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Alaska State Office
222 W. 7th Avenue, #13
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Water Resources of Beaver Creek National Wild River, Alaska:

Stream Gaging Data for 1988 to 1992

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Table of Contents

Tables

Figure

Introduction

Beaver Creek was designated a National Wild River on December 2, 1980 when Congress amended the Wild and Scenic Rivers Act (P.L. 90-542) as part of the Alaska National Interest Lands Conservation Act (P.L. 96-487). The Bureau of Land Management (BLM) in its *River Management Plan for the Beaver Creek National Wild River* (USDI 1983) proposed that "a reservation of minimum water flows sufficient for public recreation and to support the values for which the area was designated will be determined in cooperation with the Alaska Department of Natural Resources, Division of Land and Water Management."

In April 1985, the BLM initiated a water rights quantification project for Beaver Creek. This project culminated in the report, *Water Rights Assessment for Beaver Creek National Wild River, Alaska* (Van Haveren, et al. 1987), which became the basis for an application for reservation of water with the State of Alaska. On May 26, 1989, the Alaska Department of Natural Resources (DNR), Division of Land and Water Management issued a Certificate of Reservation for Beaver Creek (LAS 11997). The water right issued to the BLM by the DNR is at three locations on Beaver Creek: Mile 6, Mile 36.5, and Mile 110.5. In granting this right, the DNR required that this reservation be reviewed at least once every 10 years to determine if the reservation is still needed. Part of this review process includes documentation of the streamflow during the 10-year period. To achieve the best estimates possible for annual streamflow on Beaver Creek, the DNR requested that hydrologic monitoring be done at the three locations noted above and that winter as well as summer flows be determined.

This report is a summary of the streamflow data from 1988 to 1992 collected by the BLM in response to the DNR's request. The BLM will continue to inventory the water resources on Beaver Creek, not only to comply with DNR's request, but also to provide managers and resource users with information necessary for management and utilization of this watershed.

Basin Characteristics

The Beaver Creek watershed, located in the eastern interior of Alaska, is part of the Yukon-Tanana physiographic province. This area is characterized by forested upland plateaus, some of gentle relief, but others topped by steep 4,000- to 5,000-foot tundra-covered mountains. Beaver Creek, like its tributaries, is narrow and steep in the headwaters, but widens downstream as the gradient decreases, increasing the meandering to form sloughs and extensive marshy lowlands. The relatively flat floodplain, often underlain by discontinuous permafrost, ranges from one to three miles wide. Numerous springs occur in the basin, especially in the area downstream of Big Bend (River Mile 37), and contribute significantly to winter streamflow. The region is drained ultimately by the Yukon River.

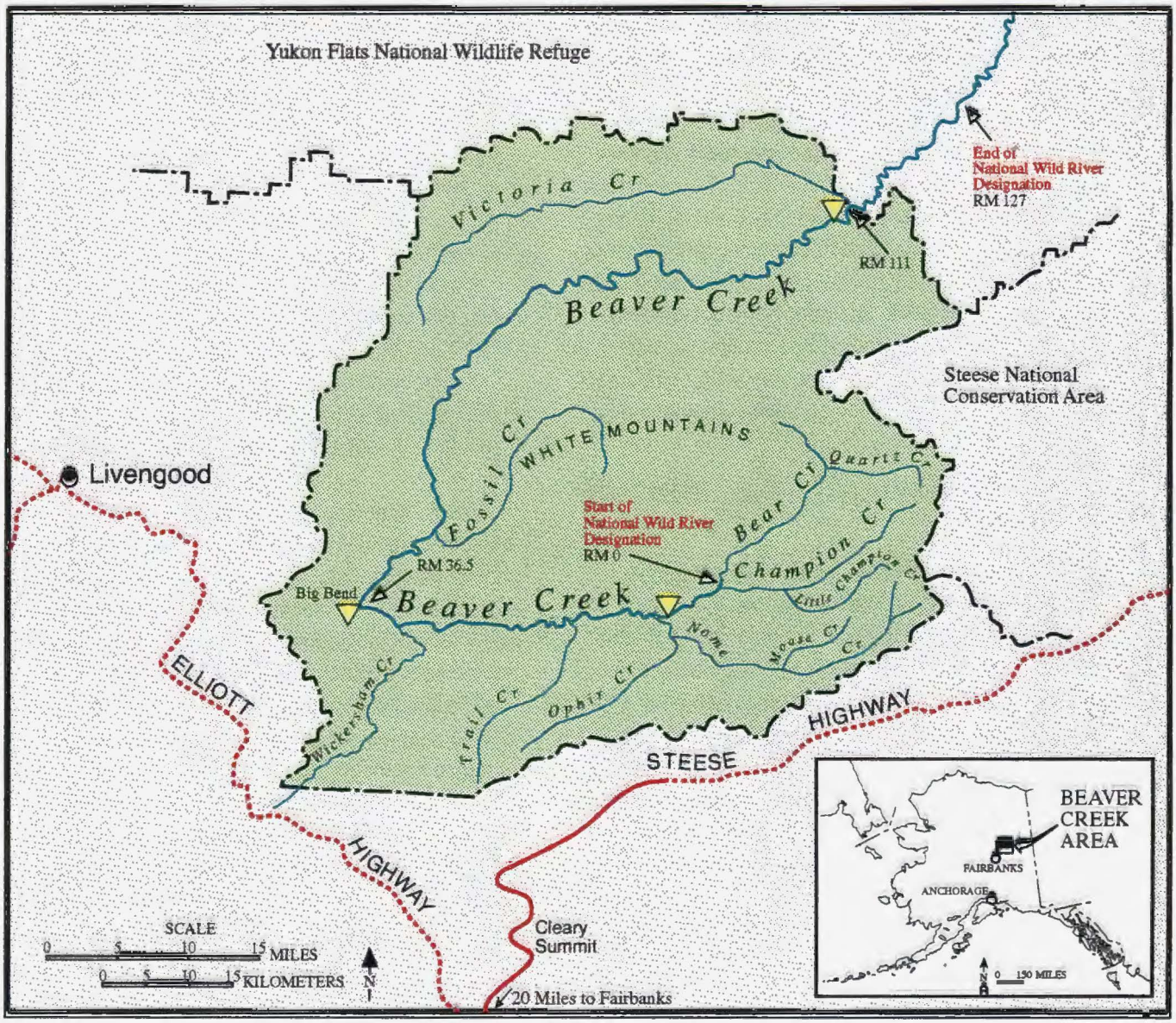
The basin lies in the subpolar continental climatic zone: long, cold winters and short, hot summers. Temperature extremes range from -70° F in winter to +90° F in summer. Precipitation averages 10 to 15 inches per year at nearby recording stations, though variations are great due to the surrounding topography. Precipitation is generally greater at higher elevations and during the summer, with most coming as rainfall from late June to early September (U.S. Department of Commerce 1963). Snowfall averages about 50 inches per year, with about 20 inches remaining on the ground prior to spring break-up. Break-up usually begins in late April to mid-May and high streamflow may persist into June. Freeze-up on streams often begins at higher elevations in mid-September, though some streams lower in the basin remain open until November. Ice cover is usually continuous for the winter, except in the vicinity of springs, and freezing to the bottom may occur in places.

This report covers the first 111 miles of Beaver Creek (Figure 1) included in the National Wild and Scenic Rivers System and the White Mountains National Recreation Area, beginning at the confluence of Bear and Champion Creeks (RM 0) and ending at the confluence with Victoria Creek (RM 111). Additional information can be found in the *Proposed Inclusion of the Beaver Creek into the National Wild and Scenic Rivers System* (U.S. Department of the Interior 1973) and the *River Management Plan for the Beaver Creek National Wild River* (U.S. BLM and U.S. F&WS 1983).

Methods

Stream gages were installed by BLM at three sites on Beaver Creek. They were placed as near as possible to the locations specified by DNR in LAS 11997. An automated water-level recorder (data logger and pressure transducer) was installed in 1988 above Victoria Creek at RM 110.5. This gage recorded water level data for the summer periods from 1988 to 1992, with the exception of 1990 when the recorder failed. The other two sites, at Big Bend (RM 36.5) and above Nome Creek (RM 6), had crest-stage gages installed in 1989. These are non-automated gages that record the peak water level whenever it exceeds a preset minimum (base) level. At each site visit, both types of gages were referenced to elevation (bench) marks and to the current water level. Cross-sectional discharge (streamflow) measurements were made using a Price AA current meter to measure water velocity and a top setting wading rod and tag line for depth and width. At least once a year, the stream banks, high-water marks, and water surface profiles were surveyed using a level and stadia rod. A water level versus discharge rating was developed by combining the direct discharge measurements (Rantz et al. 1982) and computer-simulated peak flows using the slope-area method (Dalrymple and Benson 1967). The rating curves—actually log-log regression plots—were then used to compute discharge from the recorded water level and crest-stage data. By

Beaver Creek National Wild River



Legend

- RM — River Mile of Beaver Creek National Wild River
- BLM River Gage
- White Mountains National Recreation Area

comparing differences in discharge measurements and peak flows at the three sites using regression analysis, data from the automated gage was used as the independent variable to compute monthly average flows for the non-automated gaging sites (dependent variable). During periods when no data is available, such as during spring break-up, fall freeze-up, or recorder malfunction, the data was estimated from similar comparisons using regression analysis with the U.S. Geological Survey data from the gage on the Salcha River (USDI 1989 to 1992). The Salcha River data produced the highest correlation values (Table B-2), while the basin closely approximates Beaver Creek in watershed characteristics.

For the winter period, beginning in the autumn of 1989, under-ice discharge measurements were made as nearly simultaneously as possible on the three sites, two to three times during the winter. These measurements were made by drilling a series of holes in the ice to define the cross-section, then measuring the depth and velocity in each hole using a USGS vertical-axis, vane-type current meter mounted on a graduated rod. Where the measurements were sufficiently accurate to represent the flow conditions, streamflow was computed directly by regressing discharge on the time (date) for the periods covered for each site. This methodology is based on the assumption that once ice and snow cover isolate the stream from precipitation and temperature changes, the flow to the stream recedes uniformly as the water table is lowered by reduction of water in the aquifer (Rogers and Armbruster 1990). Where no data was available, such as the early winter of 1989, the regression correlation to the USGS Salcha River data was used to compute the estimated streamflow for the period. Where some discharge measurements were considered unreliable, such as late winter of 1990 when flows were difficult to measure, the most reliable measurement was used to compute all three sites based on their previously measured differences.

The regression equations for the Beaver Creek basin were computed using Beaver Creek above Victoria Creek as the base station, since it had a longer and more detailed record (Table B-2). Each of the three streamflow conditions—low flow (less than about 300 cfs), medium flow (between 300 and 3,000 cfs), and peak flow (greater than 3,000 cfs)—were analyzed to provide the greatest possible accuracy. A similar approach was used to compare Beaver Creek to the Salcha River. Wherever regression equations were used to compute mean monthly discharge, the values have been identified in the tables as estimates.

Results and Discussion

Appendix A contains discharge data, listed by year and site location, for the period of record. A summary table at the end of each year's data lists the mean monthly streamflow. This was computed from the recorded daily values table, regression equations determined from winter under-ice measurements, and comparisons to other sites on Beaver Creek or to the Salcha River. Appendix B lists the discharge ratings and regression equations used in the computations.

A mean monthly data summary for the period of record was computed for the three Beaver Creek sites (Table 1, Figure 1). This can then be compared to the Salcha River (Table 2) and the monthly estimates used in the original water rights application (Table 3). In general, the flows in Van Haveren et al. 1987, used in the application, underestimated the measured streamflow by about 77 percent (ranging from 48 to 97 percent). The underestimation is probably due to a lack of comparable data to test the validity of the correlations used to estimate the original data set. Both Hess and Boulder Creeks, used for the original computations, were less comparable to Beaver Creek than was the Salcha River. Neither Hess Creek nor Boulder Creek has a significant winter base

Table 1
Monthly mean discharge data:
Beaver Creek, 1988-1992

Month	Discharge (cfs) Above Nome Creek	Beaver Creek At Big Bend	Above Victoria Creek
January	23	56	86
February	17	43	68
March	14	35	56
April	113	180	381
May	651	1,461	3,052
June	735	1,654	2,628
July	234	437	950
August	407	845	1,640
September	462	990	1,862
October	167	367	599
November	81	200	304
December	42	117	165

Table 2
Monthly mean discharge data:
Salcha River, 1949-1991

Month	(cfs)
January	247
February	198
March	181
April	352
May	4,485
June	3,943
July	2,751
August	3,074
September	2,466
October	1,073
November	474
December	336

Table 3
Monthly mean discharge data:
Beaver Creek estimates used in 1987 Water Rights Application

Month	Discharge (cfs) Above Nome Creek	Beaver Creek At Big Bend	Above Victoria Creek
January	0.1	0.4	0.9
February	0.1	0.4	0.9
March	0.1	0.4	0.9
April	6.6	29	60
May	233	1,019	2,106
June	158	691	1,428
July	77	346	696
August	71	314	649
September	67	295	609
October	13	55	115
November	1.3	5.9	13
December	0.2	1.0	1.9

Source: Van Haveran et al. 1987

flow. Beaver Creek more nearly resembles the Salcha River, with moderate streamflow persisting throughout the winter.

Finally, the peak flow statistics (Table 4) were computed from the annual peak data (Table 5) using a log-Pearson III flood-frequency relationship. These values also exceeded those used in the original 1987 estimates derived from regional flood-frequency relationships (Table 6). Since only five years of data is available for Beaver Creek, the calculations were only carried out to a 10-year recurrence interval event to avoid the uncertainty of predicting large magnitude flood events from a limited data set (Bedient and Huber 1988). The large differences probably are due to uncertainty in using regional data, lack of any precipitation data in the basin, and a small (five-year) set of measured data used for the comparison.

Figure 1
Monthly mean discharge data for Beaver Creek, 1988-1992

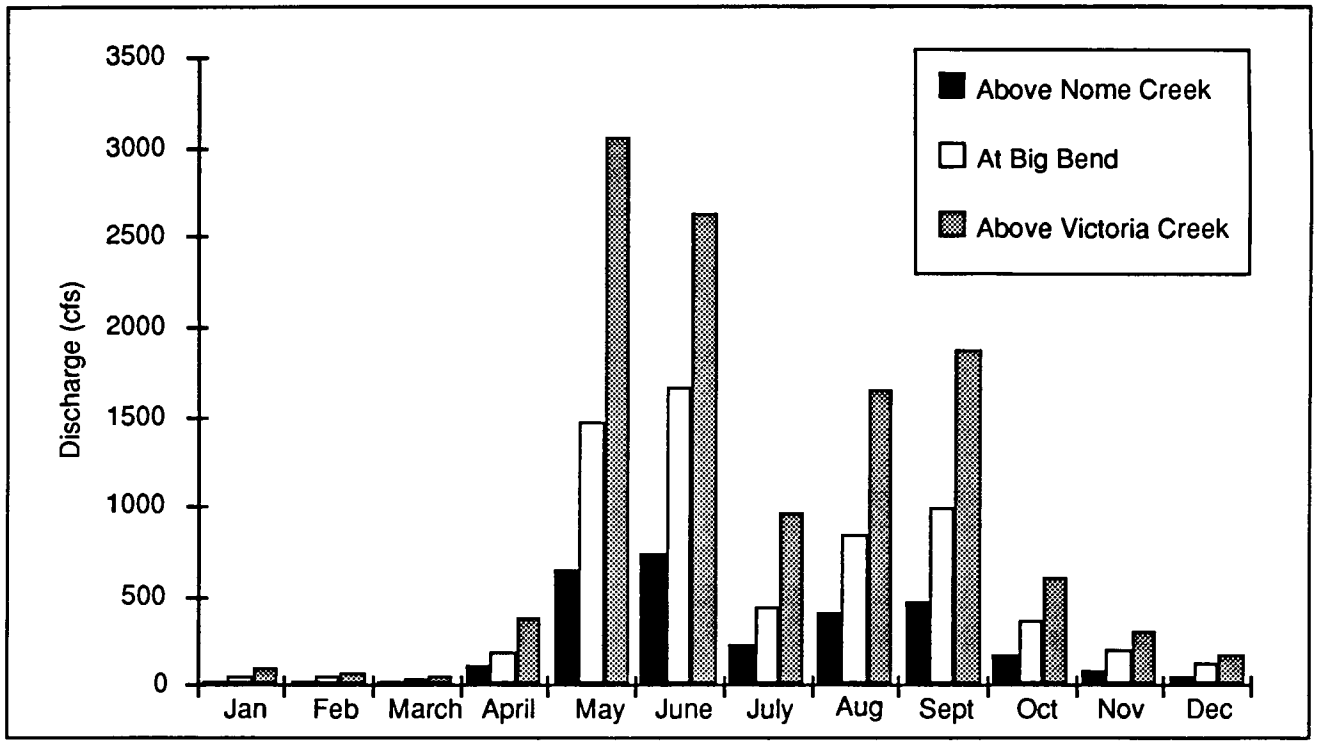


Table 4
Log Pearson III flood frequency estimates for Beaver Creek

Year	Beaver Creek		
	Above Nome Creek	At Big Bend	Above Victoria Creek
1.5	3,575	8,840	12,680
2	4,155	9,684	15,080
5	4,835	12,560	19,740
10	5,498	15,110	21,360

Table 5
Instantaneous peak flows: Beaver Creek, 1988-1992

Year	Instantaneous Peak Discharge (cfs)		
	Beaver Creek		
	Above Nome Creek	At Big Bend	Above Victoria Creek
1988	no data	no data	7,286
1989	3,810	8,750	18,800
1990	4,011	8,534	12,581
1991	3,154	10,069	15,273
1992	5,505	15,623	19,642

Table 6
1987 flood frequency estimates for Beaver Creek (derived from Parks and Madison 1985)

Year	Beaver Creek		
	Above Nome Creek	At Big Bend	Above Victoria Creek
1.5	not determined	not determined	not determined
2	867	3,114	5,851
5	not determined	not determined	not determined
10	2,224	7,037	12,424

Source: Van Haveran et al. 1987

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Appendix A

Table A1
Daily discharge of Beaver Creek above Victoria Creek, 1988

Date	Discharge (cfs) June	July	August	September
1		964	833	2,366
2		862	819	2,051
3		724	830	1,755
4		611	756	1,609
5		545	755	1,740
6		593	712	2,284
7		562	676	3,104
8		523	641	3,215
9		485	636	2,633
10	1,535	510	817	2,113
11	1,261	517	922	1,857
12	1,675	552	873	1,633
13	2,237	563	1,064	1,483
14	2,334	545	1,846	1,327
15	1,930	534	2,065	1,208
16	2,772	480	2,525	
17	5,350	492	2,654	
18	6,035	438	2,131	
19	3,607	522	1,762	
20	2,394	478	1,500	
21	1,909	458	1,382	
22	1,778	458	1,302	
23	1,749	469	1,552	
24	1,447	486	3,165	
25	1,159	536	4,459	
26	925	594	3,447	
27	858	519	2,604	
28	785	459	2,095	
29	826	473	1,984	
30	1,060	546	1,935	
31		673	2,119	
Maximum	6,035*	594	4,459	3,215*
Minimum	785*	438	636	1,208*
Mean	2,077*	519	1,764	2,054*

*Based on less than a full month.

Table A2
Daily discharge of Beaver Creek above Victoria Creek, 1989

Date	Discharge (cfs) June	July	August	September
1		3,792	632	418
2		3,693	609	406
3		2,821	597	395
4		2,030	586	372
5	1,774	1,569	628	388
6	1,820	1,293	707	398
7	1,791	1,106	738	391
8	1,703	962	827	411
9	1,395	870	810	421
10	1,378	1,142	685	409
11	2,407	897	634	403
12	2,554	802	616	450
13	2,109	731	581	
14	1,659	670	578	
15	1,351	640	605	
16	1,163	673	664	
17	963	658	645	
18	1,054	623	605	
19	1,643	596	576	
20	1,798	632	553	
21	1,479	884	536	
22	1,244	860	546	
23	1,062	862	527	
24	1,130	927	508	
25	13,489	868	480	
26	14,045	781	454	
27	8,691	840	481	
28	4,937	914	467	
29	4,546	920	453	
30	3,748	849	446	
31		724	432	
Maximum	14,045*	1,569	827	450*
Minimum	963*	596	432	388*
Mean	3,113*	863	585	409*

*Based on less than a full month.

Table A3
Beaver Creek discharge measurements, 1989

Date measured	Discharge (cfs)	Stage (ft)	Width (ft)	Area (ft^2)	Avg. velocity (ft/s)	Avg. depth (ft)
Above Nome Creek						
June 19	353	1.98	128	142	2.40	1.2
June 25*	3,810	5.18	173	722	5.28	4.2
July 25	192	1.65	153	95	1.83	.7
September 6	111	1.47	86	73	1.54	1.0
October 31	64	n/d	68	75	.90	1.6
At Big Bend						
June 25*	8,750	8.75	248	1,580	5.54	6.4
August 9	329	2.84	168	313	1.05	2.3
September 6	213	2.52	156	251	.76	1.7
November 1	191	n/d	140	242	.85	2.0
Above Victoria Creek						
May 23	2,959	3.40	262	914	3.26	3.6
June 25*	18,800	9.81	295	2,490	7.55	8.4
July 28	986	1.66	200	358	2.71	2.0
September 12	450	1.03	205	326	1.34	1.7
November 16	190	n/d	184	233	.88	1.7

n/d=not determined
*slope-area indirect discharge measurement

Table A4
Monthly mean discharge data: Beaver Creek, 1989

Month	Discharge (cfs) Beaver Creek Above Nome Creek	At Big Bend	Above Victoria Creek
January	17	43	63
February	16	41	56
March	16	41	54
April	162	278	478
May	474	1,034	2,217
June	920	2,032	3,113
July	205	372	863
August	173	302	585
September	155	264	409
October	74	197	288
November	54	155	192
December	39	100	120

Table A5
Beaver Creek discharge measurements, 1990

Date measured	Discharge (cfs)	Stage (ft)	Width (ft)	Area (ft^2)	Avg. velocity (ft/s)	Avg. depth (ft)
Above Nome Creek						
February 14	4	n/d	30	23	0.16	1.0
June 7	415	2.11	153	161	2.54	1.1
September 21	482	2.55	91	183	2.27	2.2
December 13	48	n/d	46	76	0.64	2.2
At Big Bend						
March 20	1	n/d	45	56	0.04	1.1
June 7	1,052	3.90	195	509	1.95	2.9
September 21	1,119	4.09	241	358	3.18	1.5
December 11	109	n/d	132	207	0.54	1.7
Above Victoria Creek						
March 20	10	n/d	100	72	0.24	0.7
September 21	2,005	2.91	372	779	2.58	2.2
December 11	180	n/d	120	189	0.84	1.7

n/d=not determined

Table A6
Monthly mean discharge data: Beaver Creek, 1990

Month	Discharge (cfs) Beaver Creek Above Nome Creek	At Big Bend	Above Victoria Creek
January	8	19	32
February	5	17	28
March	4	16	27
April	55	125	248
May	461	998	2,170
June	272	525	1,318
July	215	394	940
August	275	533	1,338
September	1,086	2,475	4,686
October	244	563	967
November	14	239	390
December	45	102	157

Table A7
Daily discharge of Beaver Creek above Victoria Creek, 1991

Date	Discharge (cfs) May	June	July	August	September
1		5,128	1,420		2,295
2		6,782	1,377		2,102
3		6,545	1,298		1,939
4		5,068	1,999		1,798
5		4,181	3,136		1,684
6		4,175	2,898		1,565
7		4,641	2,277		1,493
8		5,044	1,894		1,429
9		4,172	1,576		1,458
10		3,249	1,412		1,525
11		2,756	1,292		1,701
12		2,517	1,210		1,813
13		2,663	1,276		2.990
14		2,928	1,127		3,633
15		2,613	1,101	1,474	3,020
16		2,377	1,090	1,457	2,516
17		2,185	1,094	1,386	2,195
18		2,085	1,140	7,373	1,970
19		1,967	1,206	13,813	1,792
20		1,889	1,288	13,751	1,681
21		1,793	1,215	7,486	1,617
22		1,743	1,143	5,150	1,640
23		1,703	1,103	4,206	1,630
24	5,376	1,775	1,034	6,060	1,598
25	5,223	1,705	993	6,810	
26	4,946	1,601	987	5,445	
27	4,575	1,555	1,113	4,311	
28	4,490	1,539	1,212	3,573	
29	4,153	1,502	1,363	3,110	
30	4,230	1,527	1,570	2,795	
31	4,174			2,521	
Maximum	5,376*	6,782	3,136	13,813*	3,633*
Minimum	4,153*	1,502	987	1,386*	1,429*
Mean	4,646*	2,980	1,425	5,337*	1,962*

*Based on less than a full month.

Table A8
Beaver Creek discharge measurements, 1991

Date measured	Discharge (cfs)	Stage (ft)	Width (ft)	Area (ft^2)	Avg. velocity (ft/s)	Avg. depth (ft)
Above Nome Creek						
March 6	21	n/d	29	20	1.08	1.0
August 15	237	2.06	90	107	2.13	1.3
September 24	499	2.31	94	205	2.43	1.4
December 13	47	n/d	34	25	1.95	1.2
At Big Bend						
February 25	53	n/d	120	96	1.0	0.9
July 25	348	n/d	163	278	1.35	2.3
September 24	809	3.69	173	344	2.45	2.3
Above Victoria Creek						
February 25	87	n/d	95	118	0.74	1.6
September 24	1,453	2.23	379	703	2.15	2.2
December 16	169	n/d	110	160	1.16	1.5

n/d=not determined

Table A9
Monthly mean discharge data: Beaver Creek, 1991

Month	Discharge (cfs) Beaver Creek Above Nome Creek	At Big Bend	Above Victoria Creek
January	34	78	128
February	26	59	96
March	19	45	73
April	72	159	290
May	1,195	2,777	5,603
June	761	1,840	2,980
July	290	569	1,425
August	971	2,165	3,619
September	405	853	1,962
October	264	514	831
November	107	270	377
December	43	142	171

Table A10
Daily discharge of Beaver Creek above Victoria Creek, 1992

Date	Discharge (cfs) June	July	August	September
1		1,377	2,067	901
2		1,289	1,616	1,097
3		1,199	1,332	1,482
4		1,074	1,140	1,445
5		970	998	1,312
6		878	892	1,212
7		795	838	1,104
8		728	797	1,029
9		678	771	959
10	2,937	648	754	876
11	2,889	658	767	832
12	2,662	775	765	806
13	2,396	1,233	754	772
14	2,162	1,467	770	742
15	2,010	1,306	775	746
16	2,306	1,227	809	681
17	3,400	1,171	823	647
18	4,652	977	807	607
19	4,024	882	893	607
20	2,810	861	1,055	589
21	2,253	870	1,091	520
22	2,776	859	1,042	480
23	7,650	803	962	364
24	6,664	768	897	
25	3,824	759	841	
26	2,881	752	790	
27	2,692	879	788	
28	2,236	1,023	820	
29	1,827	1,496	931	
30	1,565	1,759	959	
31		1,942	939	
Maximum	7,650*	1,759	1,091	1,482*
Minimum	1,565*	648	775	364*
Mean	3,171*	1,005	895	861*

*Based on less than a full month.

Table A11
Beaver Creek discharge measurements, 1992

Date measured	Discharge (cfs)	Stage (ft)	Width (ft)	Area (ft^2)	Avg. velocity (ft/s)	Avg. depth (ft)
Above Nome Creek						
March 13	16	n/d	30	27	0.55	1.0
June 10	836	2.66	160	266	3.04	1.8
July 23	208	1.80	90	107	2.15	1.3
November 17	57	n/d	62	86	0.68	1.5
At Big Bend						
January 3	96	n/d	100	209	0.45	2.1
March 10	41	n/d	110	148	0.26	1.5
June 10	1,625	4.47	162	550	2.87	3.7
July 23	417	2.92	144	304	1.21	2.4
November 12	164	n/d	100	160	1.02	1.8
Above Victoria Creek						
March 10	75	n/d	110	90	0.59	0.9
June 10	2,927	3.44	227	934	3.09	4.1
July 23	753	1.55	227	513	1.36	2.4
November 12	265	n/d	171	195	0.93	1.2

n/d=not determined

Table A12
Monthly mean discharge data: Beaver Creek, 1992

Month	Discharge (cfs) Beaver Creek Above Nome Creek	At Big Bend	Above Victoria Creek
January	32	82	123
February	22	56	92
March	16	38	69
April	165	155	508
May	474	1,034	2,217
June	989	2,218	3,810
July	224	414	1,005
August	209	381	895
September	202	366	841
October	85	194	311
November	58	135	256
December	40	123	211

Table A13
Instantaneous peak and lowest recorded daily mean discharges: Beaver Creek, 1988-1992

			Beaver Creek		
			Above Nome Creek	At Big Bend	Above Victoria Creek
1988	Instantaneous Peak	Discharge	no data obtained at this site	no data obtained at this site	7,286
		Stage			5.74
		Date			June 17
	Lowest Recorded Daily Mean	Discharge			438
		Date			July 18
1989	Instantaneous Peak	Discharge	3,810	8,750	18,800
		Stage	5.18	8.75	9.81
		Date	June 25	June 25	June 25
	Lowest Recorded Daily Mean	Discharge	n/d	n/d	372
		Date			September 4
1990	Instantaneous Peak	Discharge	4,011	8,534	12,581
		Stage	5.26	8.51	7.99
		Date	September 8	September 8	September 8
	Lowest Recorded Daily Mean	Discharge	n/d	n/d	n/d
		Date			
1991	Instantaneous Peak	Discharge	3,154	10,069	15,273
		Stage	4.97	8.86	8.98
		Date	August 20	August 20	August 20
	Lowest Recorded Daily Mean	Discharge	n/d	n/d	987
		Date			July 26
1992	Instantaneous Peak	Discharge	5,505	15,623	19,642
		Stage	5.78	10.21	10.40
		Date	June 1	June 1	June 1
	Lowest Recorded Daily Mean	Discharge	n/d	n/d	364
		Date			September 23

n/d=not determined

Appendix B

Table B1
Discharge regressions based on Beaver Creek above Victoria Creek

Beaver Creek above Nome Creek			
Discharge (cfs)	Equation	r^2	Standard error
≤300	$Q=11.39 \times 1.0063^{Qv}$	.91	.19
>300 and ≤3,000	$Q=120.1 \times 1.0006^{Qv}$	.77	.30
>3,000	$Q=665.4 \times 1.0001^{Qv}$	.93	.21
Beaver Creek at Big Bend			
Discharge (cfs)	Equation	r^2	Standard error
≤300	$Q=29.76 \times 1.0058^{Qv}$	.90	.26
>300 and ≤3,000	$Q=193.9 \times 1.0008^{Qv}$	.89	.26
>3,000	$Q=1,376 \times 1.0001^{Qv}$	.97	.18

Q=discharge
Qv=discharge at reference site, i.e. above Victoria Creek
r^2=coefficient of determination

Table B2
Discharge regressions based on Salcha River

Discharge (cfs)	Equation	r^2	Standard error
≤1,000	$Q=29.57 \times 1.0032^{Qs}$	0.92	0.26
>1,000 and ≤7,000	$Q=605.4 \times 1.0003^{Qs}$	0.78	0.38
>7,000	$Q=2,840 \times 1.0001^{Qs}$	0.84	0.33

Table B3
Sample regression based on Beaver Creek winter discharge measurements

Period	Date	Discharge (cfs)	Equation	r^2	Standard error
Fall 1989	9/6/89 10/31/89	111 64	$Q=2,167.4 \times 0.9899^{Day}$	1.00	0.00
Winter 89/90	10/31/89 2/14/90	64 4	$Q=814,640 \times 0.9733^{Day}$	1.00	0.00