F-07-5

1980 Flathead Drainage Graham F-07-5 #85051

PROJECT PROPOSALS Region 1

for Montana Power Co.

~~1980~~ - 1979 - 1980

PROJECT PROPOSAL

Effect of Lake Level Fluctuations on Kokanee Reproduction and Fishery in Flathead Lake - Project Study Proposal submitted to Montana Power Company, October 1979, Patrick J. Graham, 10 pgs.

Little Blackfoot River Reclamation Proposal, 8/80, Jim Vashro, 7 pgs.

EFFECT OF LAKE LEVEL FLUCTUATIONS ON KOKANEE REPRODUCTION AND FISHERY IN FLATHEAD LAKE

Project Study Proposal

Submitted to Montana Power Company

October 1979

By

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INTRODUCTION

Flathead Lake provides a unique yet complex resource for the people of Montana and surrounding areas. Obvious recreational uses include sail boat racing, trophy fishing for lake trout, SCUBA diving and viewing the 126,000 acre mountain lake. The amount of recreational use has yet to be quantified by user group either in man-days or economic value.

An additional use of the lake is storage of water by Kerr Dam for power generation as part of the Bonneville Power Administration power grid. The large surface area of Flathead Lake provides an opportunity to store and utilize a large amount of water with a relatively small drawdown, a maximum of 10 vertical feet a year.

The complexity and intensity of competing uses for the lake results largely from the timing of the drawdown. Boaters want to lengthen the time they can use their boat docks into the fall. Flood storage and power demands in the B.P.A. grid affect both inflow to the lake from Hungry Horse Reservoir and outflow from Kerr Dam. This in turn influences the timing and rate of drawdown of the lake for power use and flood storage over winter.

It is our belief that the timing of drawdown in Flathead Lake has severely depleted the lake shore spawning populations of kokanee. Kokanee home to the site where they were originally spawned, thus with elimination of successful recruitment of kokanee fry into the population over several years, that particular population would not reestablish without imprinting fry to that area. Kokanee spawning on the lake shore were significant in providing several areas where snagging for kokanee could occur (Robbins 1966) and also contributed to recruitment of kokanee into the lake. Kokanee snagging fishery presently ranges along the main Flathead and lower Middle Fork of the Flathead Rivers in the fall (Hanzel 1977). Kokanee spawning on the lake shore provide an opportunity for increasing shoreline harvest and extending use on the lake into the fall. Presently kokanee harvest during the summer is from boats. Fishing success drops off in the fall as kokanee near the time of spawning.

The following proposal is an attempt to 1) define the problems, 2) state objectives for a study to collect the data necessary to quantify recreational use of the fishery resource and assess the extent of kokanee spawning areas presently lost to production in the lake, and 3) initiate a process through which better comprehensive management of our natural resources can occur.

FLATHEAD LAKE-RIVER FISHERY

Flathead Lake and its tributaries are interconnected biotically by spawning migrations of several species of adult fish from the lake into upstream areas and by subsequent movement of larval and juvenile fish back to the lake (Block 1955, Johnson 1963, Hanzel 1976). Only 10 of the 23 presently known resident fishes are native. Nine of these are adfluvial. Distance moved upstream for spawning vary by or within species and range from the mouth area of the Flathead River to 100 miles or more upstream and into tributaries.

Dolly Varden, westslope cutthroat, kokanee, and some whitefish live in Flathead and other lakes in the drainage as sub-adults and adults, migrating into tributaries to spawn. These are termed adfluvial populations. Dolly Varden and cutthroat eggs hatch and young fish live in tributaries and rivers for two to three years. Whitefish and kokanee eggs hatch and young migrate soon after hatching into downstream areas. They become adults in two to four years. Variations in habits of Dolly Varden, westslope cutthroat, and mountain whitefish cause some racial strains to live as adults in larger streams but still migrate into small tributaries to spawn. Upon hatching, the young generally stay in small tributaries from one to three years before migration into larger streams. These are termed fluvial populations. Additional variation, either genetic or somatic, cause some westslope cutthroat and mountain whitefish to live their entire life span in smaller tributaries, although access to larger streams or lakes is possible: these are termed stream resident populations. Some species and/or populations complete their life histories without leaving Flathead Lake or other lakes in the drainage.

The migrational aspects of the fishery have received a fair amount of study (see Block 1955, Hanzel 1959, and Hanzel 1970-76), but trophic relationship and quality and quantity of available spawning and larval habits are poorly documented. Rahrer (1963) studied aspects of age and growth of Dolly Varden, yellow perch, peamouth, and squawfish in localized areas at the north end of Flathead Lake. Knowledge of the fishery to 1972 has been summarized by Gaufin, Prescott and Tibbs (1976).

Construction of Hungry Horse Dam blocked access to a major spawning area, the South Fork Flathead River and its tributaries. The Swan and Stillwater rivers have also been blocked by dams to some extent. The Stillwater River Dam was removed in 1962 and spawning runs of some game fish are starting to reestablish there.

It has been estimated that 60 per cent of the original spawning runs of westslope cutthroat trout and Dolly Varden from Flathead Lake were blocked by construction of Hungry Horse Dam. In addition, some spawning and rearing areas for whitefish and kokanee were inundated by Hungry Horse Reservoir. The reservoir has developed viable cutthroat, whitefish, and Dolly Varden populations and has supported a fair fishery. But the quality and quantity of this fishery has declined in recent years. Reduced numbers and size of game fish in Hungry Horse Reservoir are thought to be a direct result of increased seasonal withdrawal and changes in water level manipulations.

As has been documented for aquatic insects, alteration of river flow and thermal regimes by hypolimnial releases from Hungry Horse Reservoir apparently have changed spawning migrations (i.e., prolonged or delayed rate of migration, thus reducing egg survival) of most adfluvial species. Movements of juveniles downstream likely are also affected. Local anglers and Department of Fish and Game personnel have observed that water regulation has increased utilization of the mainstream Flathead River by spawning kokanee salmon and decreased shoreline spawning in Flathead Lake. Significant mortality in fall-spawned eggs probably occurs in Flathead Lake due to fall and winter drawdown, thus favoring adfluvial populations.

It is also significant that kokanee populations key spawning movements by river temperatures and select spawning sites in lotic areas thermally moderated by lake discharges. In the years immediately after kokanee were introduced into Flathead Lake, most spawning occurred along the lake shoreline during fall turnover (about 7 C). For reasons not fully elucidated, kokanee now spawn most abundantly in MacDonald Creek just above its confluence with the Middle Fork. Often more than 300 bald eagles and several grizzly bears congregate annually in the fall to feed on salmon concentrated on the spawning beds. Some successful spawning also apparently occurs in the mainstream Flathead River below the confluence of the South Fork: this trend appears to be increasing (Hanzel 1970-76). Both of the consumers are listed as rare and endangered by the U.S. Fish and Wildlife Service. This area of MacDonald Creek is naturally influenced by hydrodynamics of deep Lake MacDonald and kokanee spawn during fall overturn when temperatures in the creek are around 7° C. However, kokanee spawn with some success in the South Fork below Hungry Horse Dam and in Swan River below the small hydroelectric diversion dam near Bigfork. Again, thermal moderation by the lakes upstream increases temperatures in late fall to about 7C in these areas slightly above ambient mainstream river temperature, providing a good thermal key for adfluvial populations. Furthermore, hypolimnial discharges from Hungry Horse Reservoir during late summer and fall moderate the mainstream Flathead River and may explain observed increases of river spawning. The quality of river spawning sites in the South Fork directly below Hungry Horse Dam is, however, questionable due to extreme variation in water volume and the compacted nature of the substrata.

One final aspect of the fishery deserves mention. Populations of northern pike (Esox lucius) are being discovered in new areas of the drainage every year. This carnivorous and highly competitive exotic occurs abundantly in the Flathead River below Flathead Lake and in lower Stillwater Lake. Their status in Flathead Lake is not known, but at least a few specimens have been taken there.

PROBLEM DEFINITION

Trends in abundance of kokanee spawning on the lake shore indicate a significant decline has occurred in most areas in Flathead Lake over the period of record. A snagging fishery was observed and censused by Stefanich (1954) and Robbins (1966). In recent years little effort has been expended on snagging kokanee on the lake shore spawning. We believe this is due to decreased numbers of kokanee on the spawning grounds. Trends in numbers of fishermen utilizing the kokanee can't be determined with available data.

Egg takes from kokanee salmon on lake shore spawning sites have been limited to the Hatchery Bay in recent years due to decreased availability of kokanee at lake shore spawning areas. Stefanich (1954) identified 30 spawning areas around the lake. As early as 1934, eggs were taken from at least 6 spawning areas periodically through the mid 1950's through the early 1960's. Subsequently, eggs have been collected largely from other sources in Northwestern Montana.

Little data is available on abundance and extent of lake shore spawning groups of kokanee prior to the completion and filling of Kerr Dam in 1938. Therefore, the initial effect of the lake drawdown and filling pattern on the kokanee population cannot be determined. Prior to the completion of Kerr Dam, lake levels on April 1 (approximate time of fry emergence) were within one foot of lake levels on November 14 (approximate time of spawning) over an eight-year period of record (Hanzel 1974).

Stefanich (1954) observed that eggs spawned in areas where ground water was present were still alive in the spring, although they were above present lake levels. It is our contention that if lake levels are brought up to lake levels at the time of spawning, the fry emerging from the gravel could enter the lake.

Spawning and emergence for a group of kokanee does not occur on a single day but over a period of days or weeks which may vary from year to year.

Using the November 14 lake level as the approximate time of spawning and April 1 as the approximate time of emergence, the following comparisons were made of lake levels following major events which affected lake level patterns.

Following completion of Kerr Dam, lake level records from 1939 to 1950 show that lake levels at time of emergence averaged 6.8 feet lower than lake levels at time of spawning and ranged from 1.0 to 9.1 feet lower. It took 51 days after the time of emergence for lake levels to reach the level at time of spawning on the average and not less than 45 days.

Lake levels and drawdown patterns were affected to some degree by the daming of the South Fork of the Flathead River in 1952 with Hungry Horse Dam and subsequent release patterns from the reservoir. Lake level records from 1952 through 1963 show that lake levels at time of emergence averaged 6.3 feet lower than at time of spawning and ranged 4.2 to 8.5 feet lower. It was 53 days after time of emergence for lake levels to reach lake level at time of spawning and not less than 39 days.

Power demands and flood control requirements for the entire northwest United States within the Columbia River drainage have an effect or dictate the controlling of levels of Flathead Lake. Since seasonal demands for water are not predictable, the patterns of discharge, spilling and/or lake levels are also not predictable; at least to the limits described by a memorandum of understanding approved by the Federal Power Commission in an Order issued February 24, 1966. The following are extracted from a letter by Regional Engineer, M. Frank Thomas, Federal Power Commission, that states the Order describing the operations at Kerr Dam and the levels of Flathead Lake.

"On May 31, 1962, the Montana Power Company, licensee for the Kerr hydro-electric development, on the Flathead River, and the Corps of Engineers entered a Memorandum of Understanding which set further principles and procedures for regulation of Flathead Lake, the storage reservoir of the Kerr development, in the interests of flood control. The agreement, as amended on October 15, 1965, filed on October 19, 1965, for approval by the Commission under Article 21 of the Kerr license, providing:

The operations of the Licensee, insofar as they affect the use, storage, and discharge from storage of the water of Flathead Lake, shall at all times be controlled by such seasonable rules and regulations . . . as the Federal Power Commission may prescribe in the interests of flood control and the fullest practicable utilization of the waters of Flathead River and Clark Fork for power, irrigation and other beneficial uses.

The amended agreement provides in general that: 1) The Licensee and the Corps of Engineers will cooperate in exchanging data and coordinating operation for flood control: 2) Conditions permitting, the lake will be drawn down to elevation, 2,883 feet, the minimum level under the license, by April 15 and will be raised to elevation 2,890 feet by Memorial Day (May 30) and to elevations 2,893 feet the maximum level under license, by June 15; 3) When the lake reaches elevation 2,886 feet, in a moderate or major flood year, the Licensee will gradually open its spillgates to maintain free flow and will not close the gates until after the danger of exceeding elevation 2,893 feet has passed.

The amended agreement has been endorsed by both the Flathead Lakers, Inc., an association of Lakeside residents who are interested in having the lake level brought up to the maximum under license as soon in the recreation season as possible, and the Upper Flathead Valley Flood Control Association, an organization of farm owners at the upper end of the lake who are interested in having the lake kept down to prevent inundation of their lands by late floods. At a conference held in Missoula, Montana, on September 28, 1965, attended by representatives of these two landowners' groups, the licensee, the Corps of Engineers, and the Commission, various differences were settled, and the terms of the settlement were incorporated into the agreement by the amendment of October 15, 1965." (Thomas, 1973)

Analysis of lake levels from 1965 through 1975 showed that lake levels averaged 5.0 feet lower at time of emergence than at time of spawning and ranged from 1.6 to 9.0 feet lower. It was 55 days after time of emergence on the average for lake levels to reach levels at time of spawning and not less than 14 days.

It is necessary to bring lake levels up to the kokanee redds to allow fry to emerge from the gravel and enter the lake. Variables which modify the effects of lake levels include annual variations in time of spawning and emergence, age structure and size of the spawning group, water temperature, weather conditions and others. One example is the effect of wave action which shifts gravel distribution and has been observed burying redds with up to two feet of gravel.

To fully understand the impacts of lake level fluctuations on the success of kokanee eggs laid in lake shore areas and the significance of the lake shore snagging fishery produced from these populations, a study should be conducted simultaneously on the river and lake kokanee fisheries. It should also be cautioned at this point that the inflow which is modified by Hungry Horse Dam and outflow patterns of Flathead Lake affect not only the kokanee but other organisms in the lake, river and riparian environment. It is possible that conditions optimum for one species could be detrimental to another.

The Department of Fish, Wildlife and Parks is presently engaged in a study funded by the Bureau of Reclamation to assess the impacts of flow and temperature fluctuations from Hungry Horse Reservoir on cutthroat trout spawning migrations, kokanee salmon spawning in the river and riverine macroinvertebrate populations. The Department will also engage in a study of food habits of Dolly Varden and cutthroat trout in Flathead Lake under funding from the E.P.A. We will also be studying kokanee feeding habits and distribution in the lake on a D.J. funded project.

We feel it is essential to initiate studies to: 1) assess the potential lake shore spawning for kokanee salmon in the lake, 2) determine the effects of lake level fluctuation on spawning success, and 3) assess the recreational use of fishery on Flathead Lake and attempt to quantify its value.

OBJECTIVES

1. Quantify available and potential lake shore spawning habitat for kokanee salmon in Flathead Lake.

2. Assess effects of present flow fluctuations on spawning and incubation success of kokanee salmon.

3. Assess recreational use and value of Flathead Lake fishery.

4. Recommend lake levels to enhance or maintain the fishery and recreation of the Flathead River basin with consideration of ongoing studies we are conducting for the Bureau of Reclamation and E.P.A. on the upper Flathead River.

METHODS

1. Available spawning habitat will be quantified by identifying suitable conditions on the ground and measuring these areas using aerial photographs.

2. The effect of lake level fluctuations on intergravel water temperature, ground water, and gravel distribution will be investigated at selected sites.

3. Effect of lake level and associated changes in physical environment of spawning sites will be assessed by monitoring egg survival in boxes planted in selected sites under various combinations of conditions.

4. Recreational study will include 24 months of consecutive creel census data to determine fishermen pressure, timing of use, type of use, species composition of catch, various catch statistics, angler satisfaction and preference, origin, and assessment of dollar value of fishing trip. This should be initiated in the spring, not later than April 1, to insure that the census includes a full year of the same group of fish.

5. The recreation study could and should be expanded to assess all recreation uses that could be affected by lake level changes to allow comparisons of recreation trade-offs that could be expected. This objective was not included in the present budget, although we believe it is important.

6. Recommendations would be based on data collected in this study in conjunction with data collected through several other studies presently being conducted by the Department of Fish, Wildlife and Parks in the Flathead River Basin.

BUDGET

Creel Census	Year One	Year Two	Year Three
A. Project Leader Grade 15 3 mo./yr.	4,614	4,710	4,806
Fisheries Aides Grade 7 48 mo./yr.	34,032	35,856	—
Benefits	6,570	6,896	817
B. Travel - vehicle	6,480	6,480	
boat	1,200	1,200	
per diem ($6/20 days/12mo./4 people)	5,760	5,760	300
C. Expendable equipment	1,200	1,200	
Equipment rental (boats, motors, trailer)	2,200	2,200	
Contracted services: computer time	1,000	1,500	1,000
economic analysis	1,500	1,500	
Postal survey: forms	300	300	
postage	200	200	
Office rent, phone, etc.	600	600	150
Subtotal	65,656	68,402	7,073
Kokanee spawning			
A. Asst. Project Leader Grade 13 12 mo./yr.	14,099	14,834	4,062
Fisheries Fieldman Grade 10 12 mo./yr.	10,913	11,489	
Secretarial Grade 7 6 mo./yr.	4,252	4,480	
Benefits	4,975	5,236	690
B. Travel - vehicle	2,040	2,040	
boat	600	600	
per diem	1,440	1,440	300
C. Expendable equipment	500	500	
Equipment rental	300	300	
Contracted services: computer service	500	1,000	500
aerial photos	1,000	-0-	
Subtotal	40,619	41,919	5,552
TOTAL	106,275	110,321	12,625

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Jim Vashro 8-80

LITTLE BLACKFOOT RIVER RECLAMATION PROPOSAL

The Little Blackfoot River originates just below the Continental Divide approximately 15 miles west of the city of Helena. The river runs 44 miles to its confluence with the Clark's Fork of the Columbia River near Garrison, draining more than 400 square miles.

Gold was first discovered in the drainage before 1870 and many mines were active from about 1890 to 1910 (Pedersen, 1977). A few small gold mines and a phosphate mine near Elliston still operate sporadically but the major uses of the drainage now are for agriculture, timber harvest, and recreation.

The river generally has high quality water and is classified B-1 by the Montana Department of Health and Environmental Sciences. B-1 water supplies are suitable for drinking and culinary uses after treatment and also for bathing, recreation, fish propagation and growth, and agricultural and industrial water supplies. The lower Little Blackfoot had an average discharge of 176 cubic feet per second from 1974 to 1980 with maximum and minimum flows of 3,650 cfs and 6 cfs respectively (USGS,). The river contributes approximately one-third to one-fourth of the average flow of the Clark's Fork River near Garrison and provides enough high quality water to change the Clark's Fork's designation from C-1 (not suitable for drinking) to B-1 (suitable for drinking after treatment).

Above U. S. Highway 12 near Elliston the river flows through narrow mountain valleys. It is speculated that timber harvest practices may have changed the seasonal discharge pattern of the drainage but heavily vegetated banks and a cobble, boulder substrate have maintained a stable stream channel. Below Elliston man has altered the stream channel for a number of reasons including the construction of a railroad and a highway, and for agriculture. These channel changes have changed the hydraulics of the stream and resulted in increased erosion and bedload movement. Poor land use practices and several unusually high spring floods have aggravated the problem to where most of the lower river now appears to be in an unstable condition. A stream channel inventory was requested by the Deer Lodge Valley Conservation District and field surveys were completed in June, 1979 by personnel from the Soil Conservation Service and the Montana Department of Fish, Wildlife, and Parks. Preliminary data indicate that of the 26.5 miles of stream from Elliston to the mouth, 19.5 percent or 5.1 miles of channel are in an altered state (Table 1). Of the 53 miles of streambank involved, 17.9 percent or 9.5 miles of bank had been altered. Ten percent of the banks were in an eroded condition while an additional six percent were considered critical sediment sources, with nearly vertical sidewalls and large amounts of dirt collapsing into the stream (Table 1). The impact of the alterations is emphasized even more when one considers that most of the impacts are found within a 20 mile stretch of the river. Within the past decade increased erosion and bedload movement have destroyed approximately 250 acres of agricultural land valued at $200-300, required $500-1,500 of additional annual maintenance on irrigation systems, necessitated the installation of 1,805 feet of rock rip-rap at a cost of about $26,000, and decreased recreational opportunities. Stream protection legislation such as the Natural Streambed and Land Preservation Act and the Stream Protection Act has provided for better control over recent channel alterations, however, continuing problems can be expected over the next several decades as the stream attempts to regain some stability.

The impact of man's activities is also reflected by the stream's sport fishery. The upper river contains cutthroat, brook, and bull trout, along with mountain whitefish. The lower river contains predominately brown trout and whitefish, along with a few rainbow and brook trout, longnose suckers, and sculpin. The stream is fished heavily by Helena and Deer Lodge valley residents and the lower section provided an estimated 4,530 man-days of fishing in the 1975-76 Department of Fish, Wildlife, and Parks statewide mail fishing survey. Fishermen log returns indicate that catch rates are generally very good, averaging 1.8 to 5.1 trout per hour over the last 15 years. Unfortunately, altered sections of the river show a greatly reduced capacity to support trout populations. Altered sections are generally wide and shallow, dominated by riffles, and lack bank and vegetative cover. The Department of Fish, Wildlife, and Parks surveyed altered and unaltered sections of the river in 1977. It was estimated that a section of river straightened at least 25 years before contained only 12 brown trout over 6 inches per every 100 yards. An unaltered section of river one mile upstream contained 42 brown trout over 6 inches per 100 yards, an increase of 350 percent (DFWP, Unpublished data). Assuming a similar relationship within all the sections of the river, habitat improvements on the 5.1 miles of altered stream could increase the overall trout population by as much as 17 percent.

If fishing pressure is directly proportional to the trout supply this would provide an additional 755 man-days of fishing based on 1975 levels. A man-day of fishing is currently valued at $. Adjusting the fishing pressure figures forward by the annual average statewide increase of percent, the fishery on the lower Little Blackfoot can be valued at $ annually with the potential to be increased by an additional $.

In addition, spawning surveys conducted in the fall of 1976 showed that altered sections of the river supported 0.6 to 1.6 trout spawning redds per 100 yards while unaltered sections supported 3.5 to 12.5 spawning redds per 100 yards (Department of Fish, Wildlife, and Parks, unpublished data). Habitat improvements should increase trout production and therefore increase angling opportunities.

It has been shown that man's primary impact on the river has been in altering the stream's channel and hydrology, rather than degrading water quality. A reclamation plan would first require a hydrologic analysis to identify specific problem areas and best management practices (Table 2). Phase 2 would then cover actual implementation of the management practices. Drop structures would be required on severely straightened sections to reduce headcutting and bedload movement. Irrigation diversions are now commonly formed by bulldozing streambed materials into dikes. This practice destroys the natural armoring of the stream bottom and introduces tremendous amounts of bedload into the system. Many of the worst erosion problems are in the vicinity of diversion points. At least six diversion sites present suitable terrain for permanent diversion structures (Table 2) to eliminate this annual disturbance.

It is estimated that 90 percent of the critical sediment sources would be accessible and appropriate for stabilization with rock rip-rap. Twenty percent of the eroding banks would require rip-rapping while approximately 40,000 feet of streambank would benefit from revegetation measures. Revegetated areas plus those impacted by riparian grazing should be protected by streambank fencing (Table 2).

The above measures would enhance the trout habitat potential of the river. In addition, habitat improvement structures such as wing dams and plunge pools would create habitat in the five miles of altered channel. Random boulder clusters have also proved effective in providing cover and resting areas in altered streams. Finally, the river does occasionally experience extreme low flows as evidenced by the 6 cubic feet per second flow at the Beck Hill U.S.G.S. gauging station in 1977. Most irrigable land is now under development but the river's clean, cold water could prove attractive to an industrial developer. Efforts should be directed towards the reservation of instream flows to preserve the fishery, maintain irrigation flows, and maintain the present high water quality.

Table 1. Stream Channel Inventory Data for the Little Blackfoot River from U. S. Highway 12 near Elliston to the mouth, 1979

Physical Feature	Measurement	Percent of Total
Channel length, ft (mi.)	139,745 (26.5)	
Streambank length, ft (mi.)	279,490 (53.0)	
Channel alterations, ft.	27,175	19.5
Streambank alterations:		
Rock rip-rap, ft.	18,970	6.8
River gravel berms, ft.	10,085	3.6
Dikes, ft.	20,910	7.5
Total alterations	49,965	17.9
Eroding banks, ft.	27,810	10.0
Critical sediment sources, ft.	16,790	6.0
Pool/riffle ratio	0.31/1	
Irrigation diversions	23	

Table 2. Estimated Budget for Reclamation of the Little Blackfoot River from U. S. Highway 12 near Elliston to the mouth.

I.	Hydrologic analysis			
	1.	Hydrologist 72 hours @ $40/hr		$2,880
	2.	Technician 160 hours @ $12/hr		1,920
	3.	Airplane rental 5 hours @ $50/hr		250
	4.	Aerial photographs		1,100
	5.	Photography supplies		150
	6.	Drafting materials, office supplies		150
	7.	Travel and per diem		650
			TOTAL	$7,100
II.	Reclamation			
	1.	Drop structures 4 @ $40,000 each		$160,000
	2.	Permanent irrigation structures 6 @ $40,000		240,000
	3.	Streambank stabilization		
		a. rip-rap 90 percent critical sources; 15,100' @ $30/ft.		453,000
		b. rip-rap 20 percent eroding banks; 5,500' @ $30/ft.		165,000
		c. revegetation 40,100' @ $.23/ft.		9,223
		d. streambank fencing 2,400 rods @ $6.50/rod		15,600
	4.	Fish habitat improvements		
		a. wing dams, plunge pools, etc; 50 @ $750		37,500
		b. random boulder clusters: 100 @ $100		10,000
		c. instream flow reservation		
		1. 1 biologist 20 man-days @ $68/day		1,360
		2. 3 technicians 40 man-days @ $36/day		1,440
		3. travel and per diem		850
		4. supplies and materials		150
			TOTAL	$1,094,123
		TOTAL ESTIMATED BUDGET		$1,101,223