

CASE STUDY REPORT #4
TRINITY-LEWISTON DAMS
TRINITY RIVER

I. Project Description

The Trinity River Diversion Project was constructed by the U. S. Bureau of Reclamation in 1963. The three major project components are: Trinity Dam, Lewiston Dam, Clear Creek Tunnel and associated powerplants (see Figure 1). Trinity Dam on the Trinity River forms Clair Engle Lake which impounds 2,448,000 acre-feet and covers 16,400 acres. Immediately below Trinity Dam is Lewiston Dam which regulates and diverts releases from Trinity Powerhouse. Lewiston Dam has a maximum surface area of 610 acres. Water is diverted from Lewiston through the Clear Creek Tunnel to Whiskeytown reservoir, a tributary to the Sacramento River, and thence to Keswick Reservoir (see case study 67A) (Figure 1).

A salmon and steelhead hatchery was placed at Lewiston to compensate for the loss of spawning and nursery areas destroyed by the Trinity Diversion Project. The Trinity Hatchery can take up to 35,000 adult salmon and steelhead in one season. Peak production of reared fish is about 31,000,000 fingerlings and 300,000 yearling king salmon; 4,000,000 fingerling and 500,000 yearling silver salmon; and 5,000,000 fingerling and 700,000 yearling steelhead. These fish are released into the Trinity River to sustain sport and commercial fisheries.

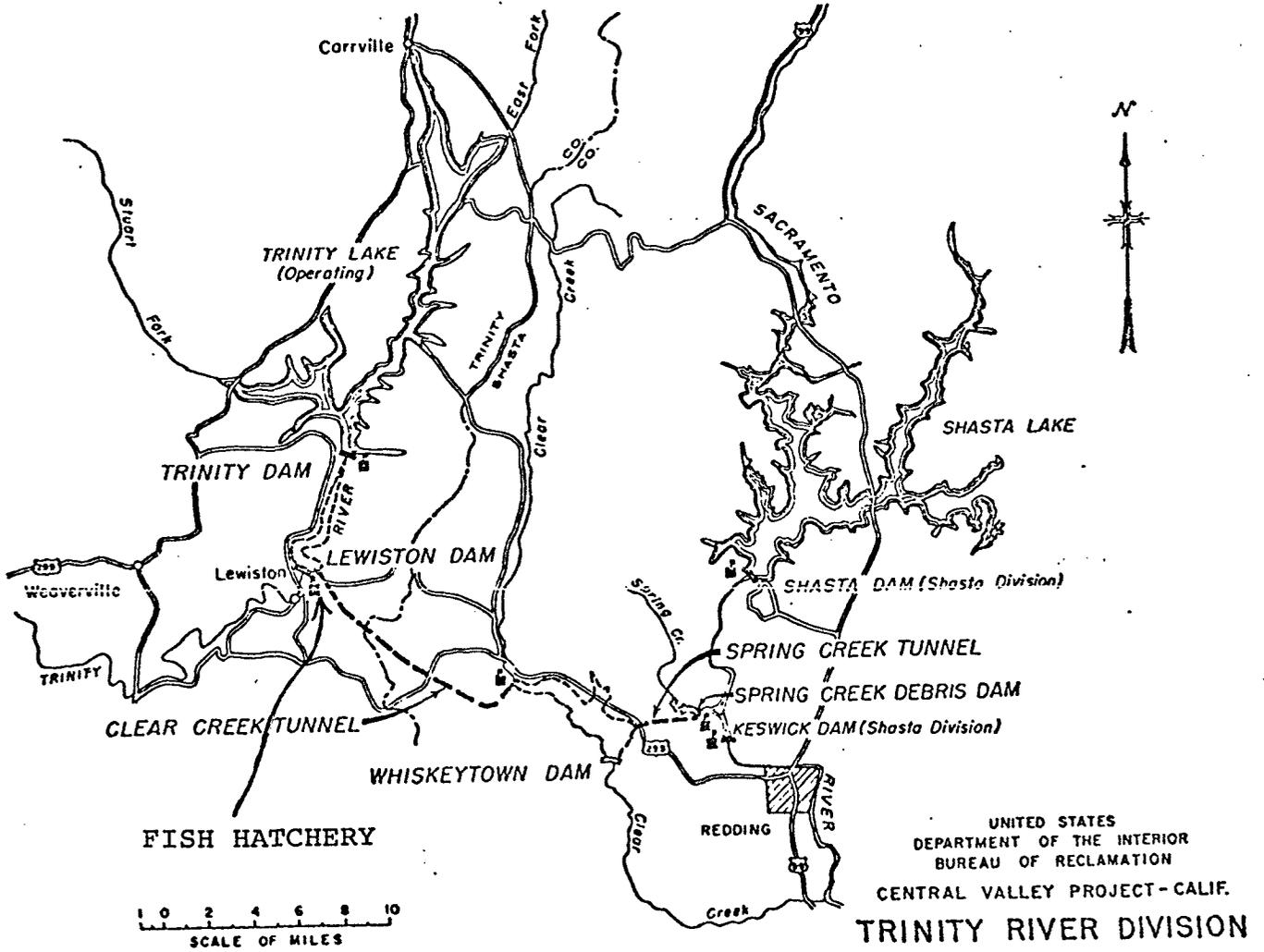


Figure 1
 LOCATION OF TRINITY DIVERSION PROJECT
 Source: U. S. Bureau of Reclamation, 1960.

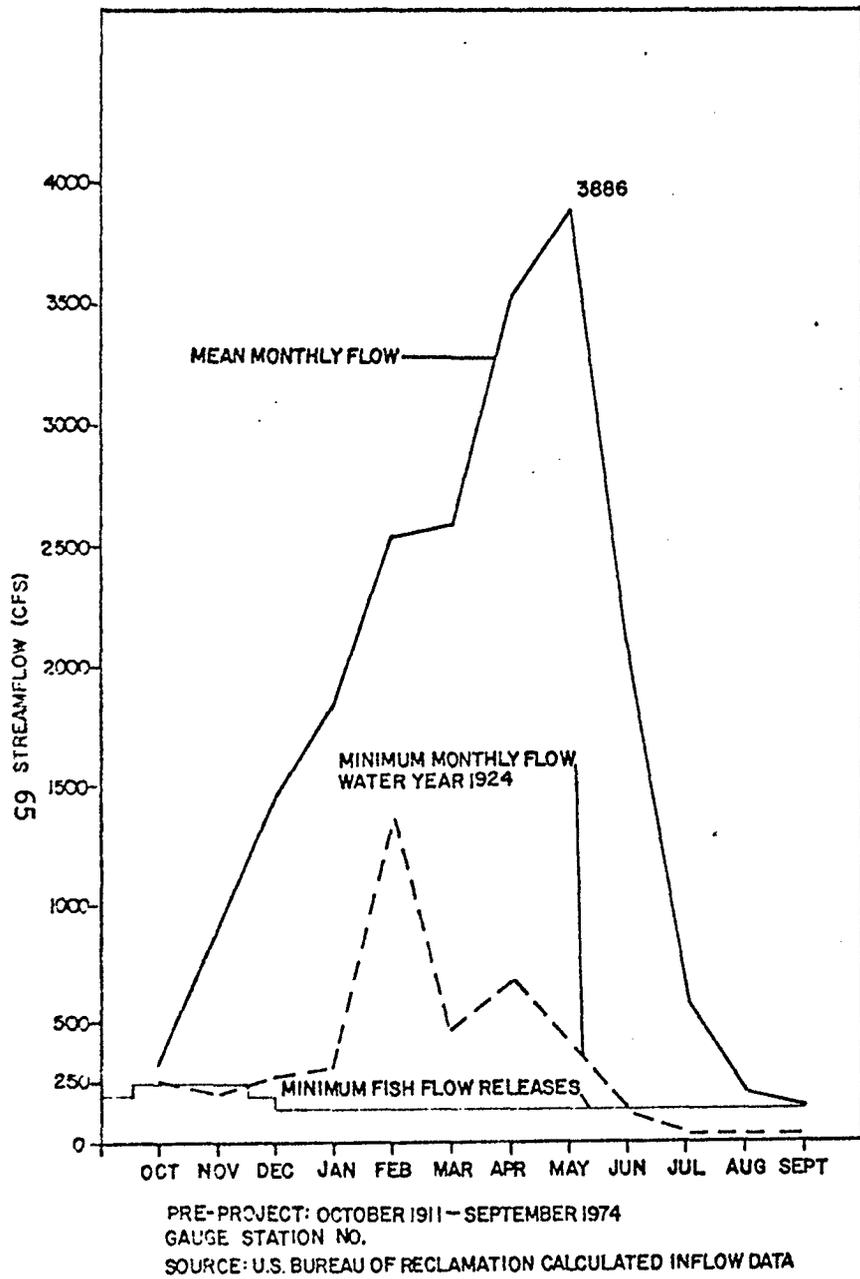
II. Pre-Project Condition

The Trinity River is a major tributary of the Klamath River and drains a semi-wilderness area of approximately 3,000 square miles (Figure 1). The river originates on the south slopes of the Trinity divide and historically flowed unimpaired approximately 170 miles to its confluence with the Klamath River at Weitchpec. Figure 2 shows mean monthly flows prior to the project.

The Trinity River is famous for its gold mining activities in the mid 1800's. In early times, some rather large gold mining communities occupied its banks and most of the presently existing towns are remnants of these settlements. The extensive gravel deposits above the North Fork Trinity River were dredged for gold. Expansive spoil piles of barren gravel constitute the original stream bank for numerous miles. Many gravel beds historically used for spawning were inundated by sediments discharged into the stream by mining operations.

By the turn of the century, the river had recovered and again the Trinity was well known for its scenic beauty and as an excellent sport fishery for salmon, steelhead, sturgeon and resident trout.

In the mid 1950's several plans for the development of dams and hydroelectric power facilities were being developed by Department of Water Resources and U.S. Bureau of Reclamation. With alteration of the Trinity River imminent, the California Department of Fish and Game initiated preliminary surveys



POST-PROJECT: OCTOBER 1965 - SEPTEMBER 1975
 GAUGE STATION NO.
 SOURCE: U.S. BUREAU OF RECLAMATION OUTFLOW DATA

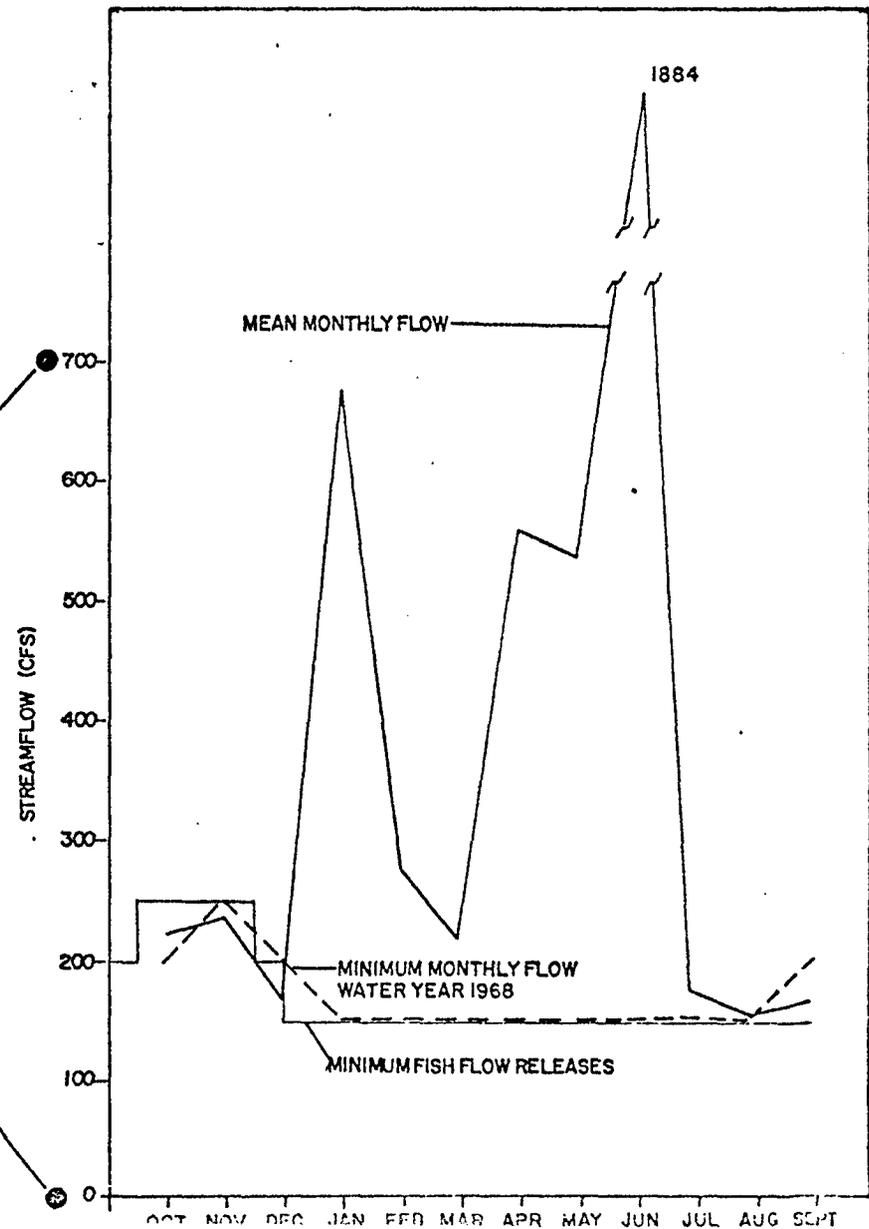


FIGURE 2
STREAMFLOW CONDITIONS, TRINITY RIVER
LEWISTON RESERVOIR

to determine the requirements necessary to maintain and manage its native populations of anadromous fishes. This work was performed as part of Dingell-Johnson Project California F-10-R, "Coastal Streams Anadromous Trout and Salmon Study," supported by Federal Aid to Fish Restoration funds.

Results of the Department of Fish and Game study indicated that:

"Almost without exception, Trinity River salmon migrating above the South Fork spawn in the 72 miles of river between the North Fork and Ramshorn Creek. In addition to the main river, three tributaries are used by spawning salmon. A dam at the Lewiston site would cut off 35 miles of the main river and all of the Stuart Fork, the most important spawning tributary. The salmon would be blocked from approximately 50 percent of their natural spawning grounds in the upper Trinity. A dam at Browns Creek site would cut off the remaining two spawning tributaries and 59 miles of the main river spawning area. This dam would eliminate 82 percent of the natural salmon spawning area."

In the course of investigating the anadromous fishery the Trinity River was mapped indicating areas of special concern. A brief description of the Trinity River in relation to associated fisheries follows:

"It is divided into five more or less distinct sections which have a direct bearing on the utilization of the stream by spawning and juvenile anadromous fishes. The uppermost 18 miles of the river from its source to Ramshorn Creek are precipitous (gradient 222 ft./mile), the channel is narrow, gravel riffles are very limited, and the bottom is covered with large boulders. The 12-miles of river between Ramshorn Creek and Trinity Center traverse a broad valley into which many small tributary streams enter. The stream has a gradient of 58 feet per mile and meanders thru wooded and pasture lands wherever gold dredges have left the original terrain. Its channel is broad and gravelly with large extensive riffles alternating with deep pools. From Trinity Center to North

Fork, the gradient is less severe (15 ft./mile), water volumes are greater, and very extensive riffles characterize the channel. Most of the spawning grounds of salmon are located in this 60 mile section of the stream. Between its North and South Forks the river passes thru a rocky canyon 40 miles in length. Water flows are concentrated and made turbulent and exceedingly rapid by the narrow confines which typify this canyon. Gradients are more severe (23 ft./mile) and volumes of flow, in relation to channel capacity, are relatively great. The Trinity between South Fork and its confluence with Klamath River meanders (gradient 12 ft./mile) the length of beautiful Hoopa Valley (29 miles) and is characterized by broad gravel riffles alternating with large, deep pools.

"Adult king salmon migrate past Lewiston enroute to their spawning grounds in what appear to be three seasonal groups: one in spring, one in summer, and one in fall. Each of these groups, excepting possibly the spring run, is distinct and divisions between them are well defined. The spring migration passes Lewiston during June and July, the summer migration during August and September, and the fall migration during October and November."

Stream flow in the Trinity prior to the construction of impoundments was a response to annual precipitation trends. The mean monthly discharge patterns as shown in Figure 2 illustrate a response to early winter rainfall and snowmelt. Summer and early autumn stream flows result mainly from subsurface accretions to stream flows. Great variations occur depending upon the water year, the rapidity of snowmelt and intensity of rainfall.

III. Project Development

Plans to divert Trinity River water to the Central Valley of California were formulated and published in 1931. These plans were further studied and refined by the U. S. Bureau of Reclamation and the U. S. Army Corps of Engineers. The final schedule for development was formulated and initial preparations

were made to solicit bids on the construction of the project by mid-1941.

It was apparent to the various agencies involved that the diversion of Trinity River water would seriously affect the fishery resources that are dependent upon the Upper Trinity River. In order to determine the magnitude and biological characteristics of these resources and to design management plans and procedures for their protection, the U. S. Fish and Wildlife Service conducted a comprehensive survey and study of the entire problem. Major features of the study were to involve: (1) the size and composition of fish population, (2) the characteristics of the seaward migration of young salmon and steelhead trout, (3) the extent and utilization of spawning gravels, (4) the physical characteristics of the drainage, (5) existing biological conditions, and (6) possible means of controlling the fishery and its environmental factors. Work was started in the fall of 1942, which included the construction of a fish counting weir at the town of Lewiston and the initiation of a formal study directed toward investigating the biological and physical conditions in the Upper Trinity River.

Studies of the Trinity River fishery continued from 1942 through 1946, at which time wartime impediments resulted in a suspension of the investigation. Subsequently it was impossible for the Fish and Wildlife Service to develop any final conclusions from the partially completed study.

These investigations were completed in August 1946 and the results were published in 1950. The final report described the physical and biological characteristics of the Trinity River, and discussed the effects of future water development plans on the fishery.

Several alternatives were evaluated for the mitigation of the loss of spawning habitat to be inundated by the construction of dams and reservoirs on the Trinity River. Three methods of maintaining the anadromous fishery were considered: increased instream flows above normal during the spawning period thereby inundating more spawning gravel, development of certain tributaries into acceptable spawning areas, and fish hatcheries could be constructed where blockage of migration routes occur.

Evaluation of these alternatives found the construction of a fish hatchery to be the most feasible. As further compensation for the reduction in fishery habitat, minimum instream flow release schedules were developed. The recommended flow releases were:

October	150 cfs
November	300 cfs
December through March	200 cfs
April through June	150 cfs
July through September	100 cfs

Wildlife evaluations contained in reports prepared by the U.S. Fish and Wildlife Service and U. S. Forest Service indicate that, prior to construction of the reservoirs, a herd of 4,000 to 6,000 black-tailed deer inhabited the project zone

of influence. The reports state that, during the winter months, the deer concentrated on south-facing slopes and portions of the main river bottoms below the 2,500-foot elevation and that a major portion of their critical winter range would be inundated (maximum pool of Trinity Reservoir being 2,390 feet). The reports also state that ancestral migration routes could be blocked by the reservoir and that the deer herd would be reduced in proportion to the carrying capacity of the habitat destroyed.

Upon notice of the U. S. Bureau of Reclamation's application for unappropriated water, the California Department of Fish and Game filed a protest to the proposed instream flow releases. Negotiations with the U. S. Bureau of Reclamation resulted in the following instream release agreement dated September 6, 1959.

"The Bureau shall at all times bypass or release over, around or through Lewiston Dam the following quantities of water down the natural channel of the Trinity River for the protection, preservation, and enhancement of fish and wildlife from said dam to the mouth of said stream":

September 1 - October 14	200 cfs
October 15 - November 14	250 cfs
November 15 - November 30	200 cfs
December 1 - August 31	150 cfs

"Any water released through said Lewiston Dam for the use in the fish hatchery now under construction adjacent thereto shall be considered as partial fulfillment of the above schedule."

This agreement was incorporated into the water rights application as a protest dismissal term.

IV. Post-Project

The storage and trans-basin diversion of Trinity River water has resulted in substantial changes in the physical character of the river downstream from Lewiston Dam. The State of California Senate Standing Committee on Natural Resources reported that:

"Average annual runoff has been reduced 88 percent, and expected peak flows during major storms have been reduced from over 70,000 to less than 300 cubic feet per second at Lewiston. Thus, the impoundment of water behind Trinity and Lewiston dams has converted a highly fluctuating river to a small, stable stream."

Historic high Trinity River flows washed out accumulated sediments, cleansed the gravel beds and retarded the growth of stream bottom and stream bank vegetation. Under the present reduced flow situation the stretch of river channel below the dams now serves as a delta for the deposition of sediments coming from uncontrolled tributaries. The river has lost its ability to flush the heavier sediments, subsequently sediments are filling pools and covering spawning grounds. Riparian vegetation and rooted aquatic plants are encroaching upon the stream channel. The Senate Task Force report indicated that due to reduced flow and slack water, aquatic vegetation is encroaching upon spawning riffles, creating more favorable conditions for the deposition of silt and accelerated habitat deterioration.

"Large numbers of king salmon and steelhead spawn in the Trinity River and its tributaries. Aerial counts of king salmon spawning nests in the Trinity River (1955, 1956, 1963, 1967) show that the 16-mile stretch between Lewiston and Douglas City is the most heavily used portion of the Trinity River for spawning. For example, in 1963, an estimated 50,000 king salmon spawned in this section of the river. This is 65 percent of the total spawning escapement in the river. A survey of steelhead nests in 1964 indicated that a minimum of 960 steelhead spawned in this same stretch. Brown trout and silver salmon are also present in this area, but comparable counts are not available.

"Spawning riffles and nursery areas for salmon and steelhead have already been destroyed or seriously downgraded in about eight miles of the Trinity River below the mouth of Grass Valley Creek. Additional stretches of the river have been less seriously affected above and below this area of extreme damage. All of this damage has occurred since flows were reduced by Trinity Dam in 1960. The sediment causing the problem is expected to remain in the areas now affected and to extend downstream as time goes on unless corrective action is taken.

Several governmental agencies have studied the sedimentation problem. The conclusion reached by each investigation varied, however, several reports agree that reduced discharge in the Trinity River is a major cause.

"Between 1961 and 1964, the U. S. Geological Survey documented changes in the geometry of the Trinity River channel and concluded that large changes in morphology were caused by the flood of 1964 and, to a lesser extent, by the regulation of flow by Lewiston and Trinity dams. The survey report placed greater emphasis on Rush Creek (and mining) than on Grass Valley Creek (and logging) as a potential sediment source. In a review of erosion and sedimentation resulting from the 1964 flood, this agency pointed out the tremendous natural erosion process underway in the Trinity River watershed.

"Important observations of changes in the fish habitat of the Trinity River were made by the California Department of Fish and Game in 1963 and 1967. The Department pointed out the formation of bars and deltas due to sedimentation, and called attention to the degradation of spawning pools and riffles. The Department believed that logging in Grass Valley Creek drainage was the main cause and source of sediment.

"In 1967, the U. S. Bureau of Reclamation, with assistance from the U. S. Bureau of Fisheries and Wildlife, investigated the situation. This agency determined that there was a siltation problem in the Trinity River at the mouth of Grass Valley Creek and ascribed the cause of excessive sediment to logging operations. Furthermore, the Bureau reported that Trinity and Lewiston dams may be of benefit to the spawning beds by keeping flood flows at a minimum and allowing coarse sand to settle out quickly instead of washing farther downstream and damaging a greater reach of spawning gravels.

"Also in 1967, the U. S. Army Corps of Engineers conducted a reconnaissance investigation of the Trinity River near Grass Valley Creek and concluded that salmon spawning areas near the mouth of Grass Valley Creek were being covered with sand and silt deposits. The Corps reported, 'It appears this could result from the combination of low flows in the Trinity River during the dry season and the heavy silt carrying capacity of Grass Valley Creek. Evidently, when the flows from Grass Valley Creek enter the Trinity River during times of low flow the sediment deposits in the river channel and form bars'."

In addition, important spawning grounds just below the dams have been scoured out due to the dam's blocking natural gravel replenishment. Two spills in 1970 and 1974 speeded this degradation.

V. Conclusions

The operation of Trinity and Lewiston Dams to produce hydroelectric power and the export of water into the Central Valley Project has resulted in an overall reduction of instream flow and changed the seasonal pattern of discharge. It is

generally accepted by several governmental agencies which have studied the sediment problem, that the reduction in flood flow is the major cause for the destruction of spawning gravels and nearby habitat below Lewiston.

Large numbers of king salmon and steelhead trout spawn in the Trinity River and its tributaries. Aerial counts of king salmon spawning nests conducted by the California Department of Fish and Game in the mid 1950's indicated that the 16 mile stretch between the cities of Lewiston and Douglas City is the most heavily used portion of the Trinity River for spawning. It was estimated in 1963 that 50,000 king salmon spawned in this section of the river.

California Department of Fish and Game reported in 1967:

"Sedimentation has destroyed an estimated 80 percent of the king salmon spawning habitat in a two mile stretch of river below Grass Valley Creek, and an estimated 50 percent in the next 6 miles. This amounts to roughly 28 percent of the total spawning area in the important 16-mile stretch between Lewiston and Douglas City. To illustrate the numbers of fish involved, based on the size of the 1963 run (50,000 fish), spawning habitat for roughly 14,000 king salmon has been lost. Sediment deposition and aquatic vegetation encroachment have also reduced fishability of the river.

"Habitat losses for juvenile salmon and steelhead are also serious, although they cannot be quantified."

Spawning riffles and nursery areas for salmon and steelhead have been destroyed or seriously downgraded in about 8 miles of the Trinity River below Grass Valley Creek. Additional stretches of the river have been less seriously affected

above and below this area of extreme damage. Reduction of rearing and downstream migration flows have produced serious problems for the juvenile fishery. All of this damage has occurred since flows were reduced by Trinity Dam in 1960.

The Senate Standing Committee on Natural Resources Task Force Report has recommended six possible methods to mitigate damage to fish habitat below Lewiston Dam. These recommendations are as follows:

- "1. The Task Force recommends that the Resources Agency enter into negotiations with the Bureau of Reclamation to determine the most feasible method or combination of methods and proceed to correct the problem.

"Although most of the area logged is recovering satisfactorily by natural revegetation processes, erosion problems caused by improper drainage and exposed soil persist on temporary roads, road spoils, and old landings.

- "2. The Task Force recommends that the Department of Conservation, the landowners, and the forest products industry jointly develop a program to stabilize sediment sources on logged areas that are not naturally stabilizing.

"In addition to the temporary logging roads, permanent roadways are contributing sediment. On many sections of roadway, localized erosion problems caused by improper drainage and unstable cuts and fills persist.

- "3. The Task Force recommends that all parties with a vested interest in roads located in the study area mutually develop an action plan to minimize erosion from roadways. This group would include landowners, the timber industry, Trinity County, Department of Conservation, Department of Fish and Game, and the Division of Highways.

"In recognition of sediment problems and the need for stronger regulations, the Forest Practice Committee of the Coast Range Pine and Fir Forest District amended the erosion control rules of this district in 1968. Other Forest Districts also have amended their erosion control rules. These more comprehensive and strengthened rules, together with improved harvesting practices, should greatly reduce sediment problems from future logging.

- "4. The Task Force recommends that the effect and adequacy of these new erosion control regulations be critically reviewed by the State Board of Forestry on an annual basis, starting this year.

"In developing various water projects over the past 25 years, agencies have given a great deal of attention to feasibility studies, authorizing legislation, pre-project planning, and project construction; however, very little effort has been given to post-construction evaluation of environmental problems. Problems similar to this one in the Trinity River might be avoided elsewhere if possible post-construction problems are known in advance.

- "5. The Task Force recommends that the Resources Agency conduct a review of existing water projects in California for the purposes of identifying downstream sediment and related problems which have developed as a result of construction or operation of water projects and were unforeseen or not taken into account during the planning process.

"Both state and federal fish and game agencies have the authority, responsibility, and programs to develop fish and wildlife mitigation and enhancement provisions for water projects.

- "6. The Task Force recommends that water development and fishery agencies be directed to broaden their pre-authorization planning to include careful consideration of the effects that water projects may have on downstream channel conditions. The State should make certain that adequate measures to prevent deterioration of downstream habitats are included in the project."

Since the 1970 task force report, a new 3-year Trinity action program has been funded by Congress.

"Congress appropriated for the Trinity River Basin Fish and Wildlife Action Program \$300,000 to initiate the program in FY 1956 with an additional \$200,000 to carry the work during the transition quarter. The Action Group level of the Task Force met on January 15, 1976, and allocated costs to the high priority work items. The Management Group and the Task Force will consider the recommended work programs for implementation." (Department of Fish and Game, 1976).

The objective of the program is to improve and restore the fisheries and river environment to pre-project levels.

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