt runoff from April to June. Summer and early autumn stream flow result mainly from subsurface accretions to stream flows. Great monthly variations occurred depending upon the water year, the rapidity of snowmelt and intensity of rainfall.

Rainbow trout were present in large numbers while brown trout were less abundant and confined to slow moving sections of the river. Ample spawning areas existed and large trout populations were maintained under natural circumstances. Trout food supply, spawning conditions and fishing were especially good in the Hell Hole region.

III. Project Development

The Middle Fork American River project was licensed (FPC #2079) for 50 years by the Federal Power Commission in 1963. After learning of the proposed project, the Department of Fish and Game began investigations to determine its effect upon the fish and wildlife resource of the Middle Fork of the American River. The Department of Fish and Game developed a description of pre-project conditions with major emphasis upon minimum stream flow conditions, stream temperature variations and aquatic habitat.

Summer stream flows on the Rubicon were examined by Department of Fish and Game field investigators for a 3-year period (1952-54) during June, July and August. All flow measurements were taken at Campers Flat. The lowest recorded flow was 4.73 cfs on August 20, 1954; however, a note in the Department of Fish and Game Region II stream files indicated that at one time the Rubicon River was so low that field personnel were unable to measure flow. The mean flows during the three summers of measurement were 29.3 cfs.

USGS surface water flow records were examined to determine annual flow characteristics of the Rubicon River prior to construction of Hell Hole Dam. A hydrograph of pre-project stream flows shows a mean monthly maximum of 2,905 cfs in June and a mean monthly minimum of less than 10 cfs in August and September. These minimum and maximum flows were taken into consideration by Department of Fish and Game prior to the development of in-stream flow release recommendations.

Stream temperatures were measured by the Department of Fish and Game during minimum summer flows, and the highest recorded temperature was 73°F in July and August of 1961.

Stream depths and aquatic habitat types were mapped from transect measurements in a section of the Rubicon River near the Hell Hole Dam site. Ten transects at 50-foot intervals

were used. The resulting maps indicate that good food and cover existed at each transect, but there was very little spawning habitat. The information generated by the stream flow-temperature-habitat investigation and Department of Fish and Game's general knowledge of fishery conditions in the river were used to formulate in-stream flow release recommendations.

Initial stream flow release recommendations were made by Department of Fish and Game at the request of the Placer County Water Agency for their use as planning guides. The preliminary recommendation, made on August 18, 1958, was: "May 1 through October 31, 20 cfs and November 1 through April 30, 10 cfs.

The Department of Fish and Game made different recommendations on April 11, 1962:

"Normal Year: 20 cfs June 1 through July 25
15 cfs July 26 through August 5
10 cfs August 6 through October 31
14 cfs November 1 through January 31
20 cfs February 1 through May 31

"Dry Year: 8 cfs June 1 through December 31
6 cfs January 1 through March 26
8 cfs March 26 through May 31"

"These flows may be rearranged as long as they do not exceed 11,000 acre-feet in a normal year or 5,500 acre-feet in a dry year. A dry year is designated as when the unimpaired runoff at Folsom Reservoir is less than 1,000,000 acre-feet per year."

As additional conditions to protect fish during construction, Department of Fish and Game recommended that:

"Where the Agency [Placer County Water Agency] proposes to remove vegetation from a reservoir site, strip earth from dam abutments, remove sand or gravel from a stream, wash gravel near a stream, or carry on any activity in or along the stream which might result in muddying, silting or allowing to enter the stream any substances, such as oil, which might injure fishlife or fish habitat, the Agency shall require all contractors to provide and maintain in effective condition check dams, settling ponds, and such other features as may be required to maintain the fishery values of streams below such operations. The Agency shall notify its contractors of the necessity for compliance with California Fish and Game Code Sections 5650, 5948, 12015, 1601 and 1602, and other applicable statutes relating to pollution prevention or abatement, and shall include reference to these items in construction contracts it may issue."

These recommendations were negotiated and a final agreement was reached on July 30, 1962. It was incorporated in Water Rights Board Decision #D-1104 (Decision approving applications 18084, 18085, 18086 and 18087) which was adopted November 21, 1962. The portion of the Department of Fish and Game-Placer County Water Agency agreement relating to Hell Hole Dam and Reservoir is presented below:

2. Minimum Stream Flows

"A. Minimum releases for stream flow maintenance shall be based on the same estimate by the California Department of Water Resources of the total unimpaired runoff into Folsom Reservoir, and shall govern such minimum releases for the same period, as in the case of minimum reservoir storage under Article 1(A) hereof. Hereinafter in this Article 2, a normal or wet year is a year in which such estimated total unimpaired runoff is 1,000,000 acre-feet or more and a dry year is a year in which such estimated total unimpaired runoff is less than 1,000,000 acre-feet. The Agency shall release not less than the following flows for the maintenance of fishlife from the various project dams into the natural streams below such dams:"

"D. From Hell Hole Dam:

1) Normal or wet years:

- a) June 1 through July 25, 20 cfs
- b) July 26 through August 5, 15 cfs
- c) August 6 through October 31, 10 cfs
- d) November 1 through January 31,
14 cfs
- e) February 1 through May 31, 20 cfs

2) Dry years:

- a) June 1 through December 31, 8 cfs
- b) January 1 through March 25, 6 cfs
- c) March 26 through May 31, 8 cfs

3) The Department [Department of Fish and Game] and the Agency [Placer County Water Agency] agree that in the event changes in the above releases are deemed desirable to improve fishery and recreational values, the flow schedules may be changed, provided both parties agree to the change and the total amount of water released does not exceed 11,000 acre-feet in a wet year and 5,500 acre-feet in a dry year."

Furthermore the construction agreement as stated earlier was retained in the final agreement, and additionally, the Agency shall allow public access to the project lands and waters except in areas where public safety, security of the Agency's property or interference with project operations are the controlling factors.

In 1964, during the construction of the Hell Hole Dam, heavy storms washed out the uncompleted structure and the ensuing flood swept down the Rubicon River Canyon with destructive force. The scouring effect of this flood eliminated riparian vegetation and eroded the banks to 50 or 60 feet above

the present level of stream flow and greatly altered the downstream channel. The dam was reconstructed and completed in 1966.

IV. Post-Project

One year after completion of Hell Hole Reservoir, Department of Fish and Game conducted a 1-day evaluation of the downstream river, the results of which were recorded in Department of Fish and Game Region II stream files. The following excerpt from this report by Eric Gerstung (Department of Fish and Game Fishery Biologist) describes the post-project stream conditions:

"On June 10, 1967, the Rubicon River immediately upstream from the Ralston Powerhouse was examined. The river was flowing at an estimated 200 cfs and clear with a water transparency of about six feet. Riffle areas appeared to be free of silt or sand. Some sand and tunnel muck could be observed in the slower pools. Pools of 10 to 15 feet in depth are frequent. Cover in the form of large boulders and turbulence is abundant. Aquatic insect life consisting primarily of mayfly larvae appeared to be fairly numerous. Considerable quantities of spawning gravel were also noted. Vegetation within the river bed seems to be recovering well. Within the denuded zone patches of alder, willow, pipevine, monkey flower, and sedge are springing up along the water's edge. Some of the alders are already five feet high. Grass is beginning to cover portions of the slides in moister areas. Slides have also moved soil into some sections of the devastated zone, thus encouraging growth of vegetation.

"As for fish, the trout population appears to be reestablishing itself although the trout density still appears to be low. Fishing a spinner along one-fourth mile of river I had 12 strikes and landed 3 rainbows 8, 10 and 12 inches long, all slim and very silvery. Most fish observed were in the 8 to 10-inch

class. Only one trout fry was observed. No squawfish or roughfish other than suckers were encountered. It was evident that a few anglers fished the river this year. Two sets of footprints were noted in the damp sand along the shore.

"Because of upstream diversions and the lack of shade, summer water temperatures may become high. Water temperature measurements should be made in July and August of 1967. If water temperatures remain favorable, the present sparse fish population might be augmented with a plant of rainbow fingerlings.

"In mid July of 1967, Larry Trumbull and Ted Fenner of the Central Valley Water Quality Control Board, hiked down the Rubicon River from Hell Hole Dam. They reported that the stream flow was beneath the dam rubble until it reappeared at the lower end of Parsley Bar.

"Downstream from this point the stream was cold and clear with an abundance of spawning gravel. Eight-inch rainbow trout and a few larger ones were prevalent and fishing was good. Some vegetation appeared to be moving into the devastated area."

A more detailed stream survey was conducted by the U. S. Forest Service in September 1973. A 9.5 mile section of the Rubicon River extending from Hell Hole Dam to Elicott's Crossing was surveyed. A considerable amount of data was collected for the upper middle and lower sections of the river.

A brief summary of the investigation is presented below along with management recommendations.

"The upper portion of the Rubicon River was surveyed on September 18 and 19, 1973. The study section extends from the Hell Hole Dam to Elicott's bridge.

"The river immediately below the Hell Hole Dam is small (3-4 cfs) and is intermittently subterranean as far down as the beginning of Parsley Bar. Small trout exist in the lower potholes. They were not identified as to species and were not significant populations.

"The river gradually increases in size until it flows at 35 cfs (est) just below Elicott's Bridge. The water has exceptional transparency, a sign of low fertility, throughout these study sections.

"Two live tributaries were recorded in this section. Long John Creek enters from the north bank about 1/2 mile below the Parsley Bar Crossing. It was barely flowing and showed no evidence of fish life. The silt load appeared negligible. The South Fork of the Rubicon enters from the South Bank approximately 1 mile upstream from Elicott's Bridge. The flow was approximately 5 cfs and the temperature was 58°F at 1330. Light amounts of sand and silt were present. Fish, probably brown and rainbow trout, were observed near the mouth.

"Several springs exist on the northwest bank 1/8 mile below Elicott's Bridge.

"The river channel consists mostly of rubble, gravel and sand. The ratio of sand to the other materials increases with downstream distance.

"In 1964, during the construction of the Hell Hole Dam, heavy storms washed out the structure and the ensuing flood swept down the Rubicon River Canyon with considerable force. The scouring effect of this flood eliminated riparian vegetation and eroded the banks to 50 or 60 feet above the present level of streamflow.

"The riparian vegetation is beginning to reestablish itself in the form of alder and willow. Midday insolation is still very high however, and might have a detrimental effect on the trout population. Some locally moderate amounts of green filamentous algae exist where velocities are low and insolation is high. Shade is important for cover and resting areas and for thermal balance during the warm summer period.

"A large portion of the steeper banks remain barren and undoubtedly contribute sediments during times of precipitation.

"A good population of rainbow trout exist from Parsley Bar downstream. Brown trout are present but not common. Fish from 4 to 16 inches were observed

upstream from Elicott's and one 24-inch rainbow was observed downstream. The stomach contents of a 14-inch male rainbow were examined from this lower section. One small trout-like fish 3 inches long, two caddis fly cases, and one adult beetle were present.

Management Recommendations:

"Chemical rehabilitation of this section is not recommended. Reinfestation of rough fish species could not be prevented.

"Investigate ways to stop earth slippage area from further damaging the river. However, I think it is too steep to revegetate.

"Monitor and regulate logging, road building and other activities on the watershed. Contain open fires to the picnic area at the powerhouse.

"Light to moderate use was evident on the trail and several old campsites existed along the way. One couple was camping and fishing at the mouth of the South Fork of the Rubicon.

"Bear sign was quite noticeable throughout the section. Tracks or scat were often visible along the trail. Two bear were sighted on September 18, 1973. The first was approximately 1/4 mile above the Elicott Bridge on the south bank. The other was seen crossing the river at Parsley Bar. Both bear were of black coloration and looked like yearlings.

"The limiting factors working on the trout population are the basic infertility of the watershed and river channel, the sparsity of canopy, and light to moderate angling pressure localized near Elicott's. The stream channel gravels appeared to be adequately free of silt for suitable spawning use and food production."

The third and most recent stream evaluation was in response to a request by the Federal Power Commission for environmental data on development of Pilot Creek and the Rubicon River as an alternative to development of the Helm's project. The

evaluation involved a review of existing reports and opinions of field personnel familiar with the Rubicon River. Emphasis was on the impact of inundation of the stream bed and adjacent land by the reservoir rather than stream conditions.

The California Fish and Game Commission designated in 1971 the lower Rubicon River as a special wild trout management stream. Under the designation, perpetuation and production of wild strains of trout will be given emphasis in contrast to the provision of a recreational fishery by planting of domestic catchable sized trout. Streams within the wild trout program are expected to receive greater attention when threatened by development than other streams. A wild trout management program has been prepared by Department of Fish and Game for the lower Rubicon River.

V. Conclusion

Comparison of the pre- and post-project hydrographs (Figure 3) illustrates similar seasonal flow patterns but greatly different quantities of stream flow. During the pre-project period, peak flows during late spring-early summer ranged from about 1,500 to 3,000 cfs, whereas since 1965 the average monthly peak flow was 131 cfs and less than 30 cfs in a dry year. One would expect such a change in flow to greatly modify the physical habitat below the dam; however, the 1964 flood and failure of the dam so altered the downstream habitat that what would have happened to the physical habitat under

normal circumstances is moot. Influxes of sediment from tributary areas have also influenced the stream channel. As a result of the dam and the 1964 catastrophe, trout habitat and populations are expected to evolve in response to the flow regime illustrated in Figure 3.

The small amount of post-project information available reports a dominance of rainbow trout. The physical habitat tends to inhibit non-game fish species other than native suckers, sculpins, and dace.

A major energy source to such streams is the inflow of detritus from bordering land. The scouring of high flows in 1964 and before has restricted riparian growth and lessened the potential for detrital input. In the long run, stabilization of riparian soils, subsequent plant growth and detritus should increase the trout production.

Because of lack of data, comparison of the post-project condition to the pre-project era is subject only to speculation.

Project development relative to fish releases was generally based on habitat assessment by transect measurement of depth and a subjective determination of areal habitat associated with depth at different levels of summer and early autumn flow. The viewpoint in such investigations seems to be to determine minimum flows that provide acceptable amounts of holding habitat in summer and spawning habitat in spring for rainbow trout.

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