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PRE-AUTHORIZATION ASSESSMENT
OF THE
PROPOSED SUSITNA RIVER HYDROELECTRIC PROJECTS:
PRELIMINARY INVESTIGATIONS OF WATER QUALITY
AND AQUATIC SPECIES COMPOSITION

by
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Alaska Department of Fish and Game
Sport Fish Division
Anchorage
May 1977

STATE OF ALASKA

DEPARTMENT OF FISH AND GAME

JAY S. HAMMOND, GOVERNOR

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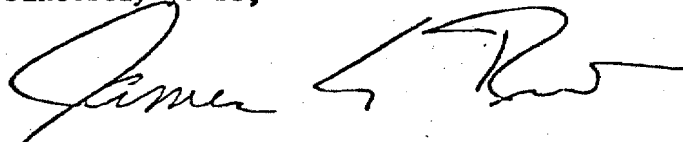
Mr. Gordon Watson
Area Director
Fish and Wildlife Service
U.S. Department of the Interior
813 "D" Street
Anchorage, Alaska 99501

Dear Mr. Watson:

The attached progress report summarizes preliminary environmental work related to the Corps of Engineers Susitna River Hydroelectric Project during the fiscal year transition quarter July 1, 1976 to September 30, 1976. This baseline inventory study was conducted by the Alaska Department of Fish and Game, Sport Fish Division, under contract to the U.S. Fish and Wildlife Service. Data collected during this study include water quantity, water quality, and biological information as outlined in Amendment #1 to the Contract Agreement.

I would like to express our appreciation to the U.S. Fish and Wildlife Service for funding this project and renewing the contract for FY-77. The ongoing studies will allow the continuity necessary for baseline investigations to be of value in planning extensive, long-term work. If the Devils Canyon/Watana project is funded, the intensive five year aquatic studies should be initiated at the beginning of FY-78, in order to assess the full impacts of hydroelectric development on the entire Susitna drainage prior to design approval and construction.

Sincerely yours,



James C. Riis
Fishery Biologist
Division of Sport Fish

Attachment

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ABSTRACT

Biological, water quality, and water quantity investigations were conducted from July 1, 1976 through September 30, 1976 to obtain baseline data on indigenous fish populations and the existing aquatic habitat as part of an ongoing environmental study to assess the potential impacts of the proposed Watana/Devils Canyon hydroelectric project upon the aquatic ecosystem of the Susitna River drainage.

Long term ecological changes to this drainage may be significant. The level and flow patterns of the Susitna River will be altered and will affect the fish and wildlife resources.

INTRODUCTION

The U.S. Army Corps of Engineers has been considering several sites within the Susitna River drainage for construction of a hydroelectric complex. The current plan includes construction of dams and power plants on the Susitna River at Devils Canyon and Watana Creek with transmission lines to the southcentral railbelt. A timetable suggested by the dams' chief advocate, U.S. Senator Mike Gravel, calls for construction authorization in 1981 and Watana Dam completion in 1986. Devils Canyon Dam will be completed in 1990.

The earth fill Watana Dam (river Mile 165) will be 810 feet high. The reservoir, when filled to capacity will have an elevation of 2,200 feet and a surface area of approximately 43,000 acres, extending 54 miles upstream.

The thin arch concrete Devils Canyon Dam (river Mile 134) will be 635 feet high. At maximum pool level, the reservoir will have an elevation of 1,450 feet and a surface area of 7,550 acres, extending upstream approximately 28 river miles to the Watana Dam site.

The estimated cost for the hydroelectric complex was 1.5 billion dollars in 1974. Inflation could increase this estimate to 6 billion dollars (Gabler, 1976). In October, 1976 the 94th Congress Second Session authorized 25 million dollars to become available in October, 1977 for preconstruction planning (Phase I) which includes engineering, economic, and environmental studies. The complex financing scheme for this project beyond Phase I will not be discussed in this report. It is, however, a giant undertaking and it is recommended that the environmental studies proceed on the same scale as the overall project.

Baseline environmental fisheries studies have been conducted over a three-year period by the Alaska Department of Fish and Game (ADF&G) and will be continued in 1977. The projects were financed with federal funding averaging \$29,000 per year. In 1974, the National Marine Fisheries Service and U.S. Fish and Wildlife Service (USFWS) contracted ADF&G to conduct a one-year assessment of salmon, (Oncorhynchus spp) populations utilizing the Susitna River in the vicinity of the proposed Devils Canyon dam site. The objectives of these studies were to determine the spawning distribution,

relative abundance, migrational timing and juvenile rearing areas (Barrett, 1974). Additional funding was received in 1975 and 1976 from the USFWS for continuing and expanding these studies downstream and to include physical and chemical parameters associated with the mainstem Susitna River (USFWS 1976). This report covers the period July 1, 1976 through September 30, 1976.

STUDY AREA

The Susitna River is approximately 275 miles long from its source in the Alaska Mountain Range to its point of discharge into Cook Inlet. The major tributaries of the Susitna originate in glaciers and carry a heavy load of silt during the ice free months. There are also many smaller tributaries which are perennially silt free. The Susitna River Basin is one of the largest chinook (O. tshawytscha) and coho (O. kisutch) salmon production areas in Cook Inlet.

The study section is located between Devils Canyon and Willow Creek (Fig. 1). Sampling sites were monitored on the Susitna River and tributaries. Twelve of these sites were clear water sloughs (sites 3c, 8, 10, 11, 13, 14, 15, 16, 17, 18, 19, and 20) adjacent to the Susitna River (Fig. 2). Three sites were on the mainstem of the Susitna River and the remaining locations were clearwater creeks and rivers flowing into the Susitna. Sites were chosen based on their proximity to the Devils Canyon dam area and past Susitna studies documenting fish usage (Barrett, 1974; USFWS, 1976).

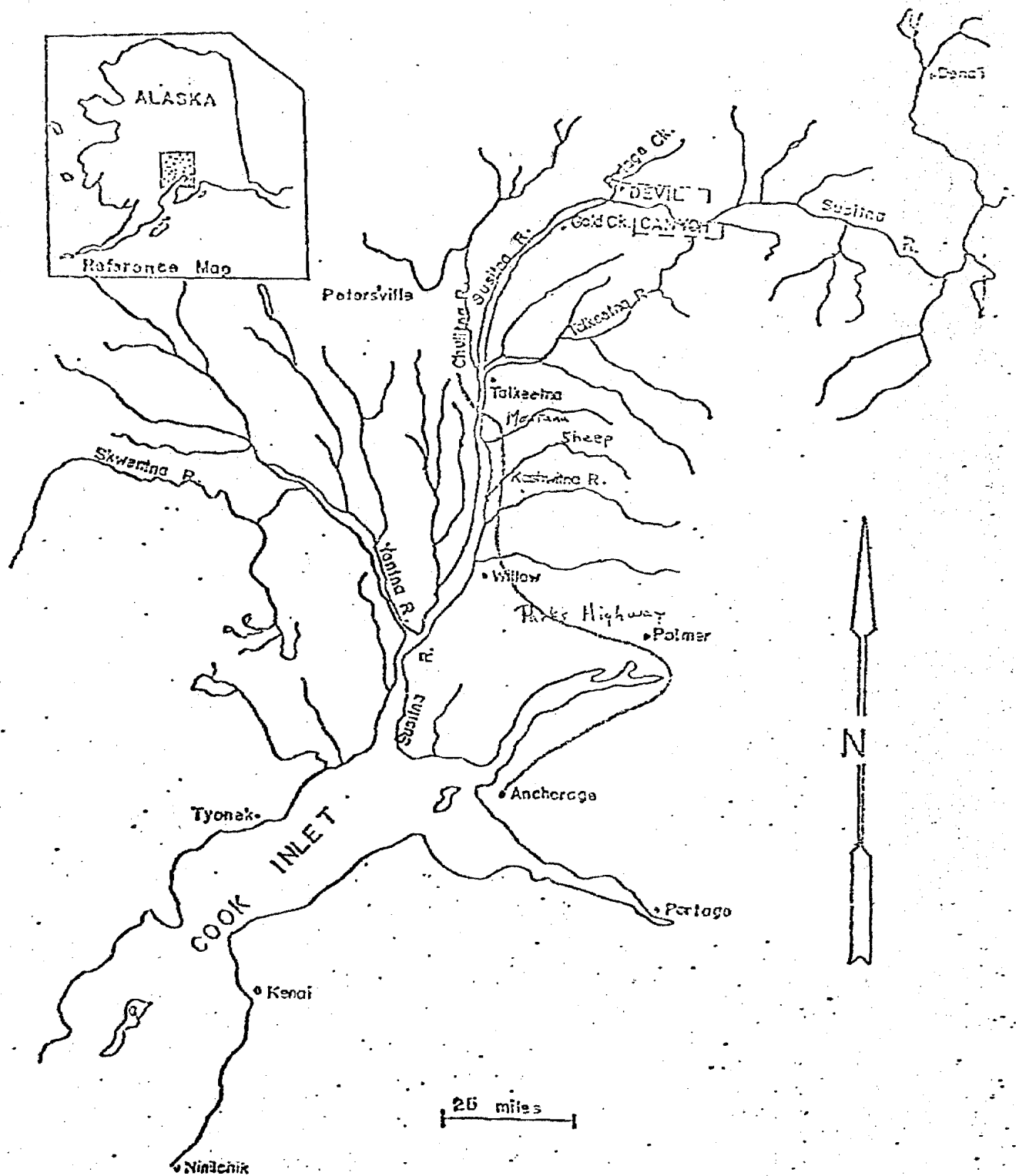


Figure 1. Devils Canyon in reference to the Susitna River watershed and northern Cook Inlet, Devils Canyon Project, 1976.

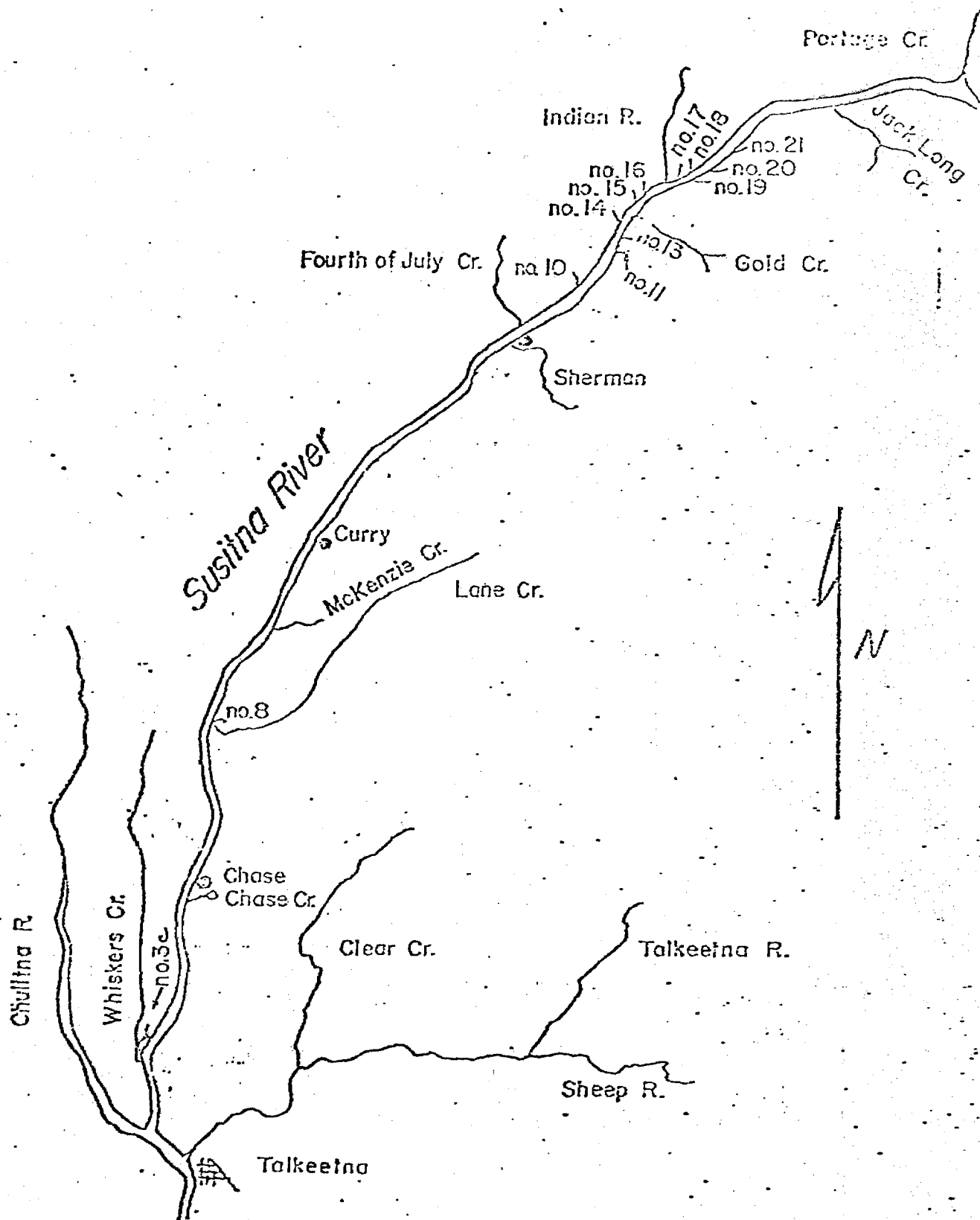


Figure 2. Map of the upper Susitna River study area encompassed in the Devils Canyon Project, 1976.

METHODS

A base camp was established at Gold Creek because of its central location to the sample sites and the logistical advantages offered by the Alaska Railroad. Travel on the Susitna River to the sites was accomplished by a 20-foot riverboat with a jet equipped 85-horsepower outboard motor. Water quantity and biological data were collected biweekly at the sites. Water quality data were collected biweekly at the mainstem Susitna sites and once per month at other site locations.

Water Quantity

Discharge data were collected by ADF&G personnel at many of the slough and tributary sites. Flows were measured with a Pygmy Gurley current meter. Leopold stage gauges were installed in the sloughs and one of the tributaries. Permanent bench marks were established on the river banks, adjacent to the gauges, for future location reference (Appendix A, Tables 19-31). Channel cross sections were measured with a wading rod and tape measure.

Mainstem Susitna River flow regimen were continually monitored by the U.S. Geological Survey (USGS) gauge station downstream from Gold Creek.

Water levels of the sloughs and one tributary were correlated with mainstem Susitna River discharges using a Wang 462 advanced statistical calculator.

Water Quality

Turbidity, conductivity, pH, alkalinity, hardness and dissolved oxygen were measured with a Hach chemical kit, model DR-EL/2, using the methods outlined by the Hach Chemical Company. Temperature data were continually recorded with Ryan thermographs, Model D-30, at three sites on the Susitna River and one at Birch Creek. A pocket thermometer was used at the remaining sites. Analysis of water samples for total suspended solids was adapted from Standard Methods (APHA, et al., 1971; USFWS, 1976).

Benthic Invertebrates

Benthics were collected with artificial substrates which consisted of a wire vegetable basket lined with nylon cloth (210 micrometre mesh) and filled with 40 rocks taken from the streambed following the procedures described by the USGS (McCoy, 1974). The basket remained in the water for 75 days.

Fisheries

Adult salmon escapement and rearing fry were enumerated by ground survey with the exception of chinook salmon counts, which were done with a Bell-47 helicopter and fixed wing aircraft. Fry samples were taken with a dip net or minnow trap and preserved with a 10% formalin solution (Brown, 1971).

Angling (using spinning and fly rods) was employed to capture grayling for tagging studies. Grayling were tagged with Floy anchor (T) tags.

FINDINGS

Flow Regimens

Between May 12, 1976 and June 12, 1976 the unregulated flow of the Susitna River increased from 11,900 cubic feet per second (cfs) to a peak discharge of 33,300 cfs (Fig. 3; Appendix A, Table 18). By June 19, the flow had decreased to 19,400 cfs and remained at approximately 20,000 cfs through August 19. The flow again declined, and by September 30, 1976 was 5,800 cfs. Based upon flow data obtained between 1965 and 1975, the Susitna flow regimen continues to decrease through November and stabilizes at approximately 1,300 cfs, until it begins to increase during the spring runoff in April (USGS Water Resources Data for Alaska 1965-1975). The fluctuating flows and associated stage heights of the unregulated mainstem Susitna are compared to the projected daily 7,000 cfs discharge of the proposed regulated system in Fig. 4.

Stage fluctuations within the clearwater sloughs of the Susitna related directly to mainstem discharge variations (Figures 5-10; Appendix A, Tables 4-9. Nine (75%) of the 12 sloughs were isolated pools or completely dry when mainstem flows were 7,000 cfs. Attempts to measure flows of the sloughs were unsuccessful because of low velocities.

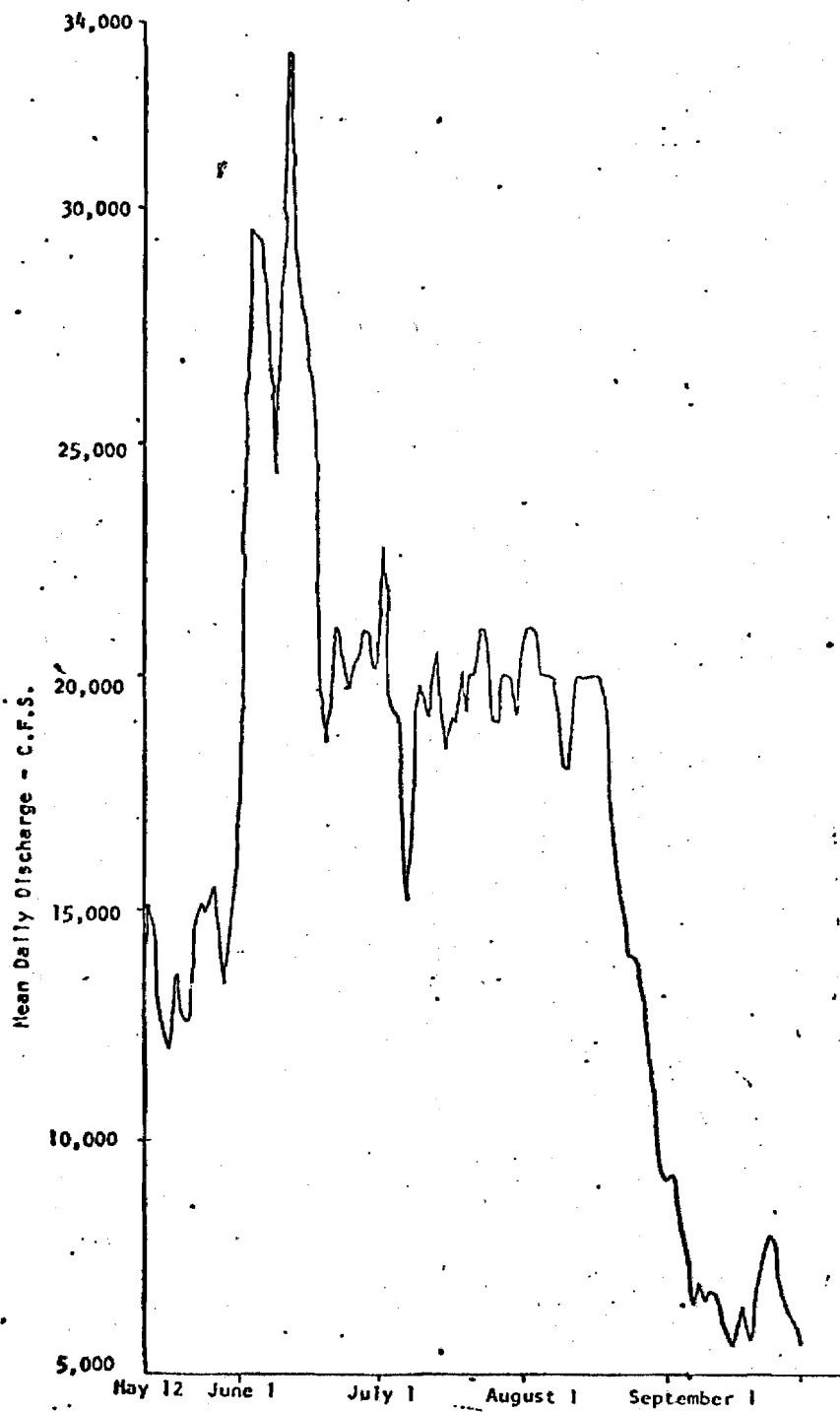


Figure 3. Susitna River Discharge at Gold Creek, USGS Provisional Records, 1976.

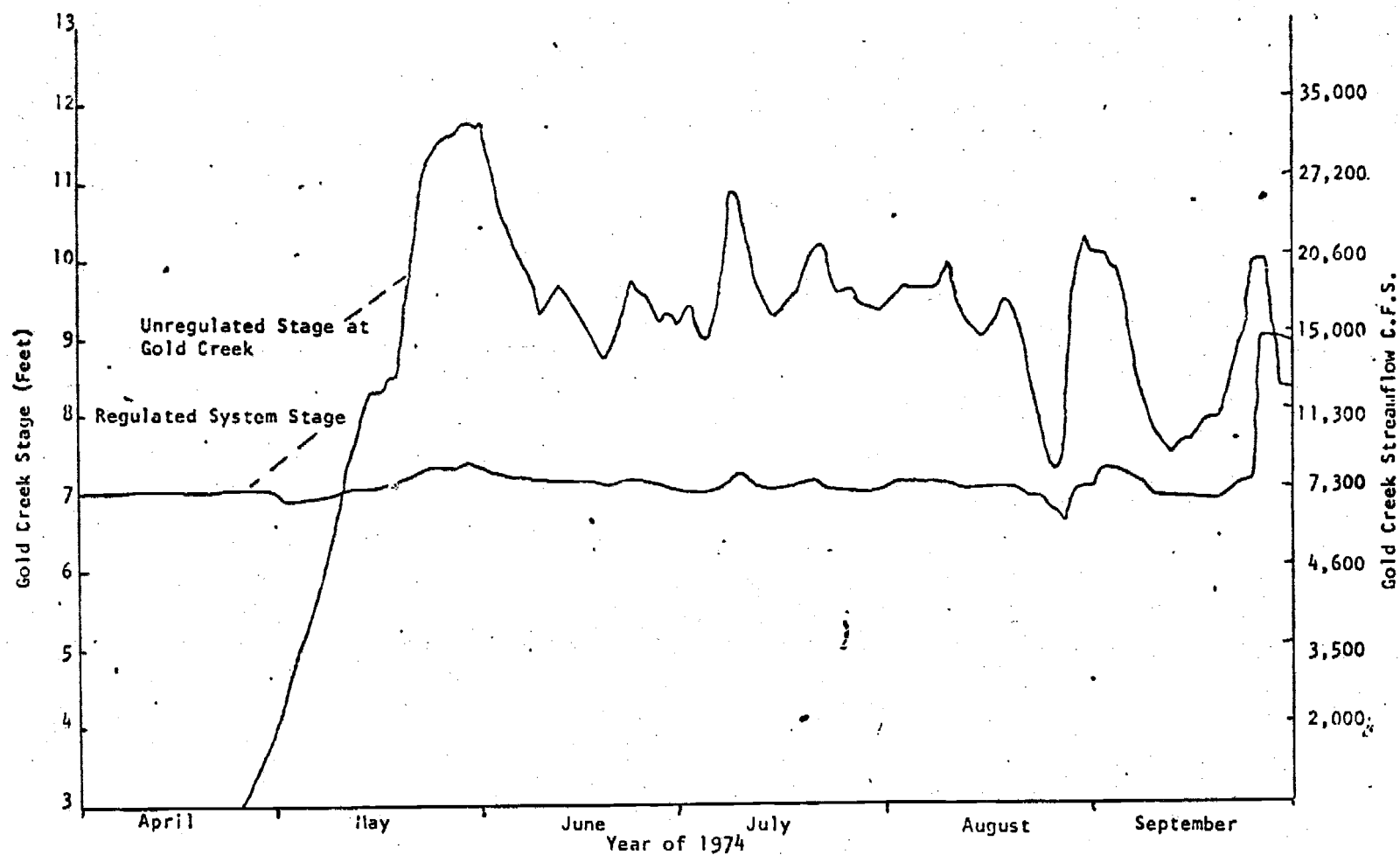


Figure 4. Devils Canyon and Watana Dams Regulated and Unregulated Daily Streamflow, U.S. Army Corps of Engineers, 1975.

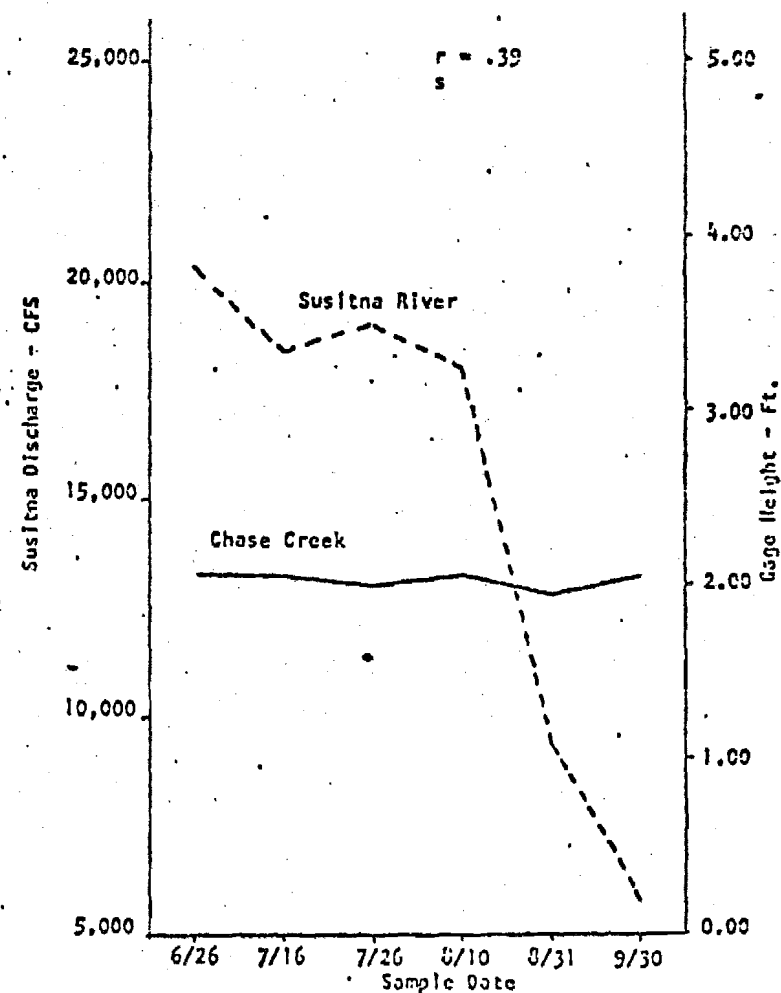
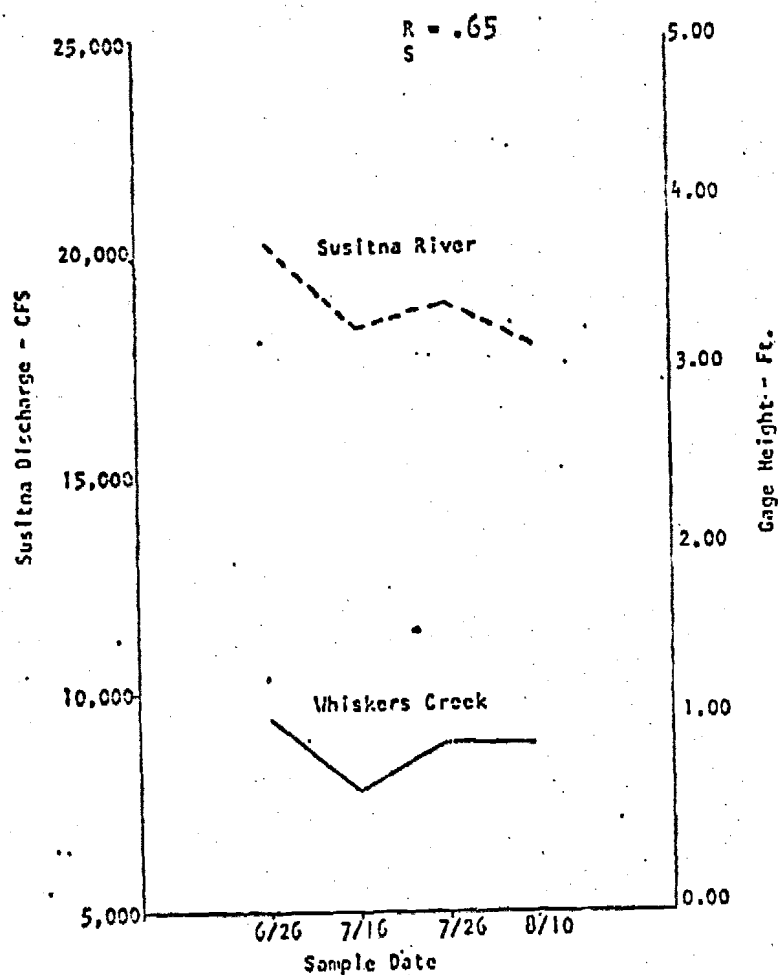


Figure 5. Correlation of Susitna River Discharge with Water Stage in Slough 3C and Chase Creek, Devils Canyon Project, 1976.

S = Non Significant

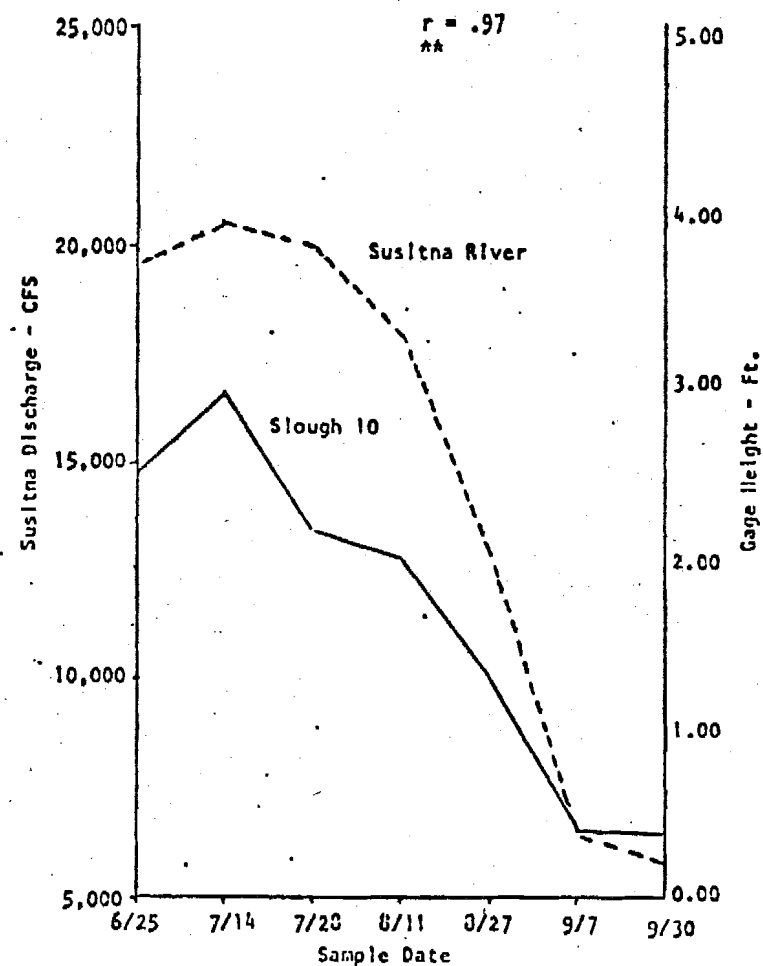
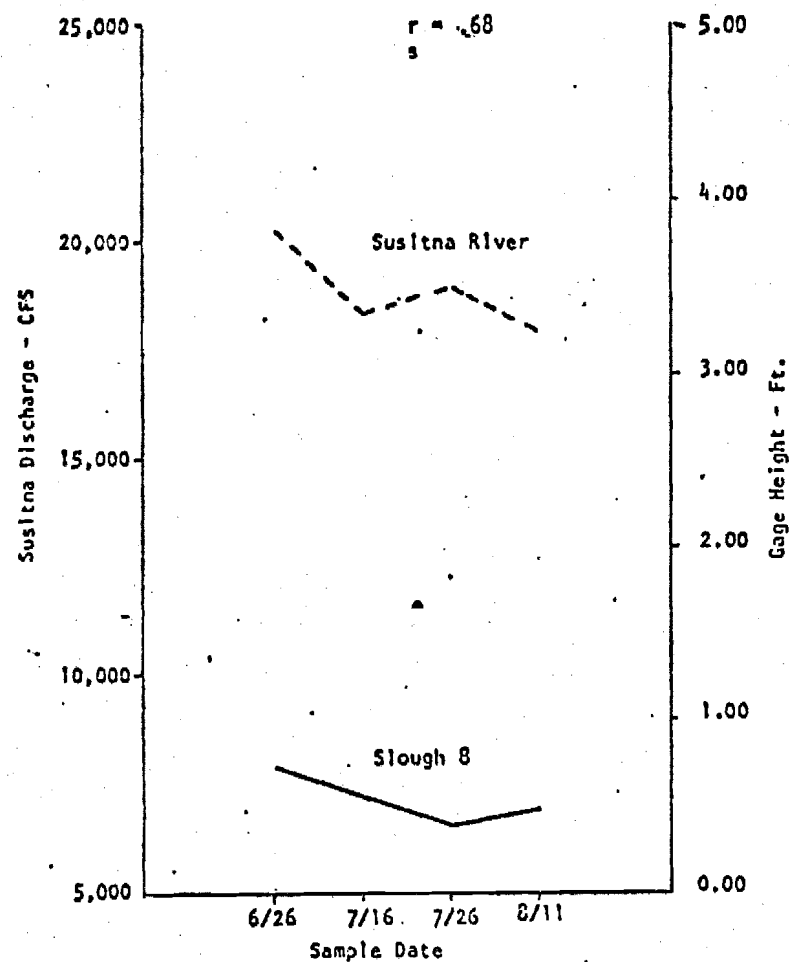


Figure 6. Correlation of Susitna River Discharge with Water Stage in Sloughs 8 and 10, Devils Canyon Project, 1976.

** = .01 Significant
S = Not Significant

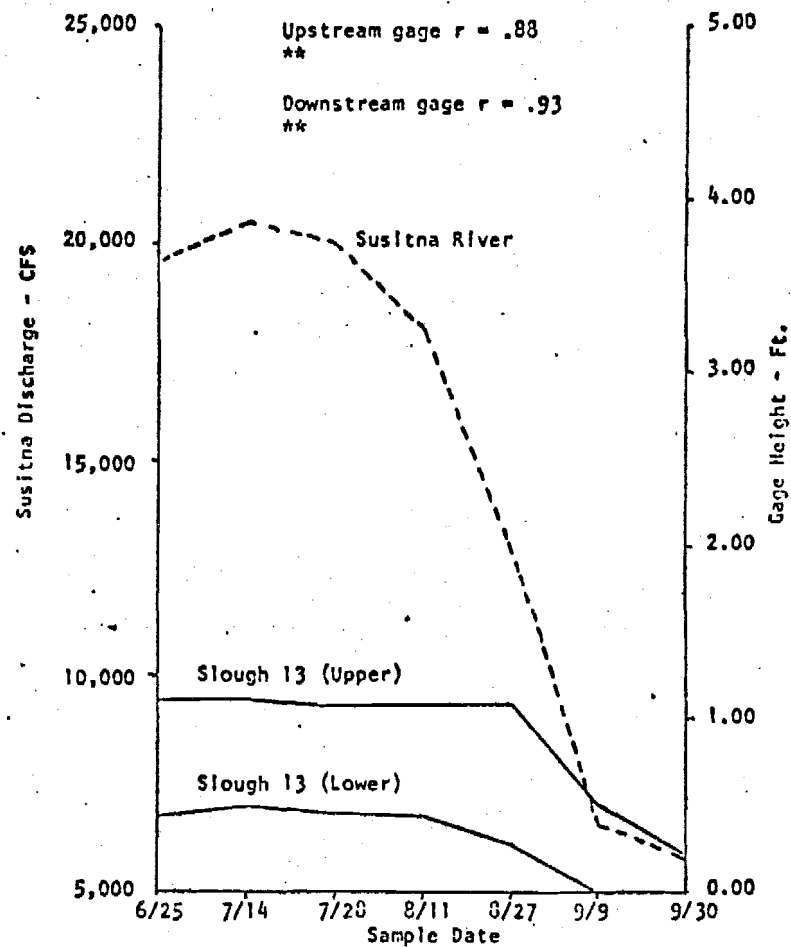
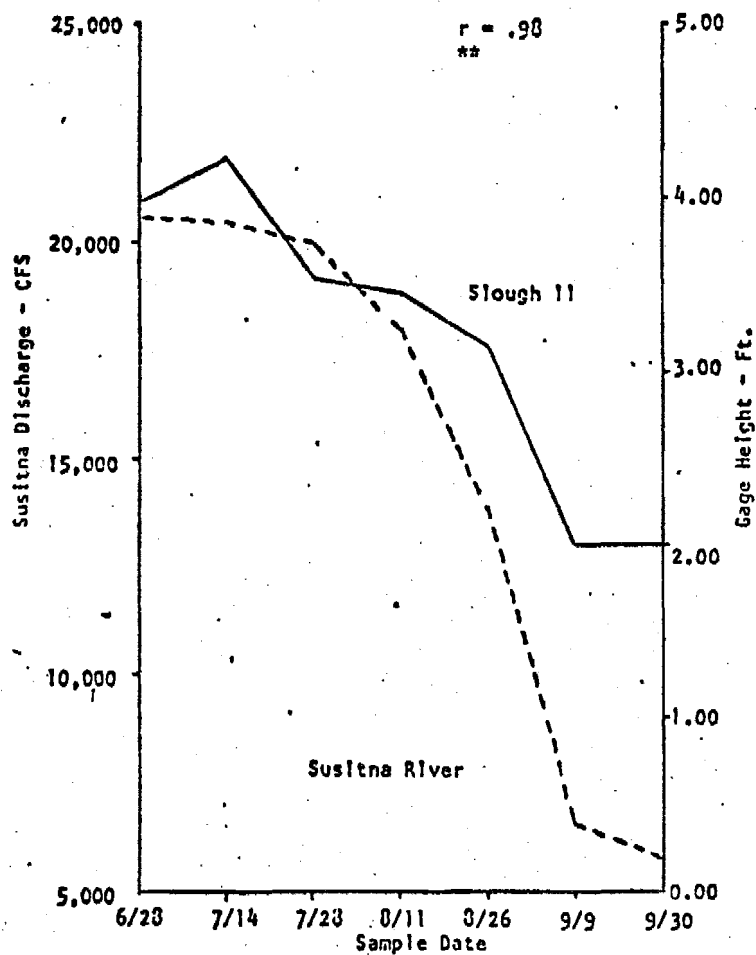


Figure 7. Correlation of Susitna River Discharge with Water Stage in Sloughs 11 and 13, Devils Canyon Project, 1976.

** = .01 Significance

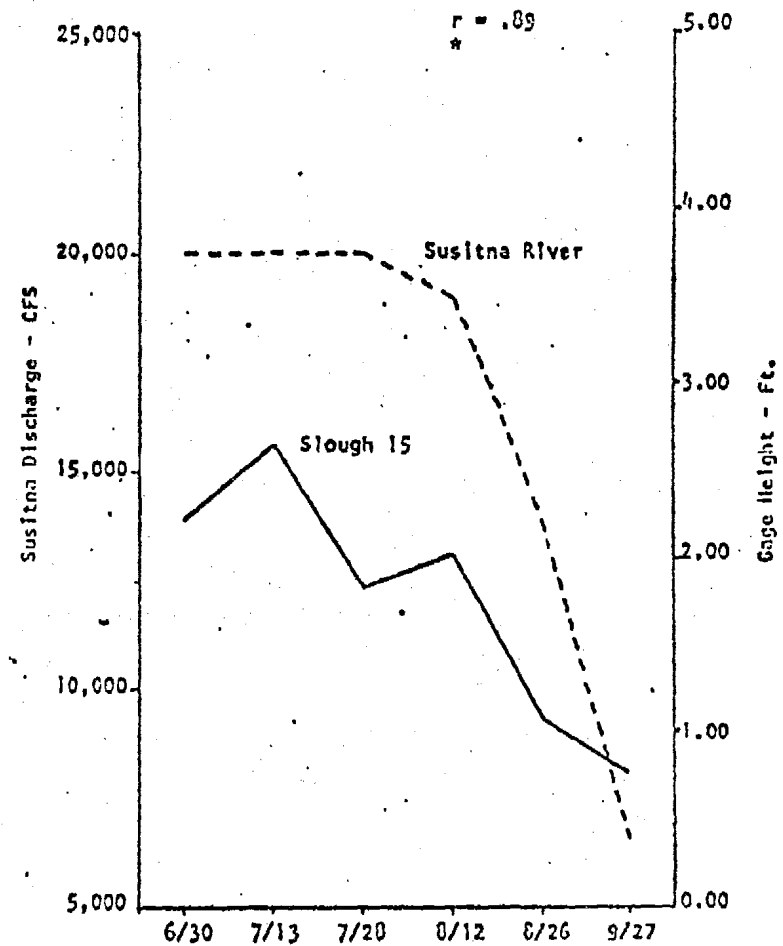
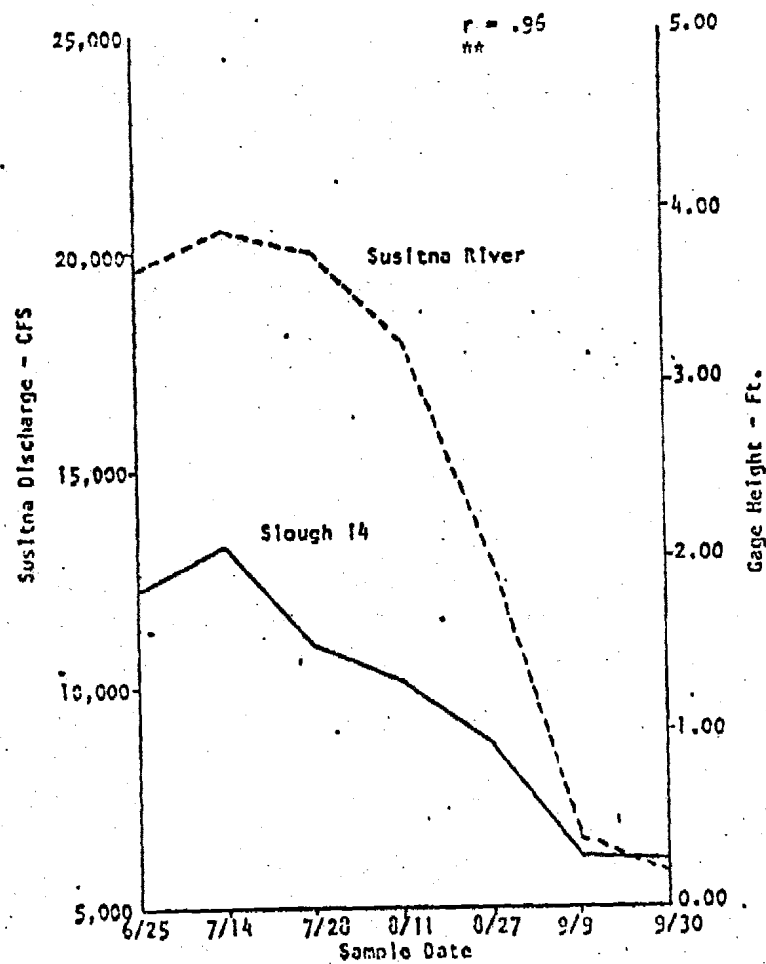


Figure 8. Correlation of Susitna River Discharge with Water Stage in Sloughs 14 and 15, Devils Canyon Project, 1976.

* = .05 Significance
 ** = .01 Significance

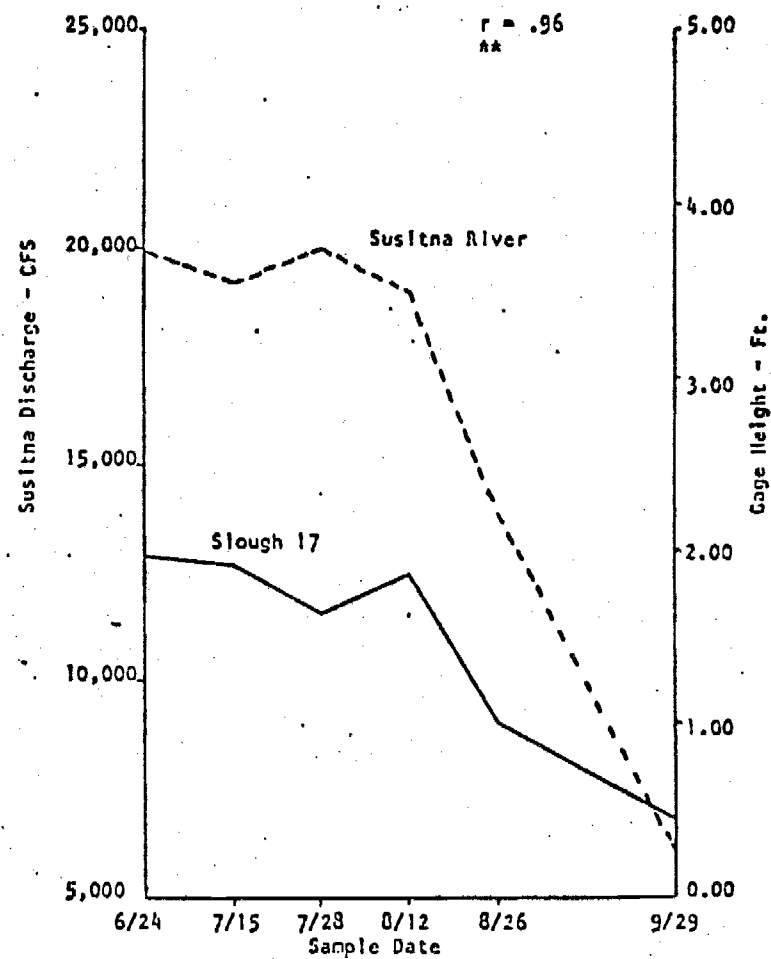
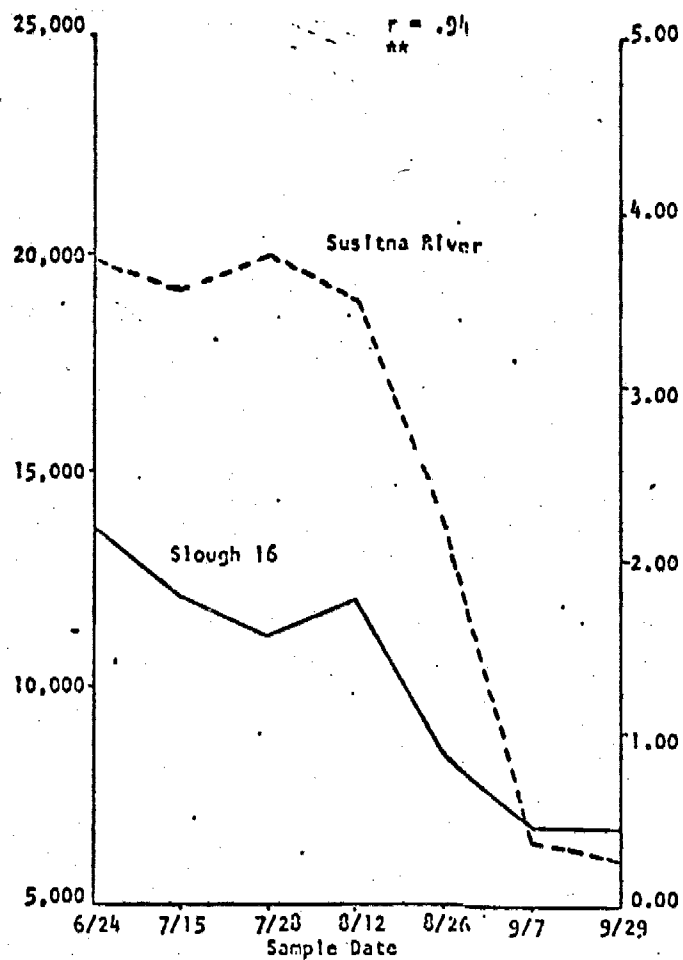


Figure 9. Correlation of Susitna River Discharge with Water Stage in Sloughs 16 and 17, Devils Canyon Project, 1976.

** = .01 Significance

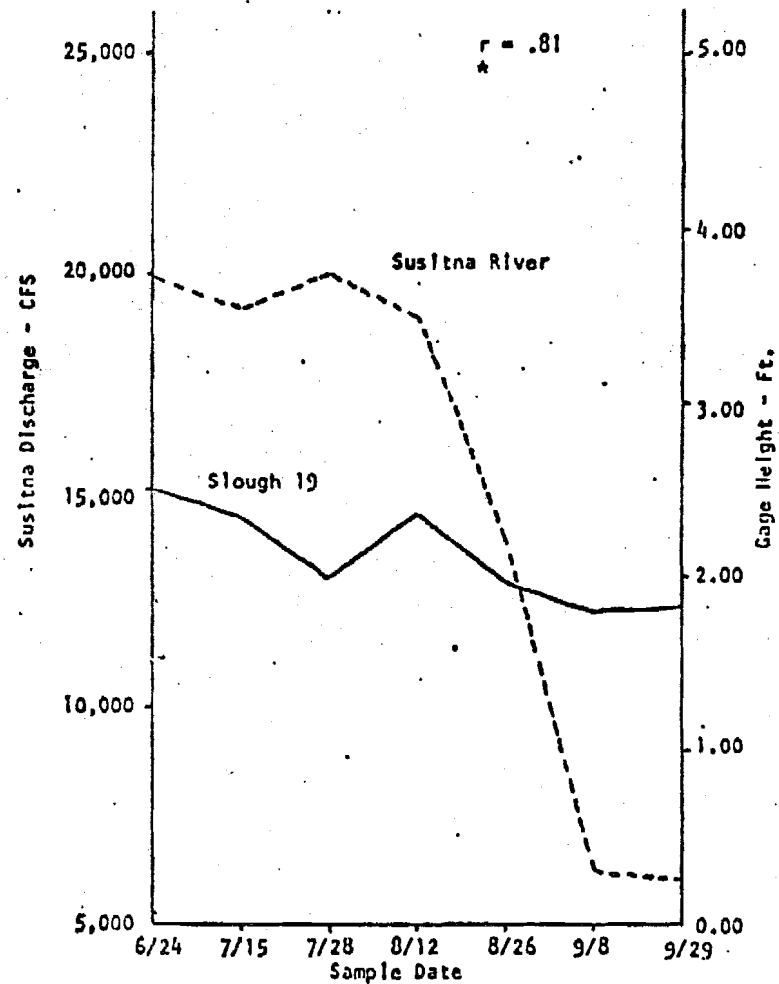
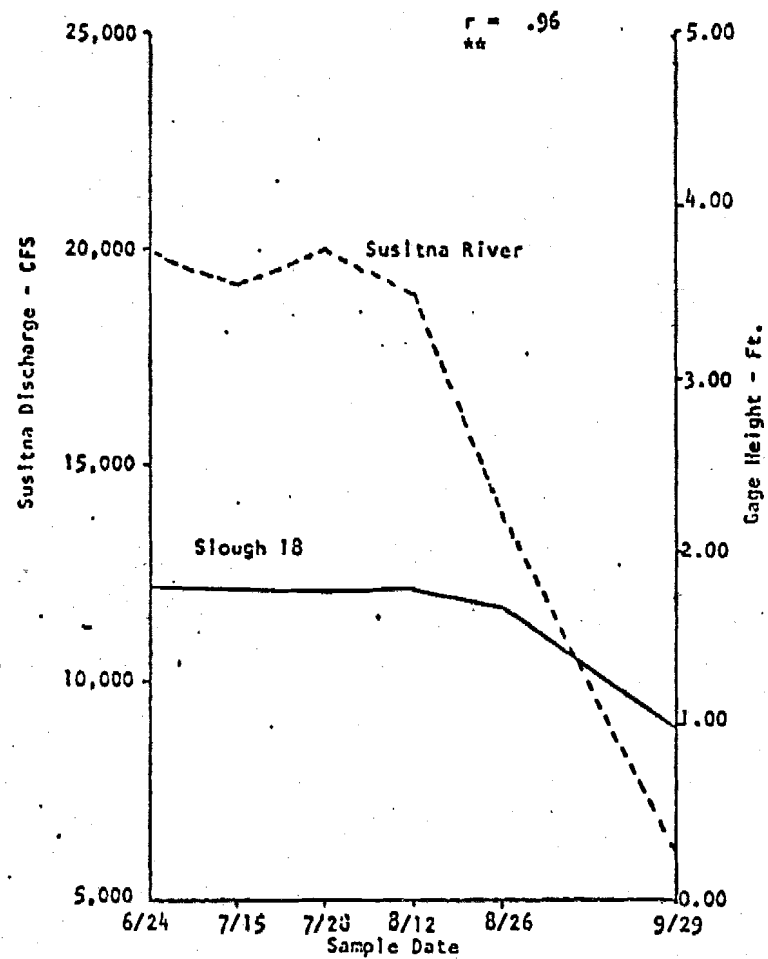


Figure 10. Correlation of Susitna River Discharge with Water Stage in Sloughs 18 and 19, Devils Canyon Project, 1976.

** = .01 Significance

* = .05 Significance

Flows of Portage, Gold, Fourth of July, Chase and Whiskers creeks are presented in Appendix A, Table 32. Insufficient data were collected to analyze trends.

Temperature

Thermographs were located on the Susitna River at the Parks Highway bridge, upstream of Chase Creek, and between Devils Canyon and Portage Creek. Temperature trends were similar at the three sites. Temperatures at the Parks Highway Bridge site varied from 54 F on June 26 to 56 F on July 11 and August 4, and decreased to 32 F by October 26 (Fig. 11; Appendix A, Table 14). Temperatures at the Chase Creek location ranged from 51 F on June 21 to 59 F on July 30, 31, August 1, and 3, and dropped to 41 F by September 29 (Fig. 12, Appendix A, Table 15). Temperatures at the station between Devils Canyon and Portage Creek varied from 50 F on June 22 to 58 F on August 2 and decreased to 31 F by October 30 (Fig. 13, Appendix A, Table 16). Temperatures at Birch Creek (a potential future fish facility location) were also monitored and averaged 10 F higher than those recorded in the Susitna (Figure 14). Temperatures were also recorded at the thermograph and other study sites with a pocket thermometer (Tables 3-8). Slough water temperatures were more stable than those of the mainstem Susitna.

Suspended Solids and Turbidity

Total suspended solids (TSS) levels, measured immediately downstream from Devils Canyon, varied from 1,300 milligrams per liter (mg/l) on July 16 to

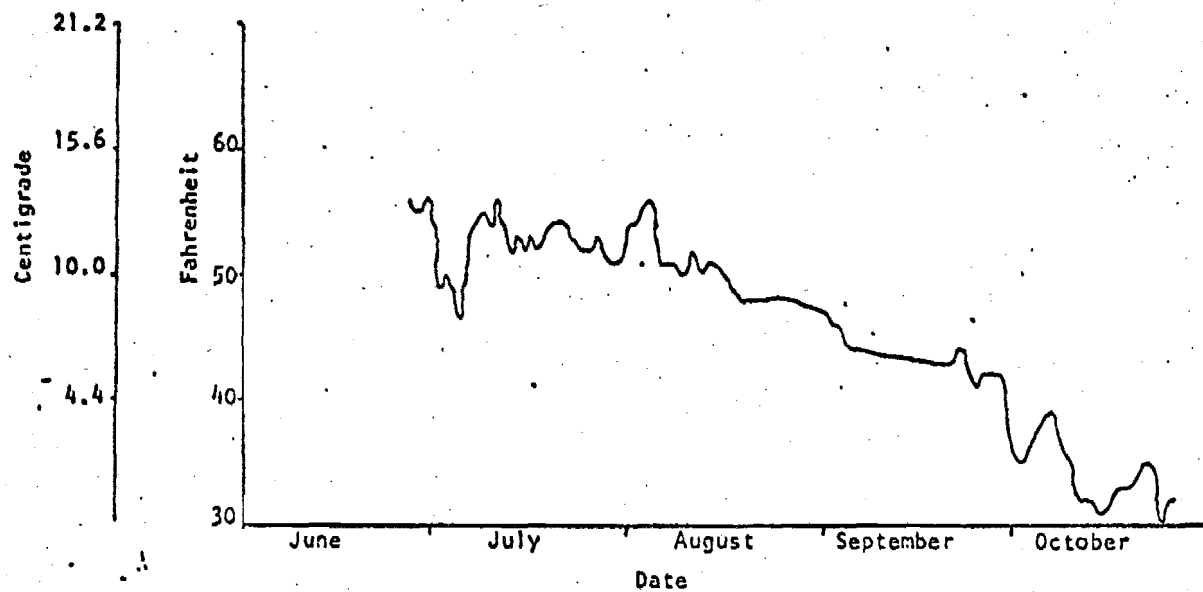


Figure 11. Maximum Daily Water Temperatures of Susitna River at Parks Highway Bridge, Devils Canyon Project, June 27 to October 26, 1976.

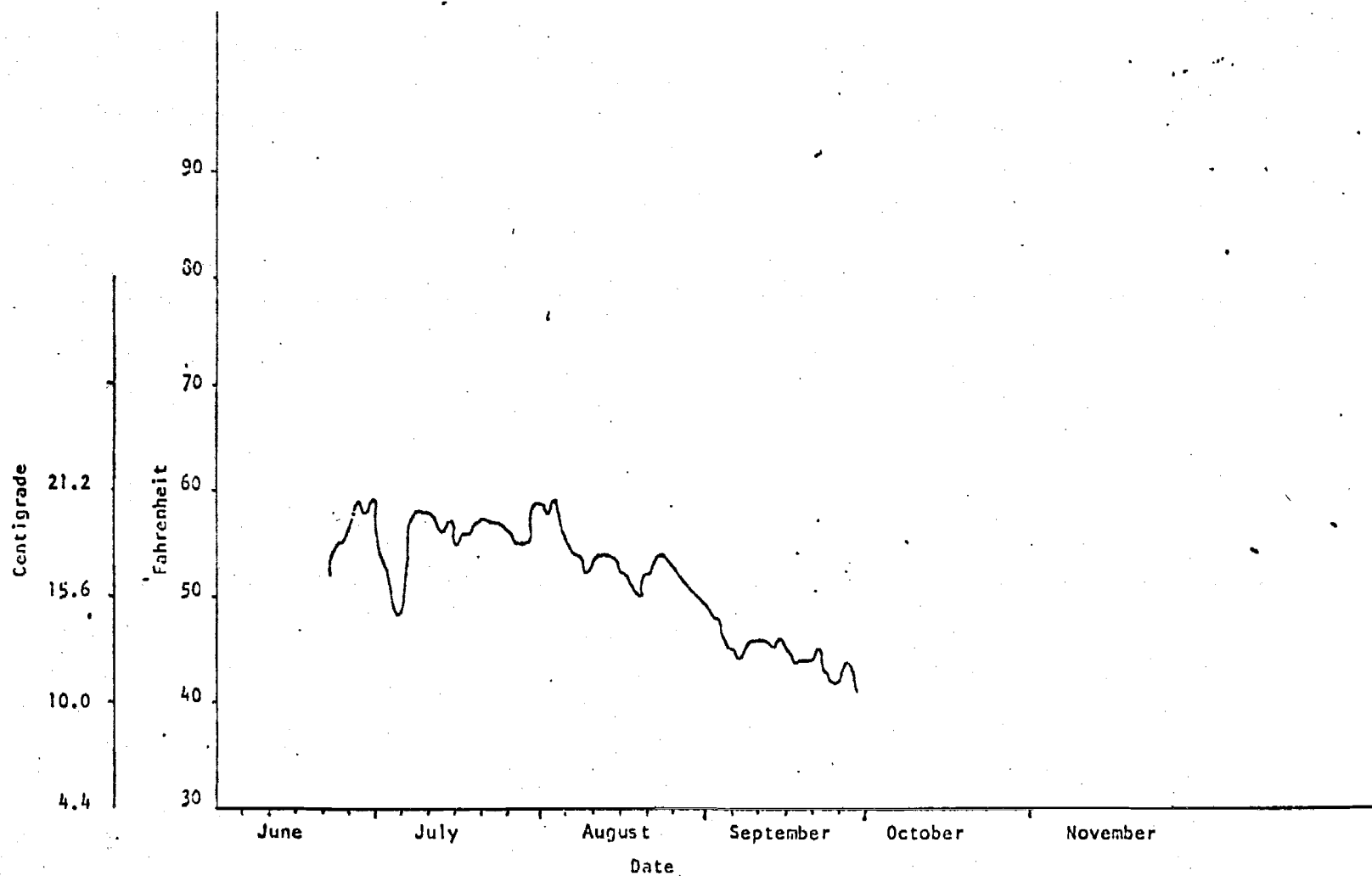


Figure 12. Maximum Daily Water Temperatures of Susitna River Upstream from Chase Creek, Devils Canyon Project, June 22 to September 29, 1976.

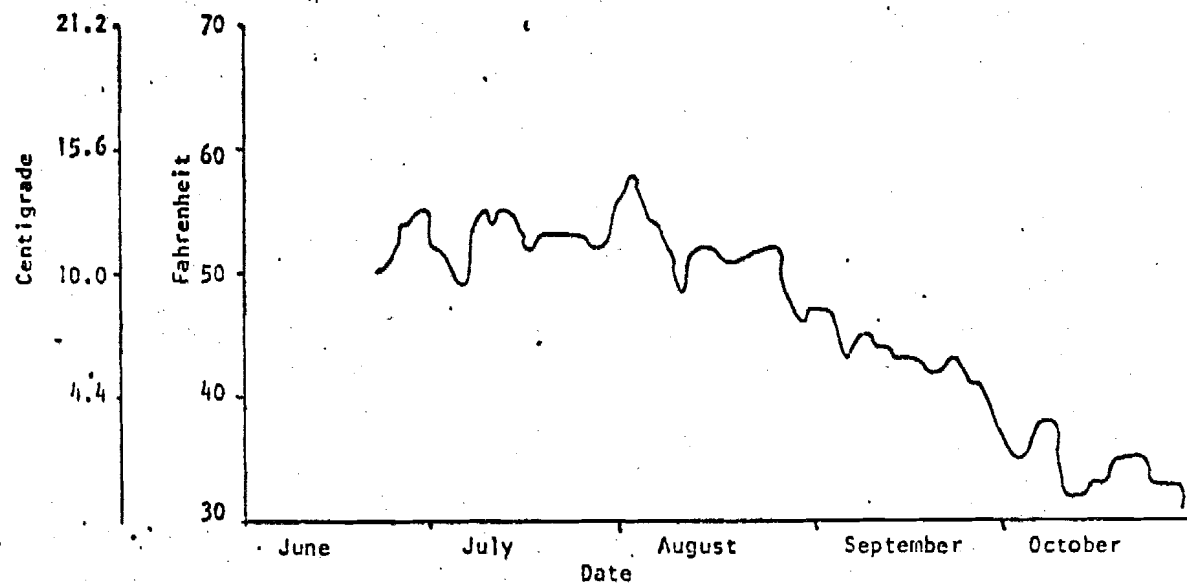
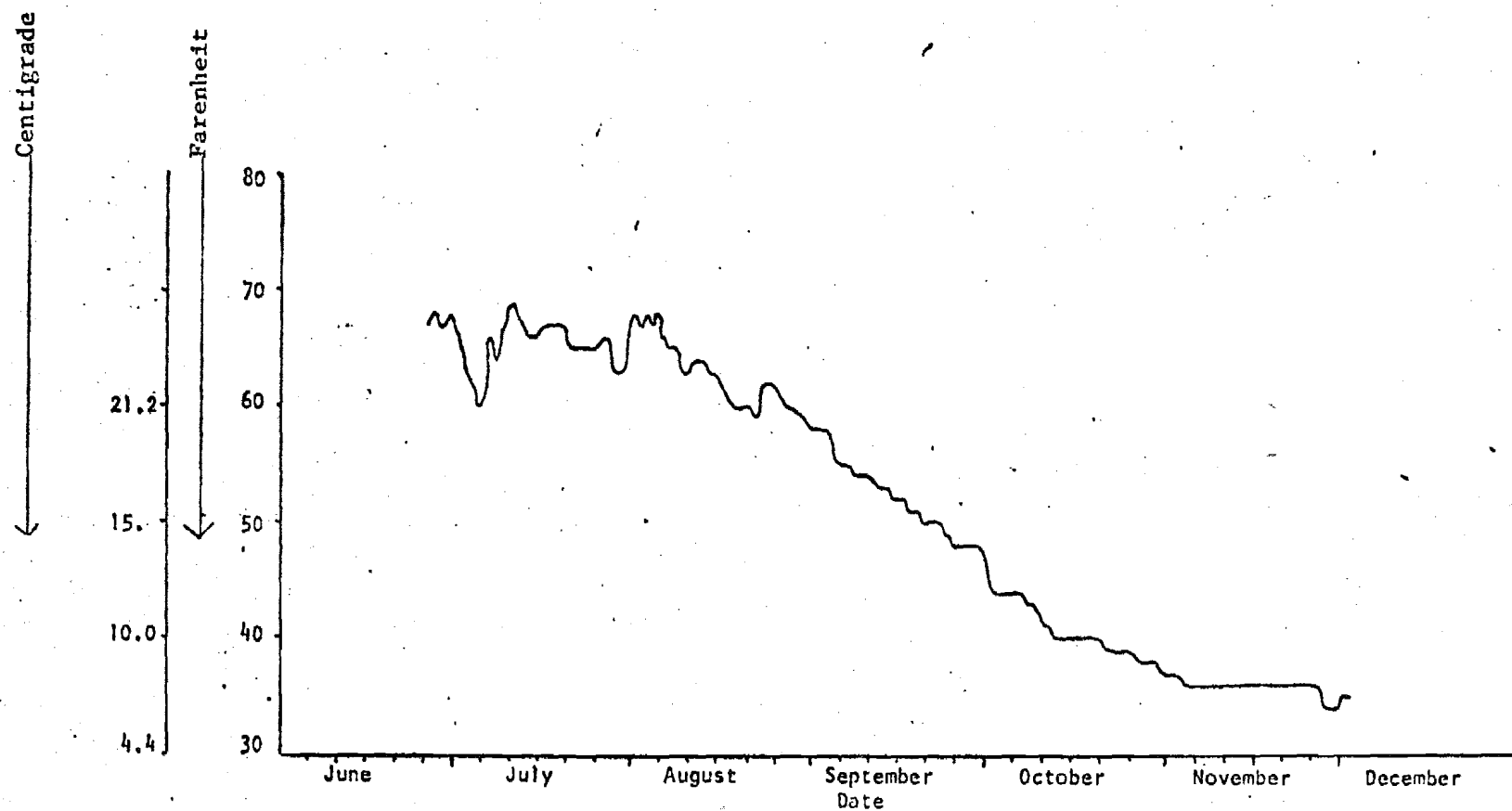


Figure 13. Maximum Daily Water Temperatures of Susitna River between Devils Canyon and Portage Creek, Devils Canyon Project June 22 to October 30, 1976.



Figure, 14. Maximum Daily Water Temperatures of Birch Creek Below Highway Crossing, Devil's Canyon Project, June 26 to December 1, 1976.

500 mg/l by the end of July and remained constant throughout August (Fig. 15). The TSS decreased to 30 mg/l during September. Formazin turbidity unit (Ftu) measurements followed a similar trend between July and September, ranging from 300 to 20 Ftu's (Fig. 16). TSS levels and turbidity levels correlated with Susitna River discharge fluctuation trends. Based upon past observations, the TSS and Ftu levels continue to decrease as flow decreases, stabilizing between November and April, and begin to increase with the increased flow in spring.

Water Chemistry

Field analyses of dissolved oxygen, pH, hardness, total alkalinity, and specific conductance are presented in Appendix A, Tables 1 through 13. Measurements of these parameters expands the Susitna River data base considerably and will be valuable in future studies and post-impoundment comparisons if the dams are built.

Oxygen concentrations were close to saturation throughout the study, ranging from 10 to 13 parts per million (ppm) in the Susitna River, 6-12 ppm in the sloughs, and 9 to 14 ppm in the tributaries. The dissolved oxygen concentrations exhibited a tendency to rise during the summer. Hydrogen ion (pH) concentrations ranged from 7.6 to 8.3 in the Susitna, 6.6 to 8.0 in the sloughs, and 7.0 to 8.3 in the tributaries. The range in pH at each station remained relatively stable for the three months of monitoring. Hardness, as CaCO_3 , varied from 40 to 60 ppm in the Susitna River, from 20 to 95 ppm in the sloughs, and from 10 to 105 ppm in the tributaries. These readings all fall within the soft to medium water hardness classification.

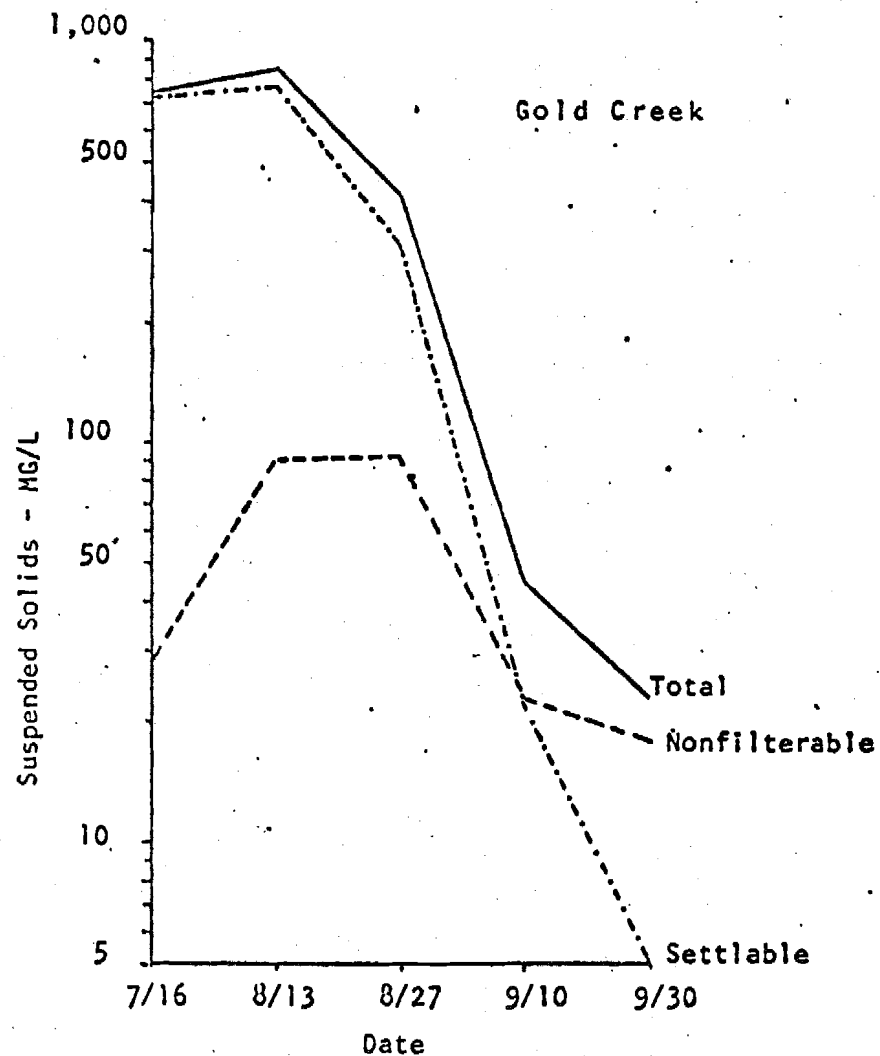
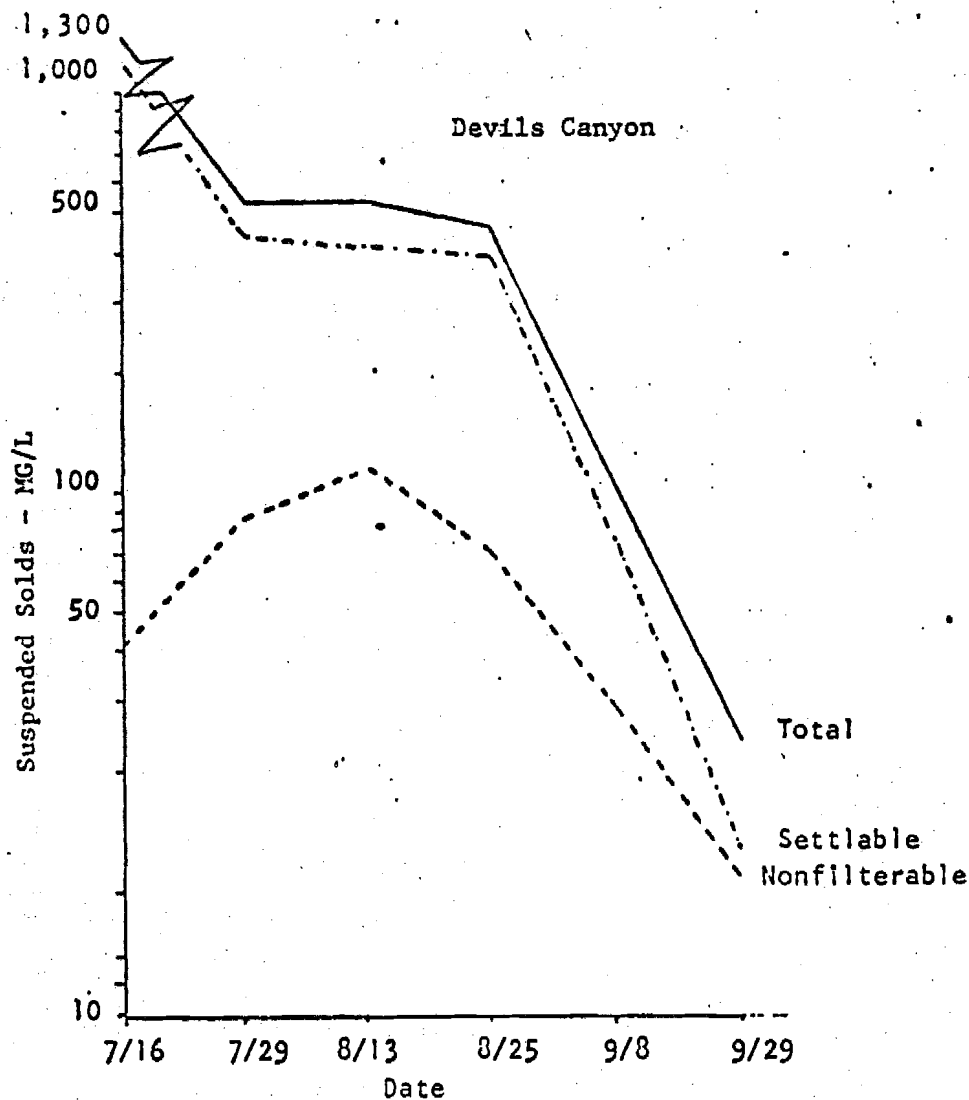


Figure 15. Susitna River Suspended Solids Collected Downstream of Devils Canyon and Below Gold Creek Railroad Bridge, Devils Canyon Project, 1976.

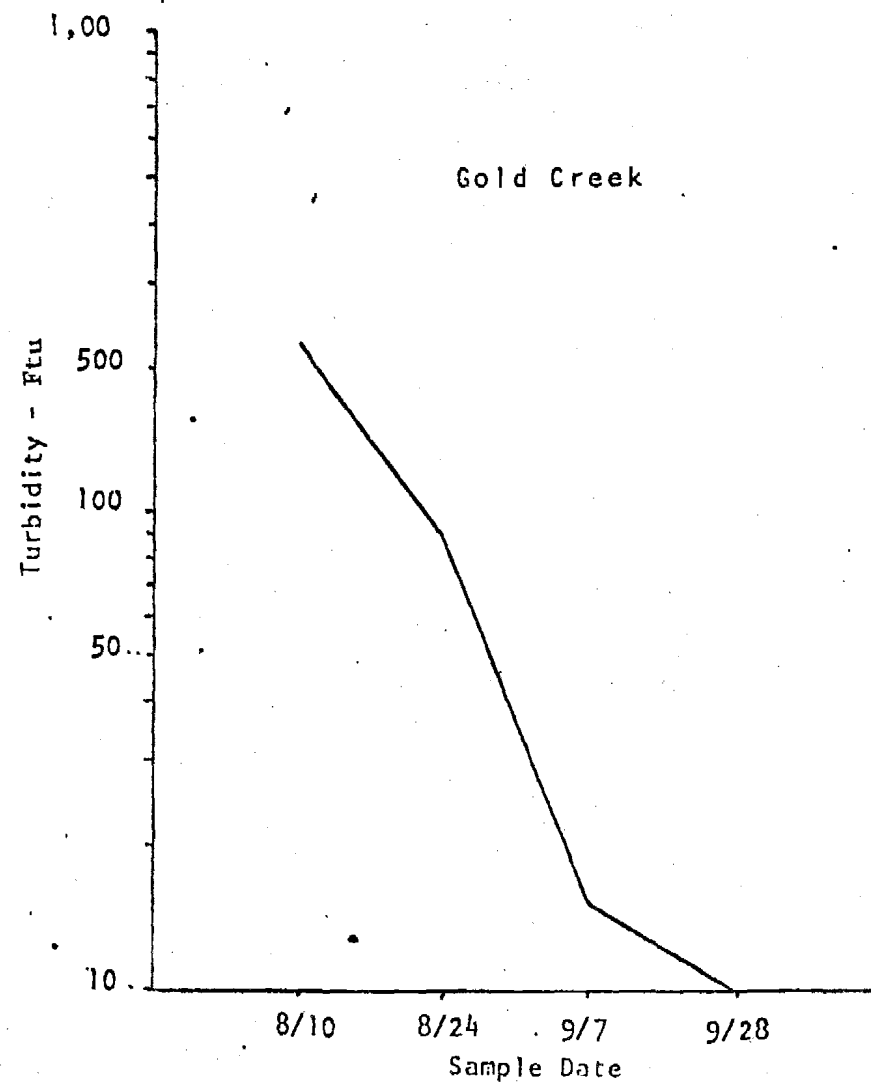
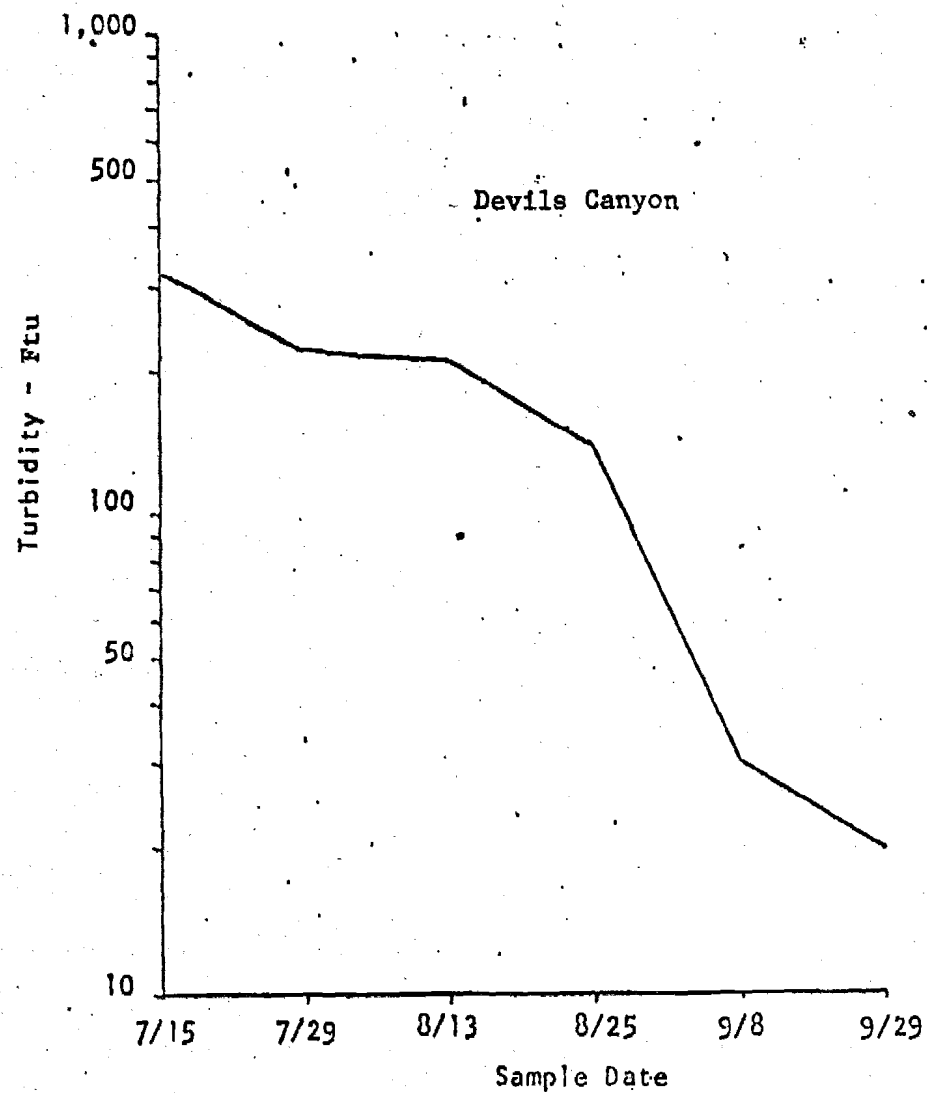


Figure 16. Susitna River Turbidity (Ftu) Levels Downstream of Devils Canyon and Below Gold Creek Railroad Bridge, Devils Canyon Project 1976.

Total alkalinity measurements were fairly uniform at each site during the study. Concentrations ranged from 30 to 55 ppm in the Susitna, from 10 to 105 ppm in the sloughs, and from 10 to 80 ppm in the tributaries. Conductivity readings, which were standardized to 25 C, ranged from 105 to 170 micro mhos per centimeter (micro mhos/cm) ranged from 105 to 170 micro mhos/cm in the Susitna, 55 to 230 micro mhos/cm in the sloughs, and 25 to 120 micro mhos/cm in the tributaries.

Benthic Invertebrates

Seven artificial substrate baskets were installed in the mainstem Susitna River on July 14, 1976. Two were located under the Gold Creek railroad bridge on the north side of the river and four on the south side of the river (two upstream of Gold Creek and two downstream of Gold Creek). One substrate was also placed in the Susitna upstream of Chase Creek on the east side of the river. Only the two baskets under the Gold Creek railroad bridge on the north side of the river can be discussed because the four on the south side were vandalized; and the water level dropped below the one at Chase Creek immediately preceding the recovery date. At the point where the two baskets remained in the water, the bottom material ranged in size from coarse gravel to large boulders (Wickett, 1959). The baskets were retrieved on September 30, 1976 and each rock was examined in the field for benthic invertebrates. The insects were keyed to order in the laboratory and of the 118 specimens (Plecoptera 77, Diptera 55, and Ephemeroptera 66), 63% were classified as being "sensitive". *(In this report the orders of mayflies [Ephemeroptera] and stoneflies [Plecoptera] are considered to be "sensitive" to changes in water quality while the order of the true flies*

[Diptera] is considered to be "tolerant" to such changes. This admittedly is a fairly general categorization, but it is a widely used practice, particularly when taxonomic breakdown are not available to the researcher. A healthy stream section would therefore contain a large number of insects, a high percentage of which would be pollution "sensitive". Any reduction in total numbers or in the percentage of sensitive organisms from a control station would indicate stream degradation when more than one sample is collected).

Fisheries

The Susitna River drainage is utilized by all five Pacific salmon species, as well as resident species such as rainbow trout (Salmo gairdneri), and Arctic grayling (Thymallus arcticus). Aerial and ground escapement surveys were conducted in 1976 on Susitna River sloughs and its tributaries (Tables 1, 3, 4, 5, 6, 7, and 8). These escapement counts indicate the relative abundance of fish observed, and should not be interpreted to be total counts.

A chinook escapement of 50,499 (enumerated via aerial survey) is tabulated in Table 1. Coho adults were observed (via ground survey) in various tributaries prior to spawning; however, it was not possible to enumerate them to the extent chinook salmon were, because they utilize and disperse throughout many tributaries rather than congregating in the larger tributaries. Large numbers of pink salmon (O. gorbuscha) were located near the mouths of tributaries (Tables 7 and 8).

Table 1. Aerial enumeration of Chinook Salmon Escapements in the Susitna River Tributaries, Devils Canyon Project, 1976.

<u>Stream</u> (West Side)		<u>Stream</u> (East Side)	
Alexander Creek	5,412	Willow Creek	1,660
Deshka River	21,693	Montana Creek	1,445
Peters Creek	1,489	Chunilna Creek	1,237
Martin Creek	791	Kashwitna River (North Fork)	303
Lake Creek	3,735	Little Willow Creek	833
Talachulitna River	1,319	Sheep Creek	455
		Indian River	537
		Portage Creek	702
		Chulitna River (East Fork)	112
		Chulitna River (Middle Fork)	1,870
		Chulitna River (Main stem)	124
		Prairie Creek	6,513
		Honolulu Creek	124
		Byers Creek	53
		Troublesome Creek	92

Table 2. Grayling Tagged at Indian River and Portage Creek, Devil's Canyon Project, 1976.

<u>Location</u>	<u>Date</u>	<u>Tag Number</u>	<u>Length-Inches (Total Length)</u>	
Portage Creek	6/22	06379	11.5	
		06378	11.5	
		06365	13.0	
		06359	12.0	
		06105	14.0	
	6/24	06108	13.0	
		06109	14.0	
		06110	14.0	
		06110	14.0	
		06118	15.0	
		06119	13.0	
		06120	15.0	
		06121	15.0	
		06122	12.0	
		06123	15.0	
		06125	12.0	
		7/15	06133	8.0
		7/29	06137	15.0
		8/25	26107	13.0
			26108	11.0
			06139	14.0
Indian River	6/22	06112	15.0	
		06113	11.5	
		06114	12.5	
		06115	12.5	
		06116	13.0	
	7/14	06130	14.0	
		06131	13.0	
		06132	15.0	

Table 3. Fish Surveys Conducted on Susitna River Sloughs 8, 10, and 11, Devils Canyon Project, 1976.

Location	Date	Time (Military)	Temperature (°F)		Weather Conditions	No. Fry Observed	Fry Species Identified						Adult Salmon Density				
			Air	Water			Chinook	Coho	Chum	Sockeye	Grayling	Whitefish	Chinook	Coho	Sockeye	Chum	Pink
Slough #8	6/26	1200	62	46	Excellent	200		x					0	0	0	0	0
	7/16	1130	58	44	Poor	50		x									
	7/26	935		42	Good	300		x									
	8/11	1540	65	54	Good	300		x									
Slough #10	6/26	1200	60	52	Excellent	0							0	0	0	0	0
	7/14	1230	61	49	Poor	0											
	7/28	1000	63	38	Fair	1		x									
	8/11	1745	63	42	Fair	0											
	8/27	1200	58	43	Good	0 ^{1/}											
	9/7	1410		42	Excellent	5		x									
	9/30	1500		40	Excellent	0											
Slough #11 ^{2/}	6/23	1405	60	45	Excellent	0							0	0	0	0	0
	7/14	1545	74	51	Good	0											
	7/25	1100	60	46	Fair	0											
	8/11	1900	59	47	Good	0										12	
	8/26	1230			Excellent	0									28	57	1
	9/4	1620	45	39	Good	0									78	66	
	9/30	1220	42	38	Excellent	0											

^{1/} Approximately 300 coho fry observed in clear water channel between Slough 10 and Susitna main channel, water temperature was 52°F.

^{2/} Slough No. 11 was excellent rearing habitat prior to this year. An ice jam in the spring of 1976 destroyed this slough.

Table 4. Fish Surveys Conducted on Susitna River Sloughs, Devils Canyon Project, 1976.

Location	Date	Time (Military)	Temperature (°F)		Conditions	No. Fry Observed	Fry Species Identified						Adult Salmon Density				
			Air	Water			Chinook	Coho	Chum	Sockeye	Grayling	Whitefish	Chinook	Coho	Sockeye	Chum	Pink
Slough No. 13	6/25	1100		41	Excellent	100		x	x	x		x	0	0	0	0	0
	7/14	1630	72	44	Good	150		x		x							
	7/28			43	Fair	200		x									
	8/11	2000	55	40	Good	250		x									
	8/27				Good	250		x									
	9/9	1735	52	47	Good	3		x									
	9/30	1345	48	36	Excellent	0		x									
Slough No. 14	6/25	1650		46	Excellent	10		x					0	0	0	0	0
	7/14	1800	63	45	Good	10		x									
	7/28	1300		43	Fair	0		x									
	8/11	2050	49	43	Good	25		x									
	8/27	1300	57	43	Fair	20		x									
	9/9	1840	49	44	Good	4		x									
	9/30	1405	47	44	Excellent	1		x									
Slough No. 15	6/30		66	43	Excellent	250	x	x		x			0	0	0	0	0
	7/13	2030	54	47	Poor	100	x	x		x							
	7/28	1500		50	Fair	200	x										
	8/12	1002	52	44	Poor	200	x										
	8/26	1900	57	47	Excellent	50	x								1		
	9/7	1720	47	41	Fair	50	x				x						

Table 5. Fish Surveys Conducted on Susitna River Sloughs 16, 17, and 18, Devils Canyon Project, 1976.

Location	Date	Time (Military)	Temperature (°F)		Conditions	No. Fry Observed	Fry Species Identified						Adult Salmon Density				
			Air	Water			Chinook	Coho	Chum	Sockeye	Grayling	Whitefish	Chinook	Coho	Sockeye	Chum	Pink
Slough No. 16	6/24	1330		54	Excellent	200	x	x					0	0	0	0	0
	7/15	1930	52	49	Poor	200	x	x									
	7/28	1530		50	Fair	500	x	x									
	8/12	1050	51	45	Poor	225	x	x									
	8/26 ^{1/}	1700	60	49	Excellent	75	x	x									
	9/7	1830	47	42	Fair	0											
	9/29	1740	41	47	Excellent	0											
Slough No. 17	6/24	1550		48	Excellent	100		x					0	0	0	0	0
	7/15	1845	64	40	Fair	100		x									
	7/28	1600		42	Fair	100		x									
	8/12	1340	51	38	Fair	2		x									
	8/26	1600	60	41	Excellent	60		x			x						
	9/29	1550	43	41	Excellent	0											
Slough No. 18	6/24			53	Excellent	50		x					0	0	0	0	0
	7/15	1900	60	48	Poor	25		x									
	7/28	1630		49	Fair	25		x									
	8/12	1535	54	48	Fair	5		x									
	8/26	1630	54	42	Excellent	10		x									
	9/29 ^{2/}	1635	50	47	Excellent	0											

^{1/} Flow and water level dropped considerably.

^{2/} Entry and exit to Susitna blocked.

Table 6. Fish Surveys Conducted on Susitna River Sloughs 19, 20, and 21; Devils Canyon Project, 1976.

Location	Date	Time (Military)	Temperature (°F)		Weather Conditions	No. Fry Observed	Fry Species Identified						Adult Salmon Density			
			Air	Water			Chinook	Coho	Chum	Sockeye	Grayling	Whitefish	Chinook	Coho	Sockeye	Chum . Pink
Slough No. 19	6/29	1700		43	Excellent	100		x	x	x			0	0	0	0
	7/15	1700	64	49	Good	100		x		x						
	7/28	1700		49	Fair	100		x		x						
	8/12	1850	55	45	Fair	300		x		x						
	8/25 ^{1/}			47	Good	200		x							32	
	9/8	1710	47	44	Poor	0									30	
	9/24	1510	44	42	Excellent	0										
Slough No. 20	6/29		62	49	Good	1000		x			x					
	7/15	1600	76	55	Good	1000		x			x					
	7/28	1800		52	Fair	200		x			x					
	8/12	2000	53	50	Fair	85		x			x					2
	8/26	1900			Good	0										
	9/8	1605	47	43	Poor	0										
	9/29		48	39	Excellent	100					x					
Slough No. 21	8/25	1300			Good	200	x	x		x	x				10	30
	9/18	1400		40	Good	200	x	x			x				23	6
	9/29 ^{2/}	1600		40	Fair	450	x	x			x				15	

^{1/} Entry and exit to Susitna blocked at mouth of slough.

^{2/} Fry trapped in small pools.

Table 7. Escapement Surveys Conducted on Susitna River Tributaries, Devil s Canyon Project, 1976.

Location	Date	Time (Military)	Temperature (°F)		Weather Conditions	No. Fry Observed	Fry Species Identified						Adult Salmon Density				
			Air	Water			Chinook	Coho	Chum	Sockeye	Grayling	Whitefish	Chinook	Coho	Sockeye	Chum	Pink
Whisker's Creek	6/26	1350		58	Excellent	1000+	x	x									
	7/16	1330	66	54	Good	1000+	x	x					4				
	7/26	1635	60	56	Good	1000+	x	x					8				
	8/10	1130	75	56	Excellent	1000+	x	x					2				75
	9/1	1010	35	37	Excellent												
Chase Creek	6/26	1245	68	56	Excellent	1000+	x	x									
	7/16	1300	64	54	Poor	1000+	x	x									
	7/26	1930			Good	1000+	x	x									
	8/10	1310	70	58	Excellent	1000+	x	x									50
	8/31	1545	59	50	Good	1000+	x	x									
	9/30	1700	43	41	Excellent	0											
Fourth of July Cr.	7/14	1130	63	50	Good								14				
	7/27			54	Excellent								14				30
	8/11	907	59	53	Good								1			8	4000
	8/27	1100	57	47	Excellent									17		78	3 live
	9/19	1130	62	45	Excellent												3000 dead
Gold Cr.	8/10	1130		46	Good	50					x						32
	8/26	1030		43	Good												20

Table 8. Escapement Surveys Conducted on Susitna River Tributaries, Devils, Canyon Project, 1976.

Location	Date	Time (Military)	Temperature (°F)		Weather Conditions	No. Fry Observed	Fry Species Identified						Adult Salmon Density				
			Air	Water			Chinook	Coho	Chum	Sockeye	Grayling	Whitefish	Chinook	Coho	Sockeye	Chum	Pink
Indian R.	6/22				Good	10					x		537				
	7/14	1730	67	42	Good												
	8/12	1200	50	48	Fair									18		134	5000
	8/26	1300		46	Excellent								8	30	2		300
	9/28	1755		44	Fair												
Portage Creek	6/22	1200			Good	45					x		702				
	7/15	1330	76	44	Good												
	8/13	1130	68	47	Excellent									75		250	3000
	8/25	1200		50	Excellent									100		300	200
	9/8	1240	45	43	Poor												

Fry salmon observations were conducted in the sloughs and tributaries of the Susitna (Tables 3-8). Fry were located in clearwater sloughs during the early summer when stage heights of the water were highest. As the summer progressed and water depth within the sloughs decreased, so did the number of fry observed.

A tagging program was initiated to determine grayling movements within the Susitna and its tributaries. Twenty-nine fish were captured, measured (length), and released at the mouths of Portage Creek and the Indian River (Table 2). One tagged grayling was recaptured and released by an angler one and one-half miles above the mouth of Portage Creek one month after it was tagged. The angler did not record the tag number.

DISCUSSION

Flow Regimens

The effects of flow regulation on various fish and wildlife resources in the Susitna River basin is a primary concern of the Alaska Department of Fish and Game. Depth, width, and velocity of the flow determine the quality and quantity of habitat available to aquatic organisms. High discharges associated with spring run-off result in a number of physical actions which are important to aquatic life in the Susitna River. A flushing or scouring action is produced which removes deposited sediments and fines,

resulting in an annual cleansing of the river bottom. This is an important aspect of river ecology, particularly for rivers like the Susitna, which transport large amounts of sediment. Deposition of sediment without the annual scouring could change the overall productivity of the river, eventually suffocating all aquatic organisms within the system.

High spring flows may trigger upstream spawning migrations of salmon and resident fish species to spawning areas in sloughs and tributaries of the Susitna. The tributaries and sloughs of the Susitna also serve as rearing habitat for salmon and resident fish fry. Upstream movements of some fish species to these areas may be restricted or blocked by reduced flows. Successful salmonid egg incubation is dependent upon adequate flows to maintain flow-percolation-intragravel water movements within a redd (Stalnaker and Arnette, 1976).

Water velocity and stage determine the availability of wetted areas necessary for benthic species production. Discharges which would alter and reduce the benthic population and composition of the Susitna would also reduce its carrying capacity.

Aquatic populations in free flowing rivers have evolved to their current levels due to extreme flow variations (very high to very low). Some aquatic species may be present only because the particular hydrologic regime exists.

Water Quality

Dissolved oxygen, pH, alkalinity, hardness, temperatures and conductivity were within acceptable limits for fish life and were in the range of expected results for natural waters in southcentral Alaska (Bauers, personal communication).

Relationships between temperature and the aquatic environment are intimate. Fish and other aquatic organisms are directly affected by changes in water temperature. Salmonids are sensitive to the slightest changes in temperature. Releases from a hydroelectric power plant and reduced flows could result in abrupt temperature changes during critical life history stages of aquatic life. Dissolved oxygen decreases as water temperature increases; yet, aquatic animals require higher dissolved oxygen levels as temperatures increase. Higher temperatures and lower dissolved oxygen concentrations could limit the diversity of organisms present.

Unregulated flowing waters dilute and transport natural and man-generated pollutants. In a relatively undeveloped river system, such as the Susitna, any alteration to the natural balance of the system may reduce the biological productivity and quality of the river.

Fisheries

The Susitna drainage, in its natural state, is a viable fishery for salmon and other freshwater species. It is known to be one of the largest chinook and coho production areas in Cook Inlet. Thus, it is essential to define

the life history (spawning, incubation, rearing, and migration) habitat requirements of indigenous fish species and other aquatic biota to sustain the existing Susitna drainage fishery.

Data collected this year indicate that in the early summer, when salmon rearing conditions are poor in the mainstem Susitna (because of high discharge and sediment loads), the clear water sloughs and tributary habitat areas are utilized by fry. As the season progresses, discharge and sediment loads of the mainstem Susitna begin to decrease. By fall and winter, the silt load and discharge appear to be low enough to transform the mainstem Susitna into suitable fry rearing habitat to replace slough areas (which are eliminated when mainstem discharge decreases), and tributaries that freeze in the winter.

Apparently these seasonably wide fluctuations of water velocity, depth, temperature, chemical composition, and clarity of the mainstem Susitna, its sloughs and tributaries determine to some extent the intrasystem migrations of fish seeking more desirable environments. Thus, any alterations to the existing aquatic ecosystem which restrict or reduce the availability of required habitat, will also reduce fish production.

CONCLUSION

Baseline inventory studies, to date, emphasize the need to initiate a comprehensive study to properly assess the potential environmental impacts

to the aquatic ecosystem of the Susitna drainage by the proposed Watana/Devils Canyon hydroelectric project prior to final design approval and construction authorization.

The Susitna River is a product of its tributaries. All aquatic habitat and populations (within the power transmission corridor site, construction road routes, and above and below the proposed dam sites) which would be directly or indirectly affected during construction and after completion of the project must be carefully evaluated. It is imperative to thoroughly investigate the interrelationships between the aquatic biology, water quantity and water quality of the existing free flowing Susitna River system. Recreational, social, economic, and aesthetic considerations should also be included.

With this information the Alaska Department of Fish and Game will be able to provide the input for preventing unnecessary losses of the fisheries and related resources.

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APPENDICES

Appendix A

Table 1. Water Quality Data Collected from the Susitna River at the Parks Highway Bridge Between July 21 and October 1, 1976, Devils Canyon Project, 1976.

Date	Barometric Pressure	Time	Weather Conditions	Temperature (°F)		D.O. (ppm)	pH	Hardness (mg/l)	Total Alkali (mg/l)	Specific Conductance (umhos/cm)	Turbidity (Ftu)	Suspended Solids (mg/l)		
				Water	Air							Non-Filterable	Settleable	Total
7/21		11:10 a.m.	mostly sunny	52	68	10	8.1	50	45	122		96	465	561
7/27		1:30 p.m.	mostly sunny									163	424	587
9/1	29.95	11:00 a.m.	mostly sunny	43	53	11	8.0	50	50	132	85	79	237	316
10/1		2:00 p.m.	mostly sunny									26	78	104
10/12	30.10	12:45 p.m.	mostly	35	38	13	7.6	60	50	160	10	3	17	20

Appendix A

Table 2. Water Quality Data Collected from the Susitna River at the Gold Creek Railroad Bridge Between July 13 - October 1, Devils Canyon Project, 1976.

Date	Barometric Pressure	Time	Weather Conditions	Temperature (°F)		D.O. (ppm)	pH	Hardness (mg/l)	Total Alkali (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (Ftu)	Suspended Solids (mg/l)		
				Water	Air							Non-Filterable	Settleable	Total
7/13		12:00 noon	Cloudy Rain	50	54		7.9	40	30	105				
7/16		2:00 p.m.										28	725	753
8/10		2:20 p.m.	Clear	53	75	11	8.3	50	45	125	230			
8/13		2:50 p.m.	cloudy Rain									90	769	859
8/24		7:00 p.m.	clear	51	63	11	8.0	50	40	125	90			
8/27		2:45 p.m.	mostly sunny									92	325	417
9/7	29.45	4:20 p.m.	Cloudy	43	53	12	8.0	58	45	146	15			
9/10		10:50 a.m.	Cloudy									23	22	45
9/28	29.15	4:25 p.m.	Mostly cloudy	44	49	13	8.3	45	30	132	10			
9/30		1:20 p.m.	Mostly sunny									18	5	23

Appendix A

Table 3. Water Quality Data Collected from the Susitna River Upstream of Portage Creek between July 15 and September 29, Devils Canyon Project, 1976.

Date	Barometric Pressure	Time	Weather Conditions	Temperature (°F)		D.O. (ppm)	pH	Hardness (mg/l)	Total Alkali (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (Ftu)	Suspended Solids (mg/l)		
				Water	Air							Non-Filterable	Settleable	Total
7/15	-	12:30 p.m.	partly cloudy-rain	49	76	11	7.9	50	45	125	320	41	1,232	1,273
7/29	-	11:30 a.m.	partly cloudy	50	65	11	8.0	55	55	140	220	86	443	529
8/13	29.50	9:30 a.m.	mostly sunny	48	55	12	8.0	55	40	115	210	117	412	529
8/25	29.45	11:45 a.m.	partly cloudy	50	57	12	8.0	50	45	120	140	71	387	458
9/8	29.30	11:55 a.m.	overcast rain	-	49	12	8.0	60	50	165	30	29	76	105
9/29	29.25	11:30 a.m.	partly cloudy	41	39	12	8.0	60	50	170	20	11	13	24

Appendix A

Table 4. Water Quality Data Collected from Sloughs 8 and 10, between June 25 and September 30, Devils Canyon Project, 1976.

Date	Barometric Pressure	Time	Weather Conditions	Temperature (°F)		D.O. (ppm)	pH	Hardness (mg/l)	Total Alkali (mg/l)	Specific Conductance (umhos/cm)	Turbidity (Ftu)	Gage Height (FT)	Susitna Flow (CFS)
				Water	Air								
<u>Slough 8</u>													
6/26	-	-	clear	46	62	-	-	-	-	-	-	0.72	20,300
7/16	-	11:30 a.m.	rain	44	58	9	7.0	30	40	88	0	0.55	18,400
7/26	-	9:35 p.m.	partly cloudy	42	-	-	-	-	-	-	-	0.39	19,000
8/11	-	2:40 p.m.	partly cloudy	54	65	9	6.9	40	35	98	0	0.48	18,000
<u>Slough 10</u>													
6/25	-	-	clear	52	-	-	-	-	-	-	-	2.44	19,600
7/14	-	12:30 p.m.	partly cloudy	49	60	9	7.5	75	50	175	50	2.91	20,500
7/28	-	10:00 a.m.	cloudy	38	61	-	-	-	-	-	-	2.11	20,000
8/11	-	5:45 p.m.	mostly cloudy	42	63	10	7.5	75	65	230	0	1.95	18,000
8/27	-	12:00 noon	clear	43	63	-	-	-	-	-	-	1.27	13,000
9/7	29.75	2:10 p.m.	mostly sunny	42	58	11	7.3	60	50	150	0	0.38	6,480
9/30	-	3:00 p.m.	clear	40	-	-	-	-	-	-	-	0.37	5,800

Appendix A

Table 5. Limnological Data Collected from Slough 11 and 13 between June 23 and September 30, Devils Canyon Project, 1976.

Date	Barometric Pressure	Time	Weather Conditions	Temperature (°F)		D.O. (ppm)	pH	Hardness (mg/l)	Total Alkali (mg/l)	Specific Conductance (umhos/cm)	Turbidity (Ftu)	Gage Height(FT)	Susitna Flow (CFS)
				Water	Air								
Slough 11													
6/23	-	2:05 p.m.	clear	45	60	-	-	-	-	-	-	4.00	20,600
7/14	-	3:45 p.m.	partly cloudy	51	74	10	7.5	85	105	55	193	4.24	20,500
7/28	-	11:00 a.m.	cloudy	46	60	-	-	-	-	-	-	3.66	20,000
8/11	-	7:00 p.m.	partly cloudy	47	59	12	7.6	90	55	230	8	3.47	18,000
8/26	-	12:30 p.m.	mostly sunny	-	-	-	-	-	-	-	-	3.17	13,900
9/9	29.85	4:20 p.m.	partly cloudy	39	45	12	7.4	95	70	210	0	2.01	6,570
9/30	-	12:20 p.m.	clear	38	42	-	-	-	-	-	-	2.00	5,800
Slough 13													
6/25	-	-	clear	41	-	-	-	-	-	-	-	0.85/0.44	19,600
7/14	-	4:30 p.m.	partly cloudy	44	72	10	6.7	90	70	200	55	0.86/0.49	20,500
7/28	-	-	cloudy	43	-	-	-	-	-	-	-	0.82/0.45	20,000
8/11	-	8:00 p.m.	partly cloudy	40	55	10	7.4	80	65	170	0	0.83/0.43	18,000
8/27	-	-	-	-	-	-	-	-	-	-	-	0.84/0.27	13,000
9/9	29.75	5:35 p.m.	partly cloudy	47	51	12	7.6	85	60	200	0	0.51/dry	6,570
9/30	-	1:45 p.m.	clear	36	48	-	-	-	-	-	-	0.22/dry	5,800

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Table 6. Water Quality Data Collected from Sloughs 14 and 15 between June 25 and September 30, Devils Canyon Project, 1976.

Date	Barometric Pressure	Time	Weather Conditions	Temperature (°F)		D.O. (ppm)	pH	Hardness (mg/l)	Total Alkali (mg/l)	Specific Conductance (umhos/cm)	Turbidity (Ftu)	Gage Height(FT)	Susitna Flow (CFS)
				Water	Air								
Slough 14													
6/25	-	4:50 p.m.	-	46	-	-	-	-	-	-	-	1.82	19,600
7/14	-	6:00 p.m.	partly cloudy	45	63	12	6.8	35	20	85	-	2.07	20,500
7/28	-	1:00 p.m.	cloudy	43	-	-	-	-	-	-	-	1.49	20,000
8/11	-	8:50 p.m.	partly cloudy	43	49	9	6.9	45	15	90	-	1.28	18,000
8/27	-	1:00 p.m.	cloudy	43	57	-	-	-	-	-	-	0.93	13,000
9/9	29.80	6:40 p.m.	partly cloudy	44	49	9	6.9	35	40	95	0	0.29	6,570
9/30	-	2:05 p.m.	clear	44	47	-	-	-	-	-	-	0.27	5,800
Slough 15													
6/30	-	-	clear	43	66	-	-	-	-	-	-	2.23	20,000
7/13	-	8:30 p.m.	cloudy-rain	47	54	9	6.8	25	30	68	-	2.65	20,000
7/28	-	3:00 p.m.	cloudy	50	-	-	-	-	-	-	-	1.83	20,000
8/12	-	10:00 a.m.	rain	44	52	7	6.7	30	10	72	0	2.02	19,000
8/26	-	7:00 p.m.	clear	47	57	-	-	-	-	-	-	1.08	13,900
9/27	29.40	5:20 p.m.	overcast	41	47	9	6.7	25	30	68	0	0.76	6,480

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Table 7. Water Quality Data Collected from Sloughs 16 and 17 between June 24 and September 29, Devils Canyon Project, 1976.

Date	Barometric Pressure	Time	Weather Conditions	Temperature (°F)		D.O. (ppm)	pH	Hardness (mg/l)	Total Alkali (mg/l)	Specific Conductance (umhos/cm)	Turbidity (Ftu)	Gage Height (FT)	Susitna Flow (CFS)
				Water	Air								
Slough 16													
6/24	-	1:30 p.m.	clear	54	62	-	-	-	-	-	-	2.17	19,900
7/15	-	7:30 p.m.	rain	49	52	10	7.2	35	20	85	-	1.77	19,200
7/28	-	3:30 p.m.	cloudy	50	-	-	-	-	-	-	-	1.55	20,000
8/12	29.50	10:50 a.m.	rain	45	51	10	7.1	45	35	80	0	1.75	19,000
8/26	-	5:00 p.m.	clear	49	60	-	-	-	-	-	-	0.81	13,900
9/7	29.40	6:30 p.m.	overcast	42	47	6	6.2	20	30	60	0	0.45	6,480
9/29	-	5:40 p.m.	clear	47	41	-	-	-	-	-	-	0.44	6,060
Slough 17													
6/24	-	3:50 p.m.	clear	48	-	-	-	-	-	-	-	1.97	19,900
7/15	-	6:45 p.m.	partly cloudy	40	64	10	7.0	30	35	80	-	1.92	19,200
7/28	-	4:00 p.m.	cloudy	42	-	-	-	-	-	-	-	1.64	20,000
8/12	29.55	1:40 p.m.	cloudy	38	51	9	6.6	25	30	66	0	1.87	19,000
8/26	-	4:00 p.m.	clear	41	60	-	-	-	-	-	-	1.01	13,900
9/29	29.30	3:50 p.m.	mostly sunny	41	43	11	6.9	25	20	75	0	0.45	6,060

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Table 8. Water Quality Data Collected from Sloughs 18 and 19 between June 15 and September 29, Devils Canyon Project, 1976.

Date	Barometric Pressure	Time	Weather Conditions	Temperature (°F)		D.O. (ppm)	pH	Hardness (mg/l)	Total Alkali (mg/l)	Specific Conductance (umhos/cm)	Turbidity (Ftu)	Gage Height(FT)	Susitna Flow (CFS)
				Water	Air								
Slough 18													
6/24	-	-	-	53	-	-	-	-	-	-	-	1.80	19,900
7/15	-	7:00 p.m.	rainy	48	60	8	7.0	60	50	118	-	1.78	19,200
7/28	-	4:30 p.m.	cloudy	49	-	-	-	-	-	-	-	1.77	20,000
8/12	29.55	3:35 p.m.	cloudy	48	54	9	7.3	40	45	105	0	1.78	19,000
8/26	-	4:30 p.m.	clear	42	54	-	-	-	-	-	-	1.68	13,900
9/29	29.30	4:35 p.m.	mostly sunny	47	50	11	8.0	55	50	135	0	0.98	6,060
Slough 19													
6/24	-	-	-	43	-	-	-	-	-	-	-	2.49	19,900
7/15	-	5:00 p.m.	partly cloudy	49	64	10	7.5	60	40	140	-	2.39	19,200
7/28	-	5:00 p.m.	cloudy	49	-	-	-	-	-	-	-	1.98	20,000
8/12	29.55	6:50 p.m.	cloudy	45	55	9	7.1	70	50	142	-	2.37	19,000
8/26	-	7:30 p.m.	cloudy	47	-	-	-	-	-	-	-	1.96	13,900
9/8	29.40	5:10 p.m.	overcast-rain	44	47	12	7.8	60	60	150	-	1.80	6,240
9/29	-	3:10 p.m.	mostly sunny	42	44	-	-	-	-	-	-	1.82	6,060

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Table 9. Water Quality Data Collected From Slough 20 between June 24 and September 29, Devils Canyon Project, 1976.

Date	Barometric Pressure	Time	Weather Conditions	Temperature (°F)		D.O. (ppm)	pH	Hardness (mg/l)	Total Alkali (mg/l)	Specific Conductance (umhos/cm)	Turbidity (Ftu)	Gage Height(FT)	Susitna Discharge (CFS)
				Water	Air								
Slough 20													
6/24	-	-	-	49	62	-	-	-	-	-	-	2.78	19,900
7/15	-	4:00 p.m.	partly cloudy	55	76	11	7.7	40	35	105	5	above gauge	19,200
7/28	-	6:00 p.m.	cloudy	52	-	-	-	-	-	-	-	2.66	20,000
8/12	29.55	8:00 p.m.	cloudy	50	53	11	7.7	35	40	95	0	2.64	19,000
8/26	-	7:00 p.m.	partly cloudy	-	-	-	-	-	-	-	-	2.60	13,900
9/8	29.35	4:05 p.m.	overcast-rain	43	47	12	7.6	55	40	110	0	2.63	6,240
9/29	-	2:00 p.m.	clear	39	48	-	-	-	-	-	-	2.70	6,060

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Table 10. Water Quality Data Collected from Willow Creek, Little Willow Creek, Kashwitna River and Caswell Creek between July 21 and October 12, Devils Canyon Project, 1976.

Date	Barometric Pressure	Time	Weather Conditions	Temperature (°F)		D.O. (ppm)	pH	Hardness (mg/l)	Total Alkali (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (Ftu)	Suspended Solids (mg/l)		
				Water	Air							Non-Filterable	Settleable	Total
<u>Willow Creek</u>														
7/21		6:50 p.m.	partly cloudy	56	68	10	7.6	20	20	72	-			
9/1	29.10	5:30 p.m.	cloudy rain	49	57	11	7.5	20	20	80	0			
10/12	30.25	10:45 a.m.	clear	-	-	14	7.4	30	30	92	0			
<u>Little Willow Creek</u>														
7/21	-	5:55 p.m.	partly cloudy	57	74	10	7.4	10	10	38	-			
9/1	30.05	5:00 p.m.	mostly cloudy	47	61	11	7.2	10	20	34	0			
10/12	30.20	5:10 p.m.	clear	-	-	13	7.1	30	20	48	0			
<u>Kashwitna River</u>														
7/21	-	4:10 p.m.	mostly sunny	55	74	11	7.7	20	15	44	-			
9/1	30.00	4:05 p.m.	partly cloudy	47	60	11	7.5	20	20	48	10			
10/12	30.15	4:20 p.m.	clear	-	-	14	7.5	25	15	65	0			
<u>Caswell Creek</u>														
7/21	-	4:50 p.m.	partly cloudy	58	77	10	7.5	20	20	55	-			
9/1	30.00	3:25 p.m.	partly cloudy	49	57	11	7.3	15	10	52	0			
10/12	30.15	3:50 p.m.	clear	-	-	13	7.1	20	15	55	0			

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Table 11. Water Quality Data Collected from Sheep Creek, Goose Creek, and Montana Creek between July 21 and October 12, Devils Canyon Project, 1976.

Date	Barometric Pressure	Time	Weather Conditions	Temperature (°F)		D.O. (ppm)	pH	Hardness (mg/l)	Total Alkali (mg/l)	Specific Conductance (umhos/cm)	Turbidity (Ftu)	Suspended Solids (mg/l)		
				Water	Air							Non-Filterable	Settleable	Total
<u>Sheep Creek</u>														
7/21	-	3:15 p.m.	clear	58	75	11	7.4	15	20	32	-			
9/1	30.00	2:30 p.m.	partly cloudy	50	61	12	7.8	15	10	40	5			
10/12	30.15	3:15 p.m.	clear			13	7.2	20	15	55	0			
<u>Goose Creek</u>														
7/21	-	2:15 p.m.	clear	44	72	11	7.3	10	20	36	-			
9/1	30.00	1:40 p.m.	mostly sunny	45	57	11	7.2	10	15	42	0			
10/12	30.10	2:35 p.m.	clear	-	-	13	7.2	20	10	50	0			
<u>Montana Creek</u>														
7/21	-	12:20 p.m.	clear	54	76	10	7.4	10	20	46	0			
9/1	29.95	12:00 p.m.	mostly sunny	47	55	11	7.4	10	10	45	0			
10/12	30.10	2:00 p.m.	clear	-	-	14	7.3	10	5	48	0			

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Table 12. Water Quality Data Collected from Slough 3C and Chase Creek between June 26 and October 1, Devils Canyon Project, 1976.

Date	Barometric Pressure	Time	Weather Conditions	Temperature (°F)		D.O. (ppm)	pH	Hardness (mg/l)	Total Alkali (mg/l)	Specific Conductance (umhos/cm)	Turbidity (Ftu)	Gage Height(FT)	Susitna Discharge (CFS)
				Water	Air								
<u>Whiskers Creek</u>													
6/26	-	1:50 p.m.	clear	58	-	-	-	-	-	-	-	1.10	20,300
7/16	-	1:30 p.m.	partly cloudy	54	66	9	7.4	20	20	46	-	0.70	18,400
7/26	-	4:35 p.m.	partly cloudy	56	60	-	-	-	-	-	-	0.97	19,000
8/10	-	11:30 a.m.	mostly sunny	56	75	9	7.1	20	20	48	5	0.96	18,000
10/1	29.90	10:10 a.m.	clear	37	35	12	7.0	20	10	22	0	(-)0.2	-
<u>Chase Creek</u>													
6/26	-	12:45 a.m.	clear	56	68	-	-	-	-	-	-	5.40	20,300
7/16	-	1:00 p.m.	cloudy-rain	54	64	9	7.3	15	20	48	-	5.39	18,400
7/26	-	7:30 p.m.	partly-cloudy	-	-	-	-	-	-	-	-	5.33	19,000
8/10	-	1:10 p.m.	mostly sunny	58	70	10	7.1	10	20	46	0	5.39	18,000
8/31	-	3:45 p.m.	partly cloudy	50	59	-	-	-	-	-	-	5.28	9,340
9/30	29.75	5:00 p.m.	clear	41	43	12	7.1	15	15	48	0	5.38	5,800

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Table 13. Water Quality Data Collected from Fourth of July Creek, Gold Creek, Indian River and Portage Creek between July 17 and September 28, Devils Canyon Project, 1976.

Date	Barometric Pressure	Time	Weather Conditions	Temperature (°F)		D.O. (ppm)	pH	Hardness (mg/l)	Total Alkali (mg/l)	Specific Conductance (µmhos/cm)	Turbidity (Ftu)	Suspended Solids (mg/l)		
				Water	Air							Non-Filterable	Settleable	Total
Fourth of July Creek														
7/14	-	11:30 p.m.	partly cloudy	50	63	10	7.2	5	15	68	0			
8/11	-	9:05 a.m.	partly cloudy	53	59	10	7.3	10	10	35	0			
8/27	-	11:00 a.m.	clear	47	57	-	-	-	-	-	-			
9/7	29.80	11:30 a.m.	mostly sunny	45	62	12	7.5	5	10	25	0			
Gold Creek														
8/26	29.35	10:30 a.m.	mostly sunny	43	57	11	8.3	95	80	190	0			
9/8	29.45	6:40 p.m.	overcast drizzle	-	49	12	8.2	105	70	220	0			
Indian River														
7/15	-	5:30 p.m.	partly cloudy	42	67	11	7.6	10	20	42	0			
8/12	29.55	12:00 noon	cloudy rain	48	50	10	7.5	20	20	55	0			
8/26	-	2:00 p.m.	mostly sunny	46	-	-	-	-	-	-	-			
9/28	29.15	5:55 p.m.	cloudy	44	45	12	7.4	15	20	52	0			
Portage Creek														
7/15	-	1:30 p.m.	partly cloudy	44	76	11	7.5	25	20	72	0			
8/13	29.50	11:30 a.m.	mostly sunny	47	68	11	7.5	30	20	70	0			
8/25	-	12:00 noon	mostly sunny	50	-	-	-	-	-	-	-			
9/8	29.30	12:40 p.m.	overcast	43	45	12	7.9	40	10	118	0			

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Table 14. Thermograph Set in Susitna River at Parks Highway Bridge; Daily Maximum and Minimum Water Temperatures, Devils Canyon Project 1976.

Date	Temp. °F Max. Min.		Date	Temp. °F Max. Min.		Date	Temp. °F Max. Min.		Date	Temp. °F Max. Min.		Date	Temp. °F Max. Min.	
June 26	-	54	July 25	52	51	Aug. 23	48	48	Sept. 21	43	43	Oct. 20	34	33
27	56	55	26	-	52	24	48	48	22	44	43	21	35	34
28	55	54	27	53	52	25	48	48	23	44	42	22	35	34
29	55	54	28	52	51	26	48	48	24	42	41	23	34	32
30	56	54	29	51	50	27	-	-	25	41	40	24	30	31
July 1	54	49	30	51	50	28	-	-	26	42	41	25	32	30
2	49	49	31	52	51	29	-	-	27	42	42	26	32	32
3	50	49				30	-	-	28	42	42			
4	49	46	Aug. 1	54	52	31	-	-	29	42	41			
5	46	46	2	54	53				30	-	-			
6	50	46	3	55	53	Sept. 1	47	46				Oct. 1	-	35
7	54	50	4	56	55	2	46	45				2	35	35
8	55	53	5	55	51	3	46	45				3	36	35
9	55	54	6	51	51	4	45	42				4	37	36
10	54	54	7	51	51	5	44	42				5	38	37
11	56	54	8	51	50	6	-	41				6	34	38
12	54	52	9	50	49	7	-	-				7	39	38
13	52	51	10	51	49	8	-	-				8	38	36
14	53	51	11	52	51	9	-	-				9	36	33
15	52	51	12	50	50	10	-	-				10	35	32
16	53	52	13	51	49	11	-	-				11	32	-
17	52	52	14	51	51	12	-	-				12	32	-
18	53	52	15	51	50	13	-	-				13	32	31
19	54	53	16	50	49	14	-	-				14	31	31
20	54	52	17	49	48	15	-	-				15	31	31
21	54	52	18	48	48	16	-	-				16	32	31
22	54	53	19	48	47	17	-	-				17	33	32
23	53	51	20	48	47	18	-	-				18	33	33
24	52	51	21	48	48	19	-	-				19	33	33
			22	48	48	20	43	42						

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Table 15. Thermograph Set in Susitna River above Chase Creek; Daily Maximum and Minimum Water Temperatures, Devils Canyon Project 1976.

Date	Temp. °F		Date	Temp. °F		Date	Temp. °F		Date	Temp. °F	
	Max.	Min.		Max.	Min.		Max.	Min.		Max.	Min.
June 21	-	51	July 20	57	55	Aug. 18	51	49	Sept. 16	45	44
22	52	49	21	57	55	19	50	49	17	44	44
23	55	50	22	57	56	20	52	50	18	44	43
24	55	52	23	57	56	21	52	51	19	44	43
25	56	53	24	-	-	22	53	52	20	44	44
26	58	55	25	-	-	23	54	52	21	44	44
27	59	56	26	56	54	24	-	52	22	45	43
28	58	56	27	55	55	25	-	-	23	43	42
29	58	55	28	55	54	26	-	-	24	42	42
30	59	55	29	55	54	27	-	-	25	42	42
			30	59	55	28	-	-	26	43	42
July 1	55	51	31	59	58	29	-	-	27	44	42
2	53	51				30	-	-	28	43	41
3	52	51	Aug. 1	59	58	31	-	48	29	41	
4	51	49	2	58	58						
5	48	47	3	59	57	Sept. 1	49	47			
6	52	48	4	58	56	2	48	47			
7	55	51	5	56	55	3	48	46			
8	58	54	6	55	54	4	46	44			
9	58	56	7	54	54	5	45	44			
10	58	57	8	54	52	6	45	44			
11	58	56	9	52	50	7	44	44			
12	57	56	10	53	50	8	45	44			
13	56	55	11	54	52	9	46	45			
14	57	54	12	54	53	10	46	45			
15	55	54	13	54	53	11	46	45			
16	55	54	14	54	53	12	46	43			
17	56	54	15	53	53	13	45	44			
18	56	55	16	52	52	14	46	45			
19	57	55	17	52	51	15	46	45			

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Table 16. Thermograph Set in Susitna River between Devil's Canyon and Portage Creek; Daily Maximum and Minimum Water Temperatures, Devils Canyon Project, 1976.

Date	Temp. °F		Date	Temp. °F		Date	Temp. °F		Date	Temp. °F	
	Max.	Min.		Max.	Min.		Max.	Min.		Max.	Min.
June 22	50	50	July 21	53	53	Aug. 19	-	-	Sept. 17	43	43
23	50	50	22	53	53	20	-	-	18	42	41
24	51	51	23	53	53	21	-	-	19	42	41
25	52	52	24	53	53	22	-	-	20	42	41
26	54	52	25	53	52	23	-	-	21	43	42
27	54	54	26	52	52	24	-	-	22	43	43
28	55	54	27	52	52	25	52	49	23	43	42
29	55	55	28	52	52	26	49	48	24	42	41
30	55	53	29	53	52	27	48	47	25	41	41
July 1	52	52	30	55	53	28	47	46	26	41	41
2	52	52	31	56	55	29	46	46	27	-	-
3	51	51	Aug. 1	57	54	30	47	46	28	-	-
4	50	49	2	58	55	31	47	47	29	-	-
5	49	48	3	57	55	Sept. 1	47	47	39	-	36
6	49	48	4	55	53	2	47	46	Oct. 1	36	35
7	53	49	5	54	54	3	46	45	2	35	34
8	54	52	6	54	52	4	45	45	3	35	34
9	55	54	7	53	52	5	43	43	4	36	35
10	54	54	8	52	52	6	-	-	5	37	36
11	55	54	9	51	49	7	-	-	6	38	37
12	55	54	10	48	48	8	45	44	7	38	38
13	55	54	11	50	48	9	45	44	8	38	34
14	54	54	12	52	50	10	44	44	9	34	32
15	53	52	13	52	51	11	44	44	10	32	32
16	52	52	14	52	50	12	44	43	11	32	32
17	52	52	15	52	51	13	43	43	12	32	32
18	53	52	16	51	51	14	43	43	13	32	32
19	53	53	17	-	-	15	43	43	14	33	32
20	53	53	18	-	-	16	43	42	15	33	33

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Table 17. Thermograph Set in Birch Creek Below Highway Crossing; Daily Maximum and Minimum Water Temperatures, Devils Canyon Project, 1976.

Date	Temp. °F Max. Min.		Date	Temp. °F Max. Min.		Date	Temp. °F Max. Min.		Date	Temp. °F Max. Min.		Date	Temp. °F Max. Min.	
June 26	67	66	July 25	65	64	Aug. 23	61	59	Sept. 21	50	50	Oct. 20	40	40
27	68	67	26	-	64	24	62	61	22	50	50	21	40	40
28	67	66	27	66	64	25	62	61	23	50	49	22	39	39
29	67	65	28	65	63	26	61	60	24	49	49	23	39	39
30	68	67	29	63	62	27	60	60	25	48	48	24	39	39
			30	63	62	28	-	-	26	48	48	25	39	39
July 1	67	65	31	54	62	29	-	-	27	48	48	26	39	38
2	65	63				30	-	-	28	48	48	27	38	38
3	63	62	Aug. 1	68	65	31	-	-	29	48	48	28	38	38
4	62	60	2	67	66				30	48	47	29	38	38
5	60	57	3	68	66	Sept. 1	58	-				30	38	37
6	62	58	4	67	66	2	58	58	Oct. 1	-	44	31	37	37
7	66	62	5	68	66	3	58	57	2	44	44			
8	64	61	6	66	65	4	57	55	3	44	44	Nov. 1	37	37
9	66	63	7	65	65	5	55	55	4	44	44	2	37	37
10	68	66	8	65	63	6	55	54	5	44	44	3	-	36
11	69	68	9	63	61	7	55	54	6	44	44	4	36	36
12	68	67	10	63	61	8	54	54	7	44	43	Nov. 5-		
13	67	66	11	64	63	9	54	54	8	43	43	25	36	36
14	66	66	12	64	63	10	54	54	9	43	42	26	36	35
15	67	66	13	64	63	11	54	54	10	42	41	27	36	34
16	67	66	14	63	63	12	53	53	11	41	41	28	34	34
17	67	66	15	63	62	13	53	53	12	41	40	29	34	34
18	67	66	16	62	61	14	53	52	13	40	40	30	34	34
19	67	67	17	61	60	15	52	52	14	40	40			
20	67	65	18	60	58	16	52	52	15	40	40	Dec. 1	35	34
21	65	63	19	60	58	17	52	51	16	40	40	2	35	33
22	65	65	20	60	59	18	51	51	17	40	40			
23	65	65	21	60	59	19	51	50	18	40	40			
24	65	64	22	59	59	20	50	50	19	40	40			

Appendix A

Table 18.. Susitna River discharge at Gold Creek; USGS Provisional Data, 1976.

Day	May		June		July		August		September	
	Gage Height	Discharge	Gage Height	Discharge	Gage Height	Discharge	Gage Height	Discharge	Gage Height	Discharge
1			9.43	17,200	10.01	20,600		20,000	7.63	9,200
2			10.28	22,200	10.38	22,800		21,000	7.65	9,280
3			10.99	26,900	10.17	21,500		21,000	7.47	8,640
4			11.31	29,500	9.80	19,300		21,000	7.34	8,220
5			11.30	29,400	9.76	19,100		20,000	7.19	7,770
6			11.29	29,300	9.38	16,900		20,000	7.09	7,470
7			11.07	27,600	9.02	15,100		20,000	6.76	6,480
8			10.98	26,900	9.29	16,400		20,000	6.68	6,240
9			10.61	24,300	9.71	18,800		19,000	6.79	6,570
10			11.36	29,900	9.88	19,800		18,000	6.85	6,750
11			11.79	33,300	9.79	19,200		18,000	6.87	6,810
12	8.72	13,600	11.78	33,300	9.76	19,100		19,000	6.79	6,570
13	9.01	15,000	11.36	29,900	9.91	20,000		20,000	6.64	6,120
14	8.95	14,800	11.16	28,300	10.00	20,500		20,000	6.51	5,780
15	8.65	13,200	11.08	27,600	9.79	19,200		20,000	6.45	5,620
16	8.51	12,600	10.96	26,700	9.65	18,400		20,000	6.60	6,000
17	8.33	11,900	10.86	26,000	9.77	19,100		20,000	6.76	6,480
18	8.52	12,700	10.34	22,500		19,000		20,000	6.57	5,920
19	8.73	13,600	9.81	19,400		20,000	9.79	19,200	6.48	5,700
20	8.53	12,700	9.67	18,500		19,000	9.41	17,000	6.59	5,980
21	8.50	12,600	9.77	19,100		20,000	9.21	16,000	6.89	6,870
22	8.62	13,100	10.08	21,000		20,000	9.09	15,400	7.14	7,620
23	8.91	14,600	10.02	20,600		21,000	8.99	15,000	7.28	8,040
24	9.02	15,100	9.90	19,900		21,000	8.81	14,000	7.19	7,770
25	8.98	14,900	9.85	19,600		20,000	8.81	14,000	6.99	7,170
26	9.02	15,100	9.97	20,300		19,000	8.78	13,900	6.82	6,660
27	9.10	15,500	9.99	20,400		19,000	8.61	13,000	6.76	6,480
28	8.90	14,500	10.09	21,000		20,000	8.33	11,900	6.69	6,270
29	8.68	13,400	10.07	20,900		20,000	8.12	11,100	6.62	6,060
30	8.94	14,700	9.91	20,000		20,000	7.81	9,840	6.52	5,800
31	9.07	15,400				19,000	7.67	9,340		

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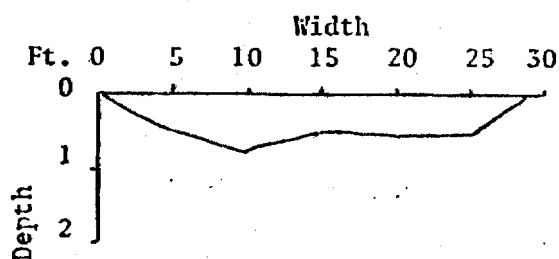
Table 19. Slough 8 Cross-Sections and Stage Gauge Information, Devils Canyon Project, 1976.

Location of Gauge: Permanent marker is a tree on eastside of slough. Mark is 10.0' above slough bed and gauge is 46' from mark (ribbon).

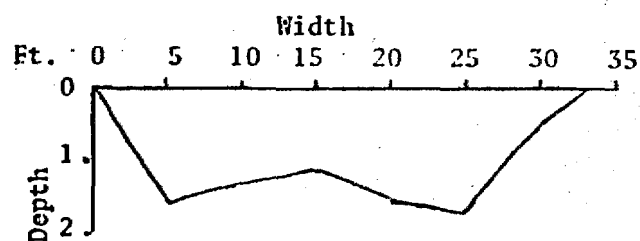
June 26, 1976

Elevation	528 ft.
Distance from mouth to gauge	30 yds.
Water surface height at gauge	0.73 ft.
Slough width at gauge	29 ft.
Maximum depth at gauge	0.75 ft.
Change in bed elevation	-
Bed surface composition	sand, gravel
Slough width at mouth	33 ft.
Slough depth at mouth	1.66 ft.
Susitna River mean daily discharge	20,300 CFS

Slough Cross-Section \perp to Banks and Adjacent to Gauge (6/26/76).



Cross-Section at Mouth \perp to Banks (6/26/76).



Appendix A

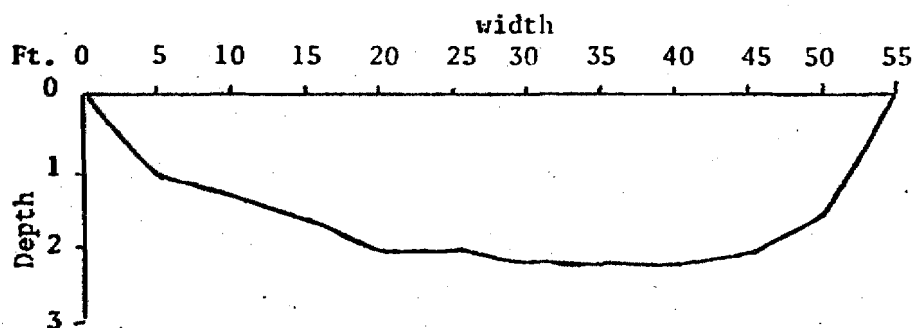
Table 20. Slough 10 Cross-Section and Stage Gauge Information, Devils Canyon Project, 1976.

Location of Gauge: Permanent marker is tree on east side of slough. Mark is 10.0' above slough bed and gauge is 67' from mark (yellow paint).

June 25, 1976 September 9, 1976

Elevation	680 ft.	630 ft.
Approximate distance from mouth to gauge	100 ft.	100 ft.
Water surface height at gauge	5.80 ft.	3.71 ft.
Actual water depth at gauge	2.47	0.13 ft.
Slough width at gauge	55 ft.	8 ft.
Maximum depth at cross-section	2.31 ft.	0.47 ft.
Change in bed elevation	-	-0.2 ft.
Bed surface composition	silt, sand	silt, sand
Slough width at mouth	-	-
Slough depth at mouth	-	-
Susitna River mean daily discharge	19,600 CFS	6,570 CFS

Slough Cross-Section 1 to Banks and Adjacent to Gauge (6/25/76).



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Table 21. Slough 11 Cross-Sections and Stage Gauge Information, Devils Canyon Project, 1976.

Location of Gauge: Permanent marker is tree on east side of slough. Mark is 12.0' above slough bed and gauge is 26.0' from mark (paint and ribbon).

June 23, 1976 September 9, 1976

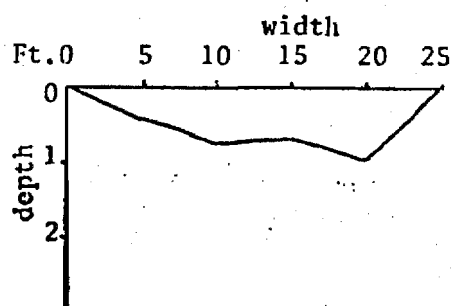
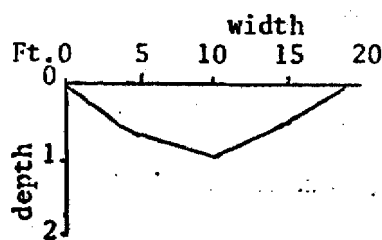
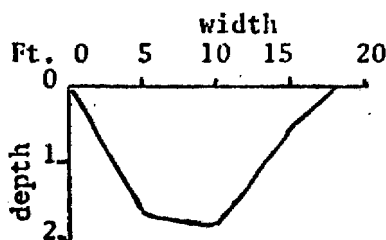
Elevation	668 ft.	656 ft.
Approximate distance from mouth to gauge	100 ft.	100 ft.
Water surface height at gauge	4.00 ft.	2.03 ft.
Actual water depth at gauge	-	2.04 ft.
Slough width at gauge	-	18 ft.
Maximum depth at cross-section	-	2.04 ft.
Change in bed elevation	-	-
Bed surface composition	gravel, boulder	sand, gravel, boulder
Slough width at mouth	-	-
Slough depth at mouth	-	-
Susitna River mean daily discharge	20,600 CFS	6,570 CFS

Slough 11 in Three Separate Channels on 9/9/76

Cross-Section of Channel
Farthest from Susitna
River to Banks and
Adjacent to Gauge 9/9/76.

Cross-Section of Middle
Channel to banks 9/9/76.

Cross-Section of Channel
Closest to Susitna River
to Banks.



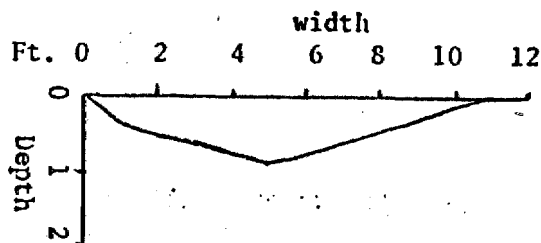
Appendix A

Table 22. Slough 13 Cross-Section and Stage Gauge Information, Devils Canyon Project, 1976.

Location of Gauge: Permanent marker is tree on east side of slough. Mark is 11.0 feet above slough bed and gauge is 10 feet from mark (paint and ribbon).

	June 25, 1976	September 9, 1976
Elevation	688 ft.	664 ft.
Approximate distance from mouth to gauge	40 ft.	40 ft.
Water surface height at gauge	4.18 ft.	3.63 ft.
Actual water depth at gauge	0.85 ft.	0.37 ft.
Slough width at gauge	11 ft.	6 ft.
Maximum depth at cross-section	0.85 ft.	0.37 ft.
Change in bed elevation	-	-0.31 ft.
Bed surface composition	silt, sand, gravel	silt, sand, gravel
Slough width at mouth	9 ft.	0 ft.
Slough depth at mouth	0.55 ft.	0.00 ft.
Susitna River mean daily discharge	19,600 CFS	6,570 CFS

Slough Cross-Section to Banks and Adjacent to Gauge (6/25/76).



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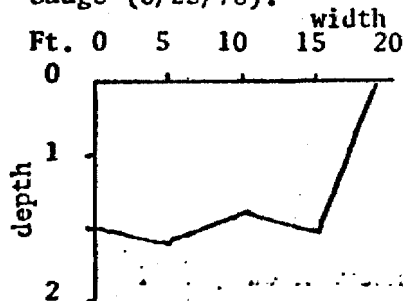
Table 23. Slough 14 Cross-Sections and Stage Gauge Information, Devils Canyon Project, 1976.

Location of Gauge: Permanent marker is tree on east side of slough. Mark is 9.0' above slough bed and gauge is 26' from mark.

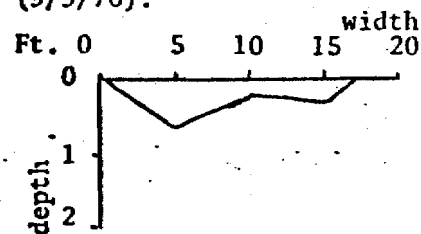
June 25, 1976 September 9, 1976

Elevation	685 ft.	660 ft.
Approximate distance from mouth to gauge	100 ft.	100 ft.
Water surface height at gauge	1.82 ft.	0.29 ft.
Actual water depth at gauge	1.82 ft.	0.22 ft.
Slough width at gauge	19 ft.	17 ft.
Maximum depth at cross-section	2.15 ft.	0.60 ft.
Change in bed elevation	-	0.0 ft.
Bed surface composition	gravel, silt	gravel, sand, silt
Slough width at mouth	15 ft.	1 ft.
Slough depth at mouth	1.41 ft.	0.3 ft.
Susitna River mean daily discharge	19,600 CFS	6,570 CFS

Slough Cross-Section 1 to Banks and Adjacent to Gauge (6/25/76).



Slough Cross-Section 1 to Banks and Adjacent to Gauge (9/9/76).



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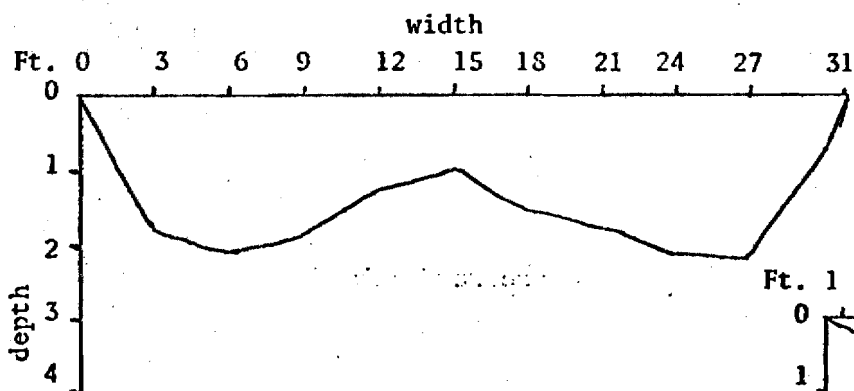
Table 24. Slough 15 Cross-Sections and Stage Gauge Information, Devils Canyon Project, 1976.

Location of Gauge: Permanent marker is tree on west side of slough. Mark is 10.0' from slough bed and gauge is located 13.0' feet from mark (ribbon).

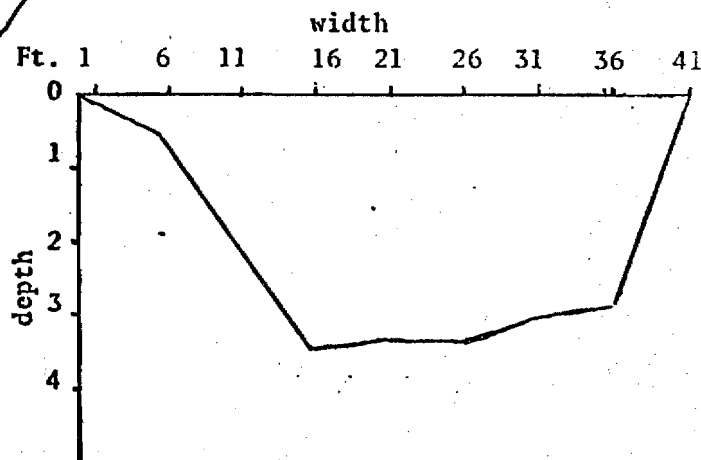
June 24, 1976 September 7, 1976

Elevation	703 ft.	691 ft.
Approximate distance from mouth to gauge	150 yds.	150 yds.
Water surface height at gauge	2.23 ft.	0.76 ft.
Actual water depth at gauge	-	0.54 ft.
Slough width at gauge	31 ft.	7.2 ft.
Maximum depth at cross-section	2.15 ft.	0.64 ft.
Change in bed elevation	-	+0.2 ft.
Bed surface composition	silt	silt, sand, gravel
Slough width at mouth	41 ft.	~1 ft.
Slough depth at mouth	3.44 ft.	0.4 ft.
Susitna River mean daily discharge	19,900 CFS	6,480 CFS

Susitna River Mean Daily Discharge
Slough Cross-Section 1 to Banks
at Staff Gauge (6/24/76).



Slough Cross-Section 1 to Banks
at Mouth (6/24/76).



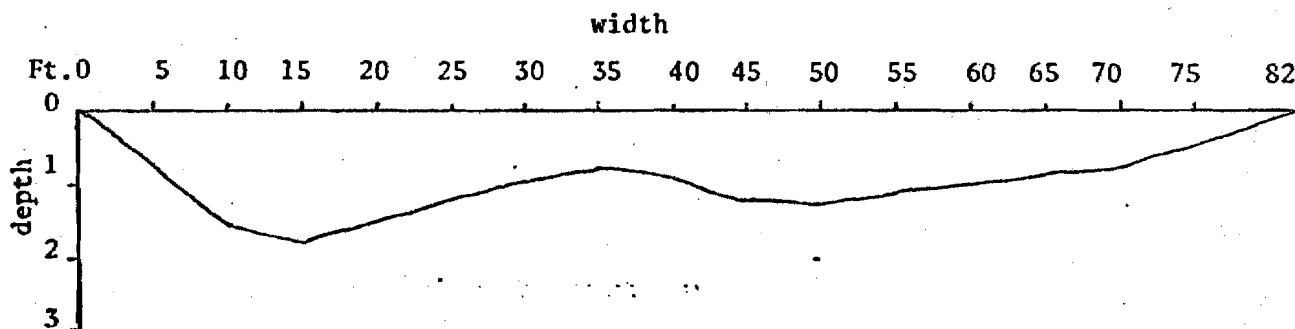
Appendix A

Table 25. Slough 16 Cross-Section and Stage Gauge Information, Devil's Canyon Project, 1976.

Location of Gauge: Permanent marker is tree on north side of slough. Mark is 13.0' above slough bed and gauge is 44' from mark.

	June 24, 1976	September 7, 1976
Elevation	708 ft.	694 ft.
Approximate distance from mouth to gauge	50 yds.	50 yds.
Water surface height at gauge	5.50 ft.	3.78 ft.
Actual water depth at gauge	2.24 ft.	0.28 ft.
Slough width at gauge	65 ft.	11 ft.
Maximum depth at gauge section	1.74 ft.	0.36 ft.
Change in bed elevation	-	-0.3 ft.
Bed surface composition	silt, sand, gravel	silt, sand, gravel
Slough width at mouth	-	-
Slough depth at mouth	-	-
Susitna River mean daily discharge	19,900 CFS	6,480 CFS

Slough Cross-Section to Banks and Adjacent to Gauge, Beginning from the North Bank (6/24/76).



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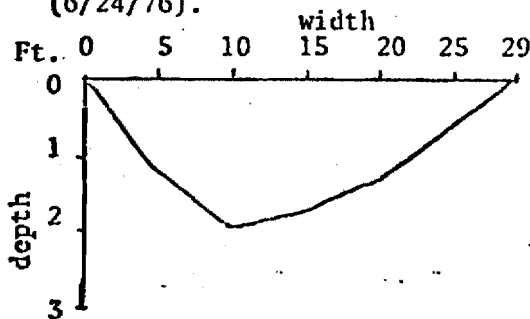
Table 26. Slough 17 Cross-Sections and Stage Gauge Information, Devils Canyon Project, 1976.

Location of Gauge: Permanent marker is tree on west side of slough. Mark is 12.0' above slough bed and gauge is 24.0' from mark.

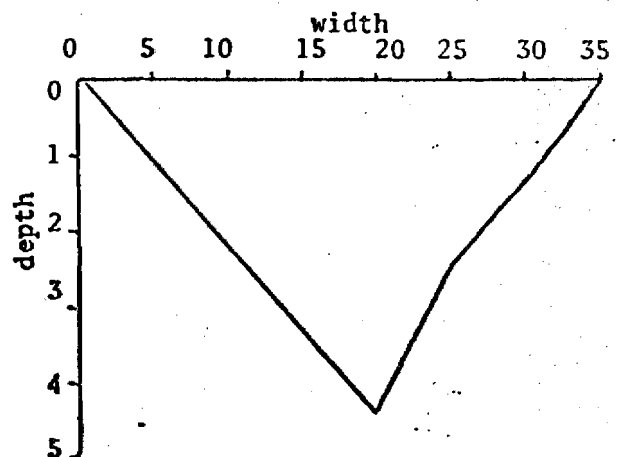
June 24, 1976 September 29, 1976

Elevation	715 ft.	-
Approximate distance from mouth to gauge	50 yds	50 yds.
Water surface height at gauge	5.30 ft.	3.78 ft.
Actual water depth at gauge	1.76 ft.	.60 ft.
Slough width at gauge	29 ft.	.60 ft.
Maximum depth at gauge	1.76 ft.	.40 ft.
Change in bed elevation	-	-
Bed surface composition	very soft silt	very soft silt
Slough width at mouth	35 ft.	0
Slough depth at mouth	4.40 ft.	0
	19,900 CFS	6,060 CFS

Cross-Section of Slough \perp to Banks & Adjacent to Gauge (6/24/76).



Slough Cross-Section \perp to Banks at Mouth (6/24/76).



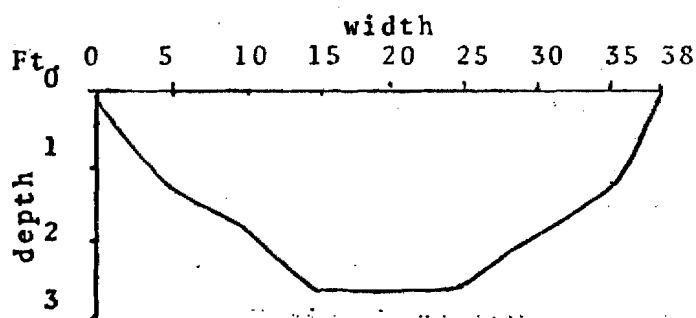
Appendix A

Table 27. Slough 18 Cross-Section and Stage Gauge Information, Devils Canyon Project, 1976.

Location of Gauge: Permanent marker is tree on north side of slough. Mark is 6.0' above slough bed and gauge is 24' from mark.

	June 24, 1976	Sept. 29, 1976
Elevation	714 ft.	-
Approximate distance from mouth to gauge	40 yds.	40 yds.
Water surface height at gauge	1.80 ft.	.98 ft.
Actual water depth at gauge	1.80 ft.	.98 ft.
Slough width at gauge	38 ft.	-
Maximum depth at cross-section	2.54 ft.	-
Change in bed elevation	-	-
Bed surface composition	silt	silt
Slough width at mouth	3 ft.	0 ft.
Slough depth at mouth	0.3 ft.	0 ft.
Susitna River mean daily discharge	19,900 CFS	6,060 CFS

Slough Cross-Section to Banks and Adjacent to Gauge (6/24/76)



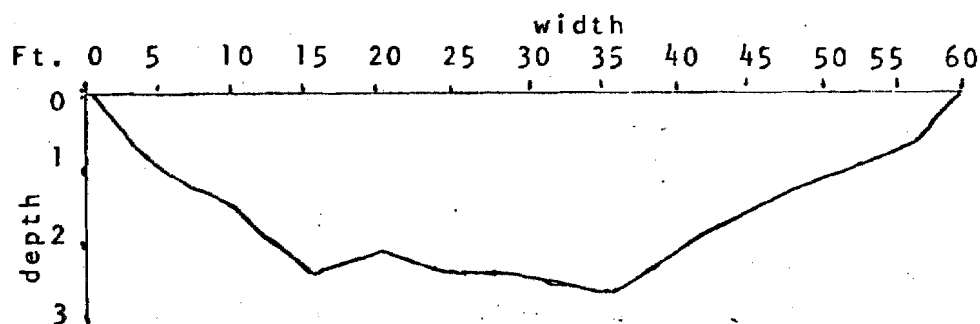
Appendix A

Table 28. Slough 19 Cross-Sections and Stage Gauge Information, Devils Canyon Project, 1976.

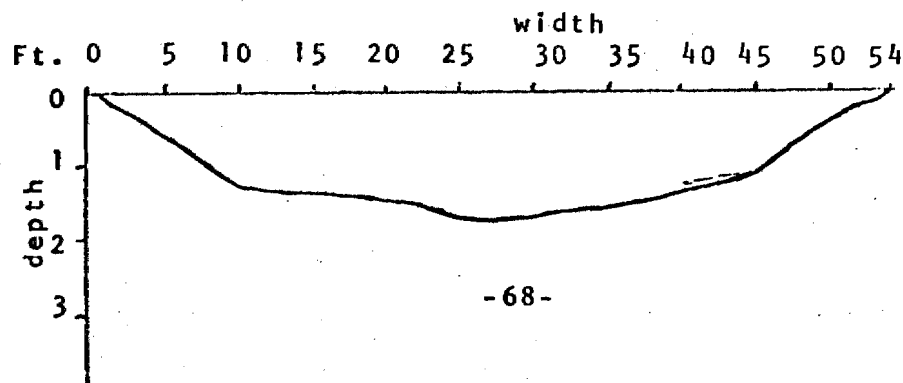
Location of Gauge: Permanent marker is tree on south side of slough. Mark is 9.0' from slough bed and gauge is 53' from mark.

	June 25, 1976	Sept. 8, 1976
Elevation	724 ft.	718 ft.
Approximate distance from mouth to gauge	50 ft.	50 ft.
Water surface height at gauge	5.82 ft.	5.13 ft.
Actual water depth at gauge	2.43 ft.	1.59 ft.
Slough width at gauge	60 ft.	54 ft.
Maximum depth at cross-section	2.53 ft.	1.72 ft.
Change in bed elevation	-	+0.1 ft.
Bed surface composition	soft silt	soft silt
Slough width at mouth	11 ft.	0
Slough depth at mouth	1.95 ft.	0
Susitna River mean daily discharge	19,600 CFS	6,240 CFS

Slough Cross-Section to Banks & Adjacent to Gauge (6/25/76)



Slough Cross-Section to Banks & Adjacent to Gauge (9/8/76)



Appendix A

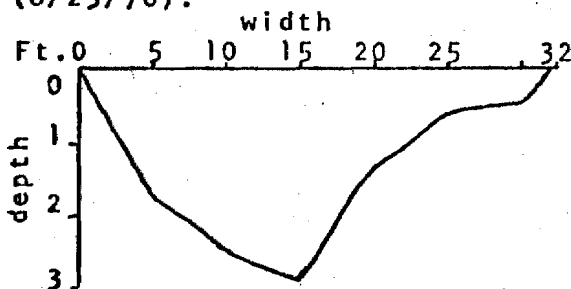
Table 29. Slough 20 Cross-Sections and Stage Gauge Information, Devils Canyon Project, 1976.

Location of Gauge: Permanent mark is tree on south side of slough. Mark is 10.0' above slough bed and gauge is 47' from tree.

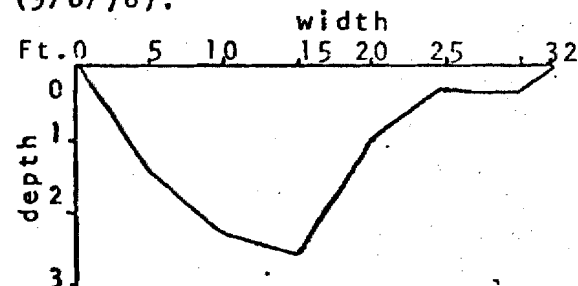
June 25, 1976 September 8, 1976

Elevation	709 ft.	724 ft.
Approximate distance from mouth to gauge	150 yds.	150 yds.
Water surface height at gauge	2.78 ft.	2.63 ft.
Actual water depth at gauge	2.50 ft.	2.50 ft.
Slough width at gauge	32 ft.	32 ft.
Maximum depth at cross-section	2.83 ft.	2.60 ft.
Change in bed elevation	-	-
Bed surface composition	silt, sand	silt, sand
Slough width at mouth	35 ft.	4 ft.
Slough depth at mouth	1.84 ft.	0.5 ft.
Susitna River mean daily discharge	19,600 CFS	6,240 CFS

Slough Cross-Section 1 to Banks & Adjacent to Gauge (6/25/76).



Slough Cross-Section 1 to Banks & Adjacent to Gauge (9/8/76).



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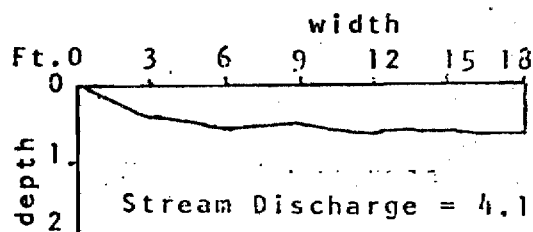
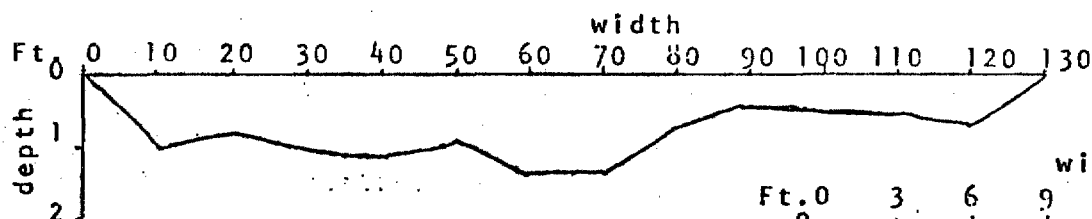
Table 30. Slough 3C Slough Cross Sections and Stage Gauge Information,
Devils Canyon Project, 1976.

Location of Gauge: Permanent marker is tree on north side of
slough. Mark is 11.0' above slough bed and
gauge is 50.0' from mark.

June 26, 1976 October 1, 1976

Elevation	426 ft.	-
Approximate distance from mouth to gauge	1,000 ft.	1,000 ft.
Water surface height at gauge	1.10 ft.	Below Gauge
Slough width at gauge	130 ft.	8 ft.
Maximum depth at cross-section	1.30 ft.	0.4 ft.
Change in bed elevation	-	-0.25 ft.
Bed surface composition	silt, sand	silt, sand, grvl.
Width	-	-
Depth	-	-
Actual water depth at gauge	1.10 ft.	0.3 ft.
Susitna River mean daily discharge	20,300 CFS	<5,800 CFS

Tributary Cross-Section ⊥ to Banks and Adjacent to Gauge (6/26/76).



Tributary Cross-Section ⊥ to Banks
Appox. 0.25 Mi. Above Gauge (7/26/76).
Chinook Salmon Spawn at this Site.

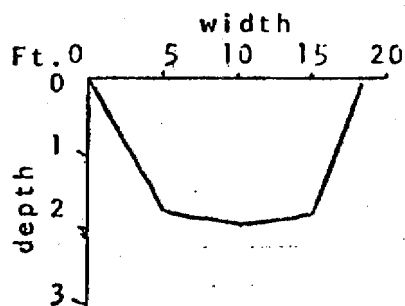
Appendix A

Table 31. Chase Creek Cross-Sections and Stage Gauge Information, Devils Canyon Project, 1976.

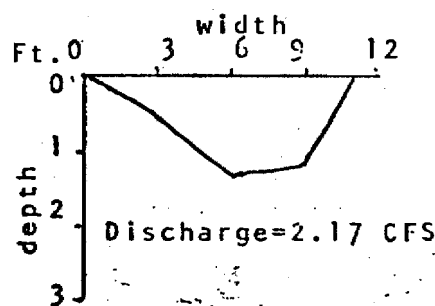
Location of Gauge: Permanent mark is rock on west side of creek.
Mark is 1.0' above creek bed and gauge is 5.0' from mark.

	June 26, 1976	Sept. 30, 1976
Elevation	462 ft.	-
Approximate distance from mouth to gauge	50 ft.	50 ft.
Water surface height at gauge	5.40 ft.	5.38 ft.
Actual water depth at gauge	2.07 ft.	2.05 ft.
Tributary width at gauge	18 ft.	18 ft.
Maximum depth at cross-Section	2.07 ft.	2.05 ft.
Change in bed elevation	3	0
Bed surface composition	sand, gravel	sand, gravel
Tributary width at mouth	17 ft.	-
Tributary depth at mouth	1.16 ft.	-
Susitna River mean daily flow	20,300 CFS	5,800 CFS

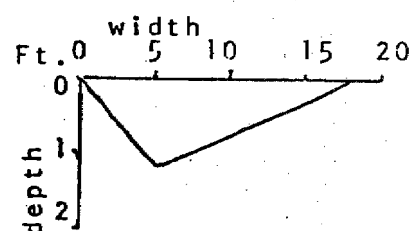
Tributary Cross-Section
⊥ to Banks and Adjacent
to Gauge (6/26/76).



Tributary Cross-Section
⊥ to Banks and Adjacent
to Gauge (7/26/76).



Tributary Cross-Section
at Mouth
(6/26/76)



Appendix A

Table 32. Tributary Flow Data, Devils Canyon Project, 1976.

<u>Tributary</u>	<u>Date</u>	<u>Flow (CFS)</u>
Portage Creek	9/8/76	500 (Est.)
Gold Creek	9/8/76	17
Fourth of July Creek	7/27/76	12
	9/9/76	37
Whiskers Creek	8/26/76	4

APPENDIX B

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