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TASK FORCE

FINDINGS AND RECOMMENDATIONS

on

SEDIMENT PROBLEMS

in the

TRINITY RIVER NEAR LEWISTON

and a

SUMMARY OF THE WATERSHED INVESTIGATION

A Report to the Secretary for Resources

JANUARY, 1970

State of California
The Resources Agency

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The Senate Standing Committee on Natural Resources requested the Resources Agency to investigate sediment problems relating to fishery values of the Trinity River near Lewiston. This request sprang from the Committee's interim study of timberland management programs (Senate Resolution 385, 1967 Legislative Session).

In October of 1967, during a field review of forest management and stream conditions in northern California, the Committee visited a section of the Trinity River about eight miles downstream from Lewiston Dam. This section of the river is extensively blanketed with coarse granitic sand, a condition damaging to fishery values. The Committee learned that, until quite recently, this section was excellent spawning and nursery habitat for king salmon and steelhead trout.

Representatives of the Resources Agency explained that the damage is apparently related to Trinity River Project streamflow control. They stated that the apparent source of the sand is Grass Valley Creek, a tributary watershed which has experienced considerable logging and highway reconstruction activity in recent years.

Because questions arose for which there were no ready answers -- questions as to losses, sources and causes of sediment, future damages, and remedial measures -- the Senate Committee asked the Resources Agency to look into the entire matter so as to clarify both the sediment problem in the Trinity River and the Agency's capability to cope with similar erosion problems elsewhere in the State.

Acting on the Committee's request, the Agency investigated the problem in considerable detail. Specialists in watershed management, hydrology, fisheries, forestry, and geology from the Department of Conservation, Department of Fish and Game, and Department of Water Resources were pooled into a task force to conduct the investigation. This report presents their findings and recommendations, together with a brief summary of the watershed investigation.

FINDINGS

1. What is the problem?

Important fish habitat is being damaged by deposition of sediment and growth of aquatic vegetation in an 8-mile reach of the Trinity River below Lewiston and Trinity dams. Impaired river flow, since the commencement of operations of the dams, has reduced the sediment transport capacity of the river to a level far below the sediment load produced by the tributaries. Accelerated erosion caused by logging and road construction has added to the sediment contribution from the tributaries.

2. What are the losses in fishery value?

Spawning riffles and nursery areas for salmon and steelhead have been destroyed or seriously downgraded in eight miles of Trinity River below Grass Valley Creek. An estimated 28% of the total spawning area in the important 16-mile stretch between Lewiston and Douglas City has already been lost. On the basis of the 1963 salmon run, spawning habitat for 14,000 king salmon has been destroyed. Losses of fish habitat are expected to continue unless corrective action is taken.

3. What prior investigations were made?

The Department of Fish and Game has been concerned with the loss of fish habitat and has investigated this aspect of the problem. There has been no other investigation of the erosion and sedimentation problem by any unit of the Resources Agency. The U. S. Geological Survey, Bureau of Reclamation, and Corps of Engineers have investigated various aspects of the problem.

4. What are the sources of sediment and causes of erosion?

All tributaries are producing sediment, Grass Valley Creek drainage the most. Normal geologic erosion of these soils (mainly granitic) is high, a process accounting for half of the sediment produced. The effects of past logging and road construction account for most of the accelerated erosion.

5. What kinds of lands, land ownership, and land use are involved?

Most of the lands of these drainages are commercial forest lands in the private ownership of industrial companies. Timber production is the main land use.

The Trinity Project, a part of the Central Valley Water Project, is operated and controlled by the U.S. Bureau of Reclamation.

6. What is the outlook for future sedimentation and damage?

Most of the marketable timber has been harvested from the watersheds, and initially high post-logging sediment yields have been reduced considerably by natural revegetation processes. If control of erosion from roads, spoils, and old landings can be achieved, a further reduction of sediment yield should occur, and the watershed could be expected to approach its original condition. However, even with this control, continued deterioration of the fish habitat is expected unless some method can be worked out to remove natural sediment from the Trinity River channel.

7. Can the problem be be corrected?

Man-caused erosion in the tributary drainages can be minimized by conventional methods; and promising measures to minimize the sediment problem in the river have been identified. However, because of the relationship of the problem to the flow in the Trinity River, its correction depends upon the cooperation and participation of the U. S. Bureau of Reclamation in operating the Trinity Project.

8. What are the prospects for applying government programs to rectify the situation?

Assuming participation by the Bureau of Reclamation, and solution of fiscal problems that may develop, the prospects for applying government programs to rectify the situation are good.

9. What is the statewide extent of similar conditions?

There are extensive areas of these erodible granitic soils in the Sierras, Coast Ranges, and mountains of Southern California where similar erosion problems could develop. Problems could also develop in non-granitic areas, such as the North Coast, where soils are unstable and landslide prone. Each proposed major water project in these areas must be separately evaluated for possible downstream sedimentation problems.

10. Is additional authority or program effort needed?

Until corrective measures are agreed upon with the Bureau of Reclamation, needs for additional authority or program effort are not known.

In the future, more complete project planning and review, to take into account fishery needs and tributary sedimentation, is needed.

RECOMMENDATIONS

The Task Force identified possible methods to mitigate damage to fish habitat below Lewiston Dam. These methods include sediment-flushing, river bed dredging, screening or other mechanical means, and construction of articial spawning beds and debris basins.

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.

TRINITY RIVER FLOW PATTERN

The Trinity River is a major drainage system in northwestern California. Until recently, the river was wild; its flow was unregulated, determined only by the characteristics of precipitation and the drainages system. In this natural state, the river and its tributary drainages were in delicate balance ecologically. Now, its flow is regulated by the Trinity Project.

The purpose of the Trinity Project is to develop the water resources of the Trinity River for diversion to the Central Valley. This objective is accomplished by means of Clair Engle and Lewiston reservoirs; water stored at Clair Engle Reservoir is released to Lewiston Reservoir for diversion to the Sacramento River through the Clear Creek Tunnel, Whiskeytown Reservoir, and the Spring Creek Tunnel.

The storage and trans-basin diversion of a major portion of Trinity River flow has resulted in substantial changes in the regimen of the river downstream. 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.

DAMAGE TO THE FISHERY

The reduced flows of the Trinity River have had profound effects on its ecology. Formerly, the high flows washed out accumulated sediments, cleansing the gravel beds and retarding growth of stream bottom and stream bank vegetation. Now, with reduced flows and consequent reduction in sediment-carrying capacity, the ability of the river to perform this necessary function has been drastically reduced. The stretch of river channel below the dams now serves as a delta for the deposition of sediment coming from the uncontrolled tributaries. Because the river has lost its ability to flush the heavier sediments, sand is filling pools and covering spawning grounds (fig. 1). Because of reduced flow and slack water, riparian vegetation and rooted aquatic plants are encroaching on spawning riffles, creating conditions for deposition of silt and further 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

Fig. 1. Sand and gravel deposits in the Trinity River at the mouth of Grass Valley Creek, October, 1967.

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.

It is difficult to quantify the impact of this sedimentation upon the king salmon and steelhead runs. However, sedimentation has already 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.

EARLIER INVESTIGATIONS

Although the California Department of Fish and Game and several agencies of the federal government investigated certain aspects of the problem prior to this present study, no thorough investigation was made by these agencies or by the Resources Agency acting as a coordinating body.

Because each of the earlier investigations was limited in scope or approached the problem differently, it is not surprising that conclusions and emphasis differ. Reported causes include mining, reduced flows, logging, the 1964 flood, and the high silt-carrying capacity of tributary streams. Significant, however, is the fact that several reports agree that reduced flow of 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."

The reports of these preliminary investigations constitute what was known about the sediment problem at the time the spawning beds were visited by the Senate Committee.

THE TASK FORCE INVESTIGATION

OBJECTIVES OF THE WATERSHED INVESTIGATION

Because of the dual nature of the cause of the problem -- reduction of the sediment-carrying capacity of the river coupled with accelerated erosion and continued sediment delivery by the tributary drainages -- the task force designed its watershed investigation along these two lines: (1) an erosion study designed to pin-point sediment sources and causes and to determine amounts and trends of sediment production, and (2) a hydrologic study designed to determine the ability of the streams to transport sediment under present and projected conditions.

DESCRIPTION OF THE WATERSHED STUDY AREA

Field investigations were conducted within the drainages tributary to that reach of the Trinity River suffering the greatest loss of fish habitat -- a reach from Lewiston dam to a point approximately eight miles downstream. Included in this drainage area are the Grass Valley - Little Grass Valley and five other small watersheds (fig. 2 and table 1).

These watersheds are ruggedly mountainous; 79 percent of this area lies at grades exceeding 50 percent. The steep slopes and narrow valleys indicate an active erosion process.

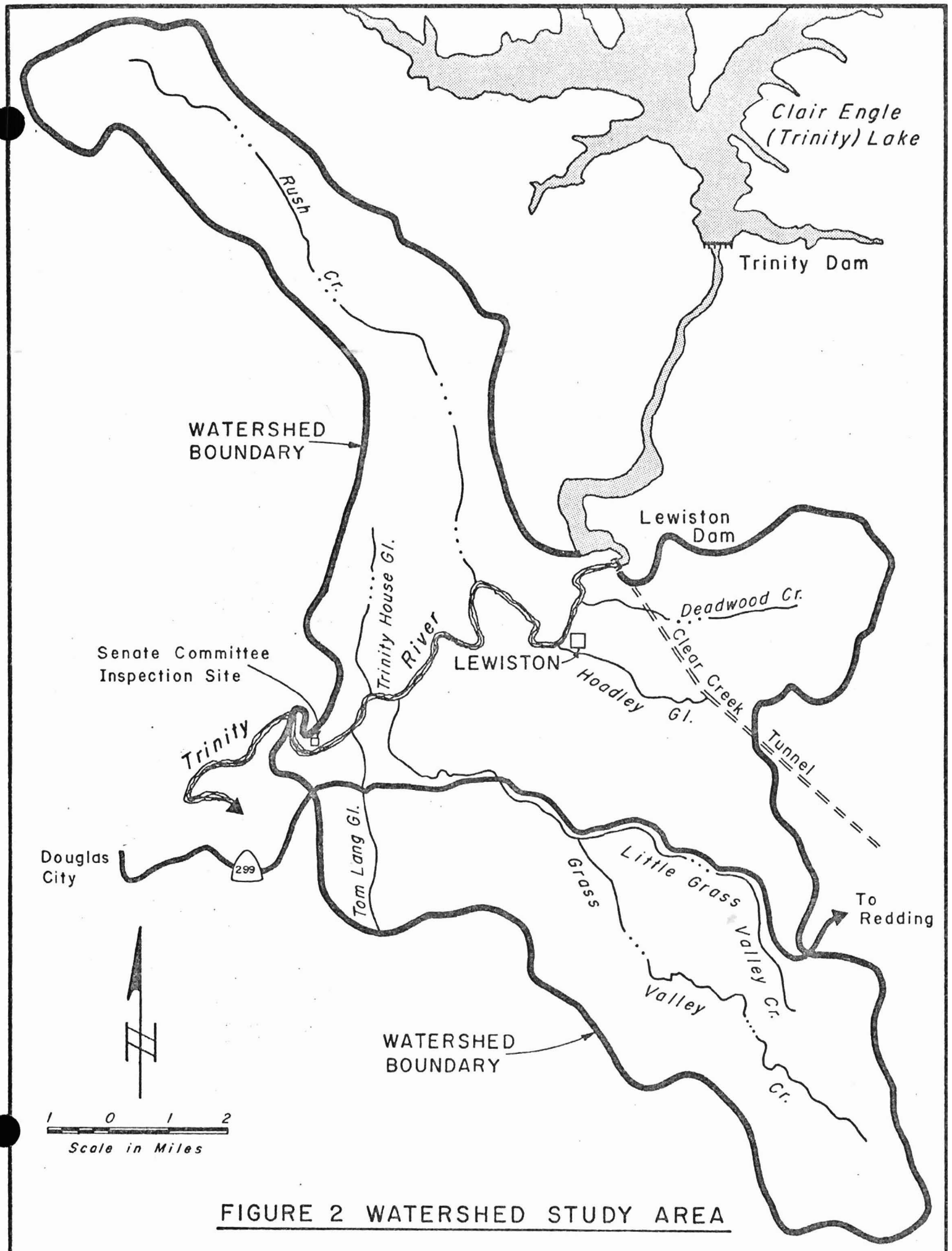


FIGURE 2 WATERSHED STUDY AREA

Table 1. Major drainages in the watershed study area.

Drainages	Approximate length of stream	Watershed area
	Miles	Acres
Grass Valley Creek	15.0	24,240
Deadwood Creek	4.0	6,000
Hoadley Gulch	2.5	4,400
Rush Creek	9.5	16,520
Trinity House Gulch	2.0	2,000
Tom Lang Gulch	4.0	2,400
	Total	55,560

Soils derived from granitic parent rock cover half of the study area. By all standards, these decomposed granitic soils are rated "high" in erosion hazard. Soils derived from metavolcanic rock and from sedimentary shales and schists cover the remaining half of the study area. These soils are rated "moderate" in erosion hazard; however, some of these soils show old landslides, evidence of past substantial soil movement.

Conifer forest is the dominant vegetation, covering 93 percent of the study area. Stands of young-growth timber are interspread with patches of oak woodland, brush, and grassy openings. The principal timber species are ponderosa pine and Douglas-fir; most of the old-growth timber has been logged in the past 20 years. The adequacy of vegetation, in terms of the protection it gives to the soil, is probably the single most important physical condition affecting the erosion process.

Annual precipitation totals from 30 to 60 inches. **Maximum recorded intensities** are 0.93 inches in one hour and 4.87 inches in 24 hours. High intensity precipitation for one-hour periods occurs as rain, usually in April or May, while high-intensity precipitation for 24 hour periods includes some snow and commonly occurs in December and January.

THE EROSION STUDY

All potential sediment source areas and causes of erosion were investigated. Watershed slopes, roads, mines, streambanks, and landslides were separate areas of investigation. The slopes of the watersheds

were further segregated into categories based on physical conditions and land use condusive to erosion and the production of sediment. These "source-cause" groups were then investigated on-the-ground to determine actual causes of erosion and to estimate amounts of sediment.

Sediment Sources and Causes of Erosion

Determination of sources, causes, and amounts of sediment as accurately as possible was necessary to clarify the several earlier appraisals of the problem and to predict future conditions. A summary of field data is shown by table 2.

Three significant conclusions can be drawn from the data in table 2. First, Grass Valley Creek watershed is the major sediment-producer. This watershed produces more sediment per acre, as well as a greater total amount, because of its high proportion of erodible soils and extensive logging activity. Second, natural geologic processes are producing approximately half of the sediment available for transport to the Trinity River. A high rate of normal erosion can be expected in such areas of steep slopes, loose soils, and high-intensity storms. Third, past logging activity, concentrated in the Grass Valley Creek watershed, is the main cause of accelerated erosion and sedimentation.

Because accelerated erosion is the result of the activities of man, sources and causes of erosion are discussed in terms of land use in the following sections:

Timber Production:

Lumbering is the major industry in this region, and private interests own about 80 percent of the land in the study area. U. S. Plywood-Champion Papers and Southern Pacific Land Company are the two largest private owners. Public agencies, mainly the U. S. Bureau of Land Management and the U. S. Forest Service, own the remaining 20 percent. Most of the study area, and all of Grass Valley Creek watershed, lies outside the Shasta-Trinity National Forest.

Nearly all the forest land has been cut over. The study area was logged at different times from late 1948 through 1966, most of it from 1949 through 1953. Shasta Box Company owned most of the Grass Valley Creek watershed and started logging in Little Grass Valley Creek in late 1948. By 1954 this entire ownership had been logged; U. S. Plywood Corporation then bought the holdings. Logging in other parts of the study area continued until 1965. Some parts of the study area have been relogged.

Thirty-nine percent of the sediment available to the streams in the study area is ascribable to logging activities. In proportion to the area actually disturbed, erosion from temporary roads has been high (fig. 3).

Table 2. Current annual sediment available to tributaries of the Trinity River

Tributary	Cause/Source								
	Geologic	Logging skid trails	Temporary logging roads & landings	Permanent roads	Deer trails	Streambanks	Mining	Landslides	Total
	Thousands of cubic yards/year								
Grass Valley Creek	60	42	19	5	9	T	0	0	135
Rush Creek-Trinity House Gulch	26	5	3	2	2	T	T	0	38
Hoadley Gulch	9	5	3	2	2	T	0	0	21
Deadwood Creek	10	3	2	T	1	T	0	0	16
Tom Lang Gulch	6	2	1	T	T	T	0	0	10
Total	111	57	28	9	14				219
(Percent of total)	(50%)	(26%)	(13%)	(4%)	(7%)				(100%)

T = trace. Less than 1,000 cubic yards/year.

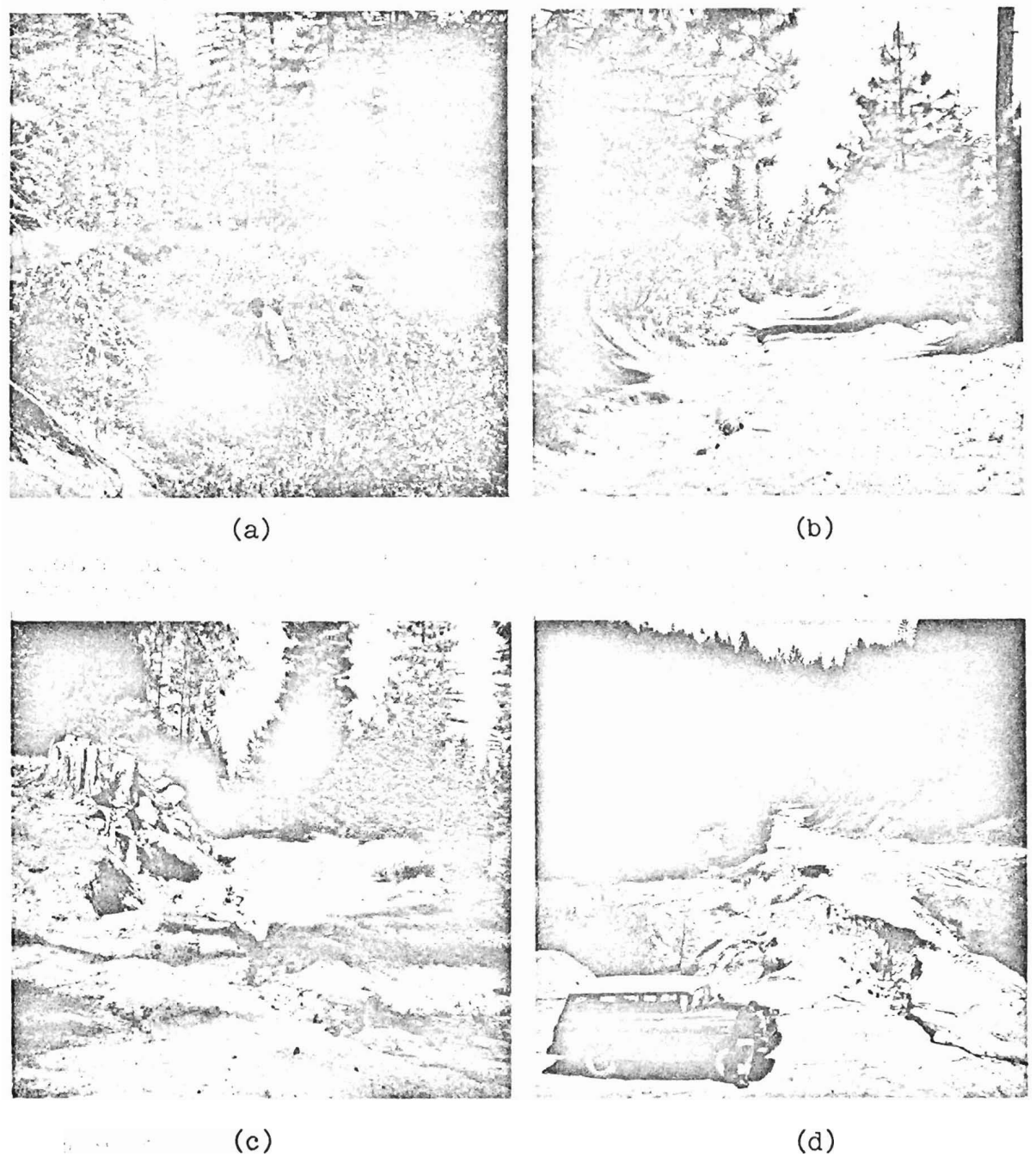


Fig. 3. Condition of old logging roads in Grass Valley Creek and Little Grass Valley Creek drainages: (a) spur road overgrown with brush and stabilized; (b,c) light and heavy gullying; (d) culverted main road across creek gullied by improper drainage -- one year's washout.

Grass Valley Creek and the other drainages of this study area lie within the Coast Range Pine and Fir Forest District, one of four forest districts outlined in the Forest Practice Act. As provided for by the Act, the forest practice rules governing timber operations on privately owned lands in this district were formulated and, in 1947, put into effect. Although logging practices having an important bearing on soil disturbances were thus regulated, these first rules contained no provisions, per se, for soil erosion control. Logging practice requirements were stated in the context of protection of the residual trees and only indirectly took into account the prevention of excessive soil erosion.

Almost all of the Grass Valley Creek - Little Grass Valley Creek watershed was logged under these first rules. During the initial period of application of the rules to logging operations within this forest district, the Forest Practice Committee recognized the shortcomings of the rules in regard to soil erosion control. Consequently, rule revisions in 1953 included erosion control as a logging practice. Operators were cautioned to conduct logging operations so as to minimize soil erosion and to construct adequate dips on skid trails and temporary roads to dispose of surface waters with a minimum of erosion damage.

Since this recognition of erosion control in the forest practice rules, its position as a logging practice has been strengthened by rule amendments in 1961 and again in 1968. Logging practice requirements are now stated in a broader context of protection which includes protection of soil as well as protection of residual trees; and specific measures for the protection of slopes, stream banks, and stream beds against excessive erosion are included in the rules.

Roads and Highways:

There are about 99 miles of permanent roads of various types in the study area. These are main logging roads, fire access roads, and county and state highways. U.S. Highway 299 transects the study area south of the Trinity River; much of this stretch was realigned between 1960 and 1963. A major access road linking Lewiston to Highway 299 was also constructed.

Four percent of the sediment produced annually in the study area is ascribable to erosion from these roads. The amount of road-caused sediment is directly related to the closeness of the roads to the streams.

Most of sediment problems related to road construction and maintenance in this area are the result of the highly erodible nature of the granitic soils. Road construction practices which are considered standard on other types of road-building material either aggravate or do not fully cope with the erosion problem on decomposed granite. Drainage, cuts. fills, and the handling of culverts and spoil material require special attention (fig. 4).

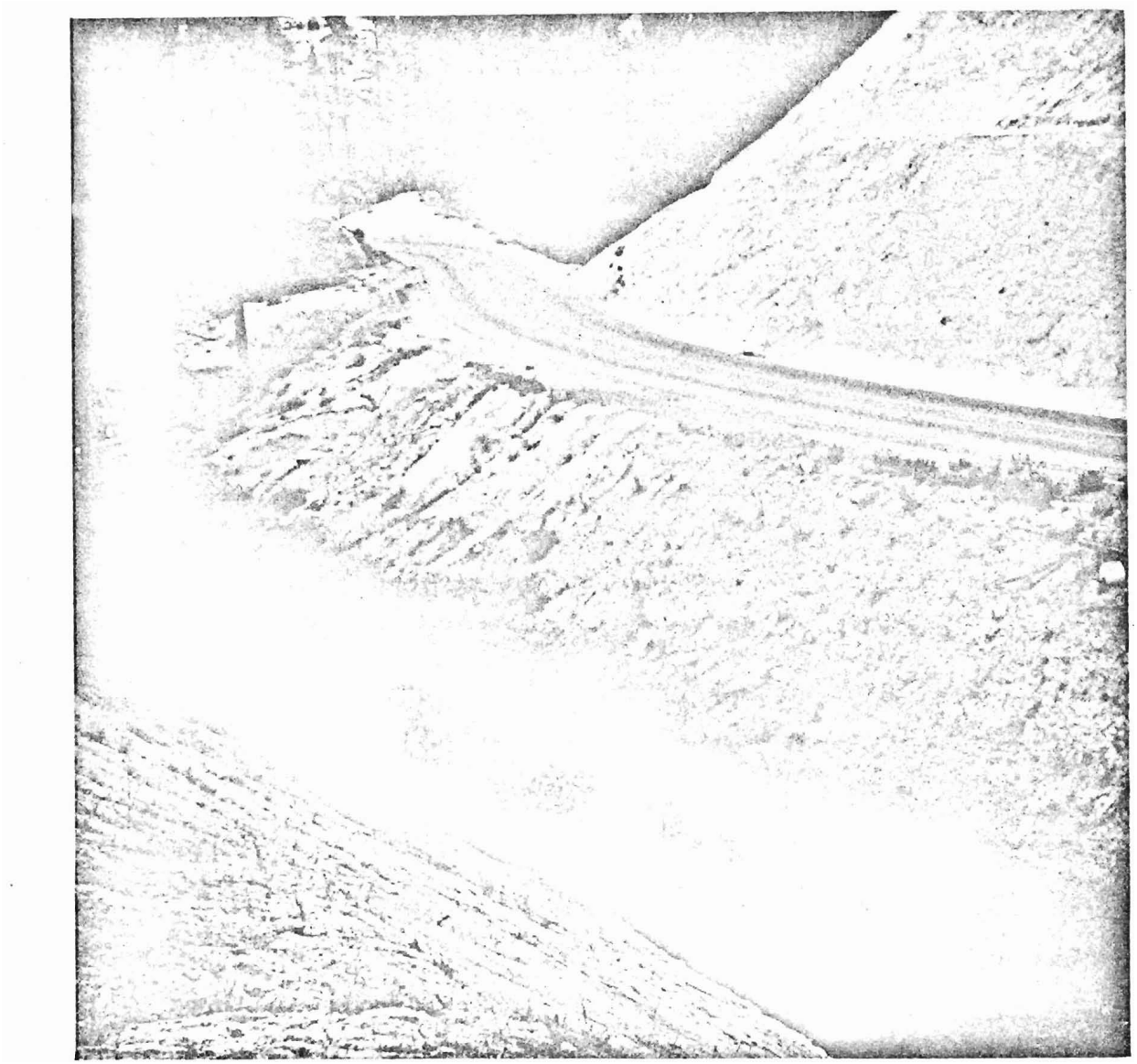


Fig. 4. Highway 299 W along Little Grass Valley Creek after realignment. The creek flows between road fill and opposite cut bank. Both cut and fill are actively eroding, depositing sediment directly into the stream.

Recreation:

Fishing and hunting are the major recreational activities in the study area; salmon and steelhead fishing in the winter, trout fishing in the summer, and deer hunting in the fall.

Except for the town of Lewiston, the area is essentially untouched by urban and commercial development. One recreational facility within the area sells supplies and has overnight accommodations. Some individuals have built summer homes in the watersheds, and the IOOF has developed summer home tracts.

Recreational use is not now contributing to the problem of sedimentation, but an associated use - that by deer - is. Deer trails cross and re-cross the watershed slopes and, in the aggregate, enough soil is disturbed that a significant amount of sediment reaches the streams annually. Deer trails account for seven percent of the annual sediment yield.

Deer, of course, are a part of the natural scene. Their effect on the sedimentation problem was considered separately because of their relationship to land use and their management potentialities. Use by deer and deer-induced erosion were greater in the logged areas.

Mining:

Mining, once an important industry, has been dormant for several years. Except for a short period of intensive mining of sand, gravel, and rock products, gold has been the principal mineral product of this region.

Sediment production due to mining activities, although relatively high at the time of mineral production, is now at a very low level. The only currently active mine in the study area is a placer mine on upper Rush Creek. This mine consists of one hydraulic pit which has been worked seasonally for the past three years. Recent mining activity in the area has consisted of shallow prospecting and exploration work, but this activity is insignificant as a cause of sedimentation.

Past lode mining activity was intensive in the upper portion of the Deadwood Creek drainage, but in the other drainages activity was limited for the most part to exploration adits and prospect pits. Past lode mining in the tributary watersheds has left a number of small mine dumps and one deposit of mill tailings, but these appear stable and are not significant sources of sediment. Past placer mining activity in the Trinity River has produced boulder tailings which support a more stable stream channel than natural sedimentary deposits would provide. These tailings are windrows or trains of boulders and cobbles which act as groins or jetties to protect the softer, natural streambank during times of flooding.

Livestock Production:

Cattle raising is the main livestock industry, but this is small and is not significant in terms of erosion and sedimentation. The bottomland along the Trinity River is the main grazing area. The Southern Pacific Land Company has granted several small grazing permits in the Rush Creek drainage, but the U. S. Plywood Corporation has not granted any permits southeast of the Trinity River. Grazing use is not expected to increase; in fact, it could decrease should recreational development produce competing or conflicting use of the land.

Streambanks and Landslides:

These two source areas were not found to be important producers of sediment in the study area. They are important in other regions and easily "triggered" by land use, and for this reason they were investigated.

Resource Protection:

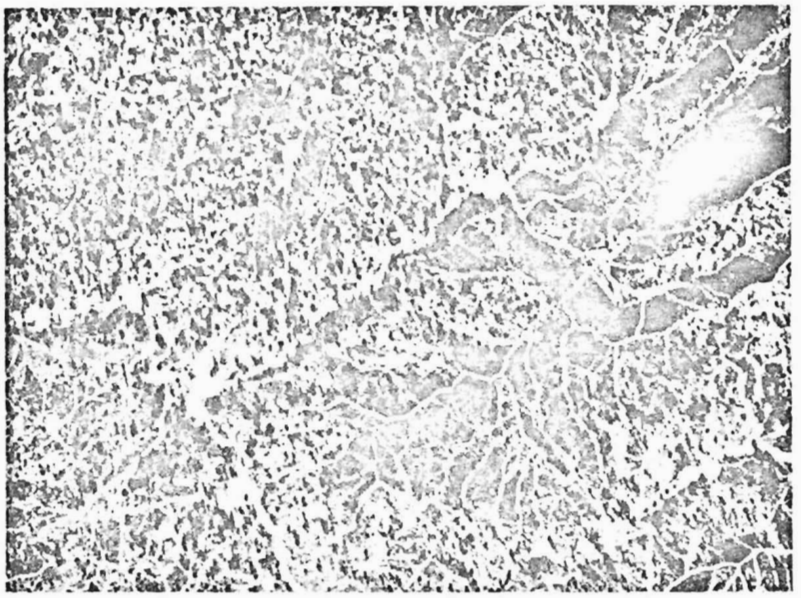
Fire control efforts have held fire losses to a minimum in the study area; only four forest fires in the past 20 years have reached the 10- to 100-acre size class. Consequently, soil erosion as the result of watershed denudation by burning has not been significant. Most of the study area, including all of Grass Valley Creek watershed, lies within the watershed fire protection responsibility zone of the California Division of Forestry. With the exception of the headwaters of Rush and Grass Valley creeks, the study area, including the community of Lewiston, lies within the Lewiston Fire District which is responsible for structural fire protection.

The study area lies within the Trinity County Soil Conservation District; however, most of the privately owned land in the Grass Valley Creek watershed is excluded from this district.

Projections of Sediment Yield

Soil loss from the tributary watersheds as a result of normal erosion processes is expected to continue at a high rate. Actual amounts of sediment produced by the tributaries during any storm period will vary according to the particular chain of hydrological events; however, the average annual amount of sediment deposited in the Trinity River will be comparatively large.

Sediment yields due to past logging have been reduced considerably over the years since logging because of the recovery of the native vegetation (fig. 5). The vegetation, however, has not completely re-established itself in its role of protecting the soil; further build-up of



1952

1965

Fig. 5. Vertical aerial photographs of an area of about 250 acres along upper Grass Valley Creek showing recovery of vegetation during a 13-year period after logging.

ground cover and litter will be gradual. Therefore, soil loss from past logging operations is expected to continue, but at a gradually decreasing rate. Complete recovery, however, is not expected under present conditions. The general trend of the skid trails is toward recovery, but some of the temporary logging roads and landings have not stabilized and will continue to yield excessive sediment to the streams.

Permanent roads also will continue to be a source of sediment. Improperly located spoil areas and inadequate drainage provisions are significant parts of the problem.

Although the mining industry could be reactivated quickly, should the price of gold greatly increase, no major changes in land use are expected in the near future. Future water development, however, could change land use considerably and completely alter Trinity River stream bed conditions in the area. Federal and State water agencies are now planning further development of the Trinity River. Proposals under consideration involve construction of a large dam downstream at Helena, a project that would back water up to Lewiston Dam and inundate that portion of the river under study in this investigation.

To illustrate what the future problem of sediment yields from the tributary drainages might be in the near future, projected sediment production for the slopes of the Grass Valley Creek watershed is shown in figure 6. This graph compares estimated sediment yields from old logged areas with "base" or "natural" yields from undisturbed slopes. The trend of sediment production has been estimated on the basis of the trend of vegetation recovery. On this basis, sediment yields are shown by the dashed line (B) to approach normality around 1980. This trend, however, is based on the assumption that all disturbed areas (skid trails, landings, and roads) will recover and at the same rate, an assumption that does not hold. Some of the logging roads are actively eroding, with little signs of stabilizing. Thus, a more realistic curve -- one which takes into account continuing erosion from roads -- is shown by the solid line (A). According to this projection, current sediment yield will be reduced about 40 percent by 1980, but the watershed will continue indefinitely to yield sediment in excess of normal or geologic yields.

If drainage problems on these roads were corrected and gully erosion stopped, the curve would be more like the dotted line (C). According to this projection, one could expect future sediment yields -- almost wholly the product of sheet erosion -- to be considerably less and to approach normality about 1980 and remain at this level.

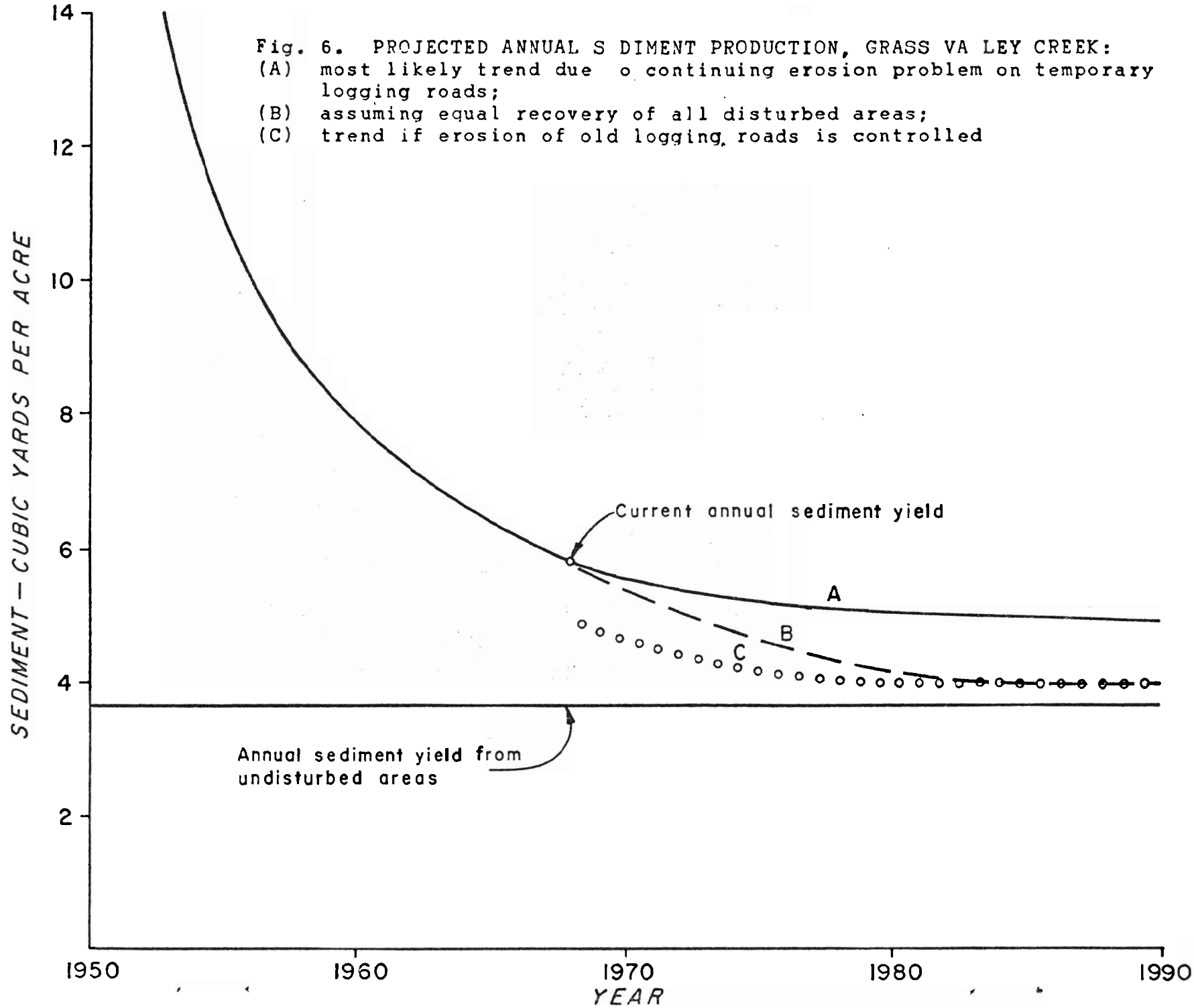


Fig. 6. PROJECTED ANNUAL S DIMENT PRODUCTION, GRASS VA LEY CREEK:
(A) most likely trend due o continuing erosion problem on temporary logging roads;
(B) assuming equal recovery of all disturbed areas;
(C) trend if erosion of old logging roads is controlled

HYDROLOGIC STUDY

The hydrologic study was undertaken to determine the relationship of streamflow to the sediment problem, especially the ability of the Trinity River to transport the granitic sand delivered to it by Grass Valley Creek.

Flow characteristics of the Trinity River below Grass Valley Creek before and after construction of the Trinity Project are shown by the flow-duration curves of figure 7.

The largest peak flow of the Trinity River at Lewiston before construction of the Trinity Project was 71,600 cubic feet per second in December, 1955. Similar weather patterns occurred in December, 1964, after the project was in operation; and although peak inflow into Clair Engle reservoir was in excess of 100,000 cubic feet per second, peak flow at Lewiston did not exceed 300 cubic feet per second.

The average annual runoff at Lewiston was reduced from 1,192,000 acre-feet to 143,000 acre-feet by the construction of the Trinity Project and diversion of water from Lewiston Reservoir.

Releases at Lewiston Dam for the fishery are made in accordance with a 1959 agreement (amended in July, 1968) between the U. S. Bureau of Reclamation and the California Department of Fish and Game. These flows range from 150 to 250 cubic feet per second and constitute nearly all of the flow now discharged from the dam.

The relative capability of Grass Valley Creek and the Trinity River to transport bedload sediments is the crux of the problem concerning the build-up of coarse sand deposits in the Trinity. To estimate such sediment-transporting capabilities, bedload movement in the stream channels was related to volume of streamflow. Three estimates of bedload transport on an annual basis were then made - one for Grass Valley Creek and one each for the Trinity River near the mouth of Grass Valley Creek before and after construction of the Trinity Project:

	Trinity River	Grass Valley Creek
Pre-dam	202,000 cu yd/yr	46,400 cu yd/yr
Post-dam	10,000 cu yd/yr	" "

These estimates show that the sediment-transport capacity of the Trinity River has been reduced from over four times to less than one-fourth the amount of sand that Grass Valley Creek is capable of delivering.

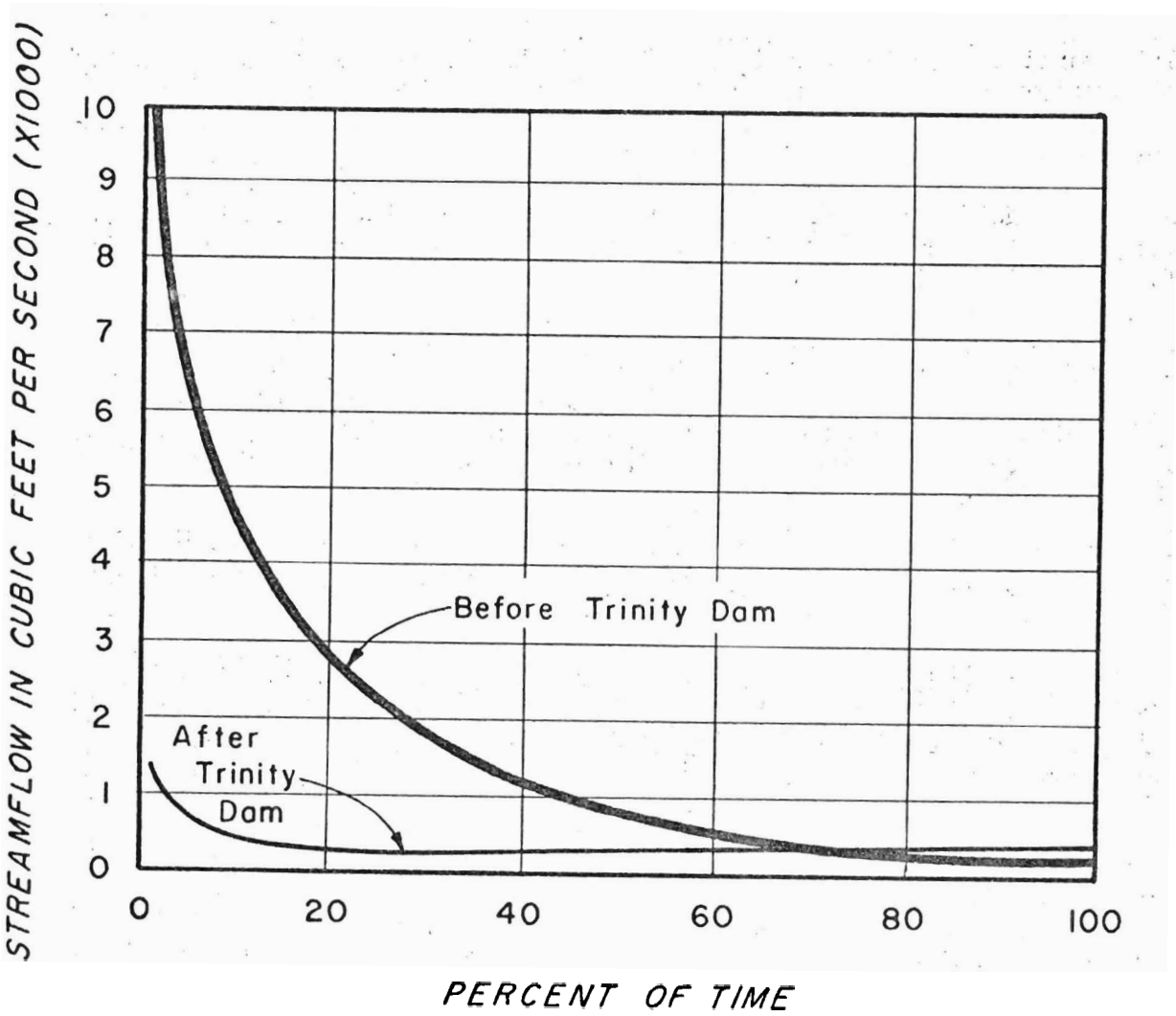


Fig. 7. Flow-duration curves for the Trinity River at and including Tom Lang Gulch, June 27, 1968. These curves represent the percent of time that a certain average flow is equalled or exceeded.

DISCUSSION OF WATERSHED INVESTIGATION RESULTS

The watershed investigation highlighted a sequence of conditions and events: an ecological and hydrological equilibrium that existed, the extent and ease with which it was upset, and the difficulty of its restoration.

The erosion study accounts for the inherent instability of the watershed slopes and points to the delicate balance that existed between the natural forces tending to create erosion and the natural forces tending to create soil stability. The study shows that man's activities have greatly increased sediment production - today, still twice normal amounts.

The estimates of amounts of sediment and transport capacities show that, before logging and dam construction, the Trinity River had no trouble transporting bedload sediment. Its capacity for this function was about twice the capacity of its tributaries. After logging, but before the Trinity Project was operating, the river's transport capacity and the sediment discharged into it were about equal; hence, the river was still able to flush out the added sediment from logging operations. This state of affairs would account for the absence of sediment problems in the Trinity River at a time when such problems existed in Grass Valley and Little Grass Valley creeks. After dam construction, the sediment transport capacity of the river was reduced to such an extent (about one-twentieth of its former capacity) that sediment in the channel quickly built up. The result, of course, has been the deterioration of the spawning grounds.

HOW DID THE PROBLEM DEVELOP?

Plans to divert Trinity River water were first published in 1931 as a part of the California Water Plan. These plans were further refined by the U. S. Bureau of Reclamation and U. S. Army Corps of Engineers in 1941. It was apparent at that time that diversion of Trinity River water would seriously affect the fishery resources dependent upon the upper river. In response, the U. S. Fish and Wildlife Service in 1942 initiated a "comprehensive" survey and study of the entire problem. This study was terminated in 1946, and an interim report was published in 1950 (see references). This study presents alternative fishery mitigation plans, but does not discuss the effects of reduced flows on sediment from tributary streams.

In 1956, the U. S. Fish and Wildlife Service and the California Department of Fish and Game jointly released a plan for the protection of fish and wildlife resources affected by the Trinity River Division, Central Valley Project (see references). This plan was developed following passage of the Trinity River Division authorization act and was intended to provide the Bureau of Reclamation with a comprehensive plan for preservation and propagation of fish and wildlife resources. The Trinity Project was under construction at the time this report was written. The writers of this report recognized the disadvantage of eliminating flood-cleansing actions on spawning gravels but concluded that the dams would trap 99 percent of the river silt; apparently the silt and sediment supplied by the tributaries downstream from the dams was not considered.

For permanent mitigation of fishery losses above the dams, a complete fish hatchery was recommended and constructed. Consideration was also given to the development of artificial spawning areas adjacent to the main stream, but this idea was rejected due to lack of available water.

According to the 1959 agreement between the Bureau of Reclamation and the Department of Fish and Game, streamflow for the Trinity River was scheduled at 120,500 acre-feet annually to accommodate fish needs; releases during the year varied from 150 to 250 cfs. These releases were presumed to be adequate for fish habitat downstream from Lewiston Dam. No releases were scheduled to compensate for the reduced capacity of the Trinity River to transport sediment coming from tributaries immediately downstream from the project.

The problem created by the diversion of water from the Trinity River in 1963 is the result of not fully considering the effect that greatly reduced streamflow would have on the sedimentation processes of the Trinity's drainage system below the dams. Consequently, even though some provision of flow was made for fishery needs, the ecology of the river has been drastically changed, and fish habitat has deteriorated. Moreover, the basic problem of sand deposits in the channel has been intensified by excessive amounts of sediment still coming from one of the tributaries as a result of logging in the early 1950's and road realignment and construction in the early 1960's.

WHAT CAN BE DONE?

Consideration of remedial measures was a part of the watershed investigation. Several measures, which might be feasible and applied to correct the erosion and sediment problem, were identified.

Fish habitat could be improved by constructing debris basins in tributary streams to trap sediment; by removing sediment deposits by dredging or other mechanical means; and by constructing artificial spawning beds or side channels parallel to the existing channel and diverting flow into the new channel.

Erosion control measures in the tributary drainages would find their most practical application in correcting drainage problems on old logging roads. These roads should be either "put to bed" or properly constructed for permanent use. Installation or repair of water diversions on permanent roads and stabilization of road spoils would reduce sediment from these sources. Seeding or planting areas of concentrated disturbance, such as some of the old log landings, would stabilize exposed soil; however, a large-scale program of reforestation would be impractical and unnecessary.

When the Task Force considered possible remedial measures, it soon became clear that the flow of the Trinity River-its capacity to transport sediment - is the central issue and the key part to corrective action. The effectiveness of measures for improving fish habitat in the river and controlling erosion in the tributaries, and the extent to which such measures can be applied practically, will hinge upon the nature of

the releases from Lewiston Dam. Moreover, the interdependence of remedial measures necessitates considering them together, rather than separately. Consequently, specific recommendations for corrective action cannot be made by the Task Force alone but must be made in concert with the Bureau of Reclamation. Once the Bureau is aware of the problem and the findings of this report, a cooperative remedial program can be investigated.

STATEWIDE VIEW

Sediment problems similar to those in the Trinity River below Lewiston Dam can result from any water project if the consequences of damming the stream and changing its flow are not taken into account and carefully evaluated. This statement applies especially to situations where flows are drastically changed and watershed soils are highly erosive. Because of varying conditions, each proposed water project must be separately evaluated for downstream sedimentation problems.

Almost every use of land causes some degree of accelerated erosion, and the amount of soil lost is a function of the extent and degree of soil disturbance. Problems of erosion and sedimentation become pronounced when land use is concentrated in watersheds of highly erodible soils. Such problems become accute when sediment is trapped in stream channels or water basins.

Serious erosion problems could develop in other parts of the state, particularly in the steep mountain areas of unstable soil. Natural erosion rates in these areas are high; road building, urban development, timber harvesting, and any other soil-disturbing activity can, unless care is exercised, greatly increase these rates.

AUTHORITY TO CONDUCT THE TASK FORCE INVESTIGATION

The Resources Agency and its Departments of Conservation, Fish and Game, and Water Resources have authority to participate in this kind of investigation.

Resources Agency. The Government Code (Sec. 12850) gives the Secretary of Resources authorization to "...appoint advisory and technical committees..." to "... accomplish comprehensive, long-range, coordinated planning and policy formulation in the matters of public interest related to his agency."

Department of Conservation. The Director of Conservation is vested with all of the powers and responsibilities exercised by departmental divisions, including Forestry, Mines and Geology, and Soil Conservation.

Division of Forestry. Division of Forestry authorization to participate in this watershed investigation stems from statutory law which declares a public interest in the management of forests, timberlands, watershed, and soil resources of the state. One group of statutory and administrative law pertinent to this investigation is the Forest Practice Act (Chapt. 8, Pt. 2, Div. 4, Pub. Res. Code) and the Forest Practice Rules formulated under it. Another group of statutes (Chapt. 10, Pt. 2, Div. 4, Pub. Res. Code) deals with the protection of forest and watershed lands. Other statutes of the Public Resources Code declare a public interest and benefit in maintaining a protective vegetative cover on forest and watershed land (Sections 4675-4677); express an interest in investigating the effect of forest cover in preventing erosion on watersheds (Section 4673); and authorize engagement in surveys of soil, vegetation, and forest products on the forest and watershed lands of the state (Section 4672).

Division of Mines and Geology. Broad authorization for participation in this watershed investigation is contained in Section 2205 of the Public Resources Code. The State Geologist may make, facilitate, and encourage special studies of the mineral resources, mineral industries, and geology of the state.

Division of Soil Conservation. Section 9043-44 of the Public Resources Code authorizes participation in investigations or planning works for control of runoff and soil erosion.

Department of Fish and Game. Section 1000 of the Fish and Game Code states: "The Department shall expend such funds as may be necessary for biological research and field investigations and for the collection and diffusion of such statistics and information as shall pertain to the conservation, propagation, protection, and perpetuation of birds and the nests and eggs thereof, and of mammals and fish."

Department of Water Resources. Sections 225-229 of the Water Code authorize the Department to conduct surveys and investigations of matters pertaining to water resources of the State including water quality. Section 15616 authorizes the Department to conduct investigations of the Water Resources of the State, formulate plans for the control, conservation, protection, and utilization of such water resources, including solutions for the water problems of each portion of the State. Section 12627.4 states that in making investigations and plans for water projects, the Department shall include consideration of seepage and erosion problems.

Water Resources Control Board. Division 7, Section 13053, of the Water Code authorizes a regional water quality control board to prescribe requirements relative to any particular condition of pollution or nuisance, existing or threatened, in the region. Additionally, under

Section 13052(e), the regional boards have authority to formulate and adopt long-range plans and policies with respect to water pollution control and water quality control.

Because abundant authorization for these kinds of investigations already exists, no new legislation is needed or proposed. However, administratively there is a need for better communications and coordination on these kinds of interdepartmental problems by the Resources Agency. The Secretary for Resources should stimulate the use of the "Issue Memo" or other appropriate system to bring these kinds of resource problems to the attention of departmental directors. Where warranted, the task force approach could then be applied to assist the State in fulfilling its resource responsibilities.

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TASK FORCE PARTICIPANTS

The following personnel contributed to the development of this report:

Department of Conservation

Edward N. Gladish

Division of Forestry

T. F. Arvola
R. H. Blanford
William Harrington

Division of Soil Conservation

Erik Beyer
Herb Iwahiro
Ken Jones
O. C. Leaf
Murt Lininger
D. P. Scott
Burton York

Division of Mines and Geology

Bob Streitz

Department of Water Resources

Bob Clawson

Department of Fish and Game

Elton Bailey
James W. Burns
Alex Calhoun
Millard Coots
Leonard Fisk
Bob O'Brien
Richard Tuggles

U. S. Forest Service (Liaison)

Lyle Klubben

U. S. Soil Conservation Service (Liaison)

William H. Payne