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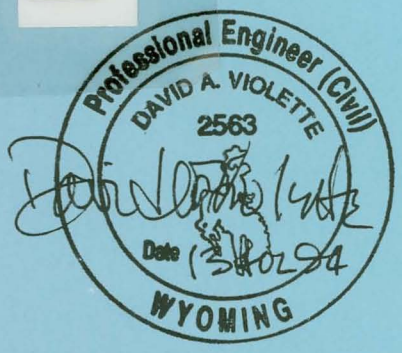
JOHNSON-FERMELIA Co. Inc.

CONSULTING ENGINEERS, ARCHITECTS AND SURVEYORS

Report on the Feasibility of Providing Instream Flow In Segments 1 and 2 of Shell Creek

FOR

Wyoming Water Development Commission
July 13, 1994
JFCo Job No. 3606-94E



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I. SUMMARY

The Wyoming Water Development Commission (WWDC) is required by W.S. 41-3-1004(a) to evaluate the capability of Shell Creek to provide unappropriated direct flows necessary to meet the Wyoming Game and Fish Department instream flow requests for the following described segments:

Table 1. Instream Flow Requests

Instream Flow Segment	Location	Stream Length	Instream Flow Request		
			Oct-Mar	Apr-Jun	Jul-Sep
Shell Creek 1	Shell Falls upstream to the Mouth of Adelaide Creek	10.5 Miles	19 cfs	70 cfs	40 cfs
Shell Creek 2	Bighorn National Forest Boundary upstream to Shell Falls	6.1 Miles	23 cfs	23 cfs	40 cfs

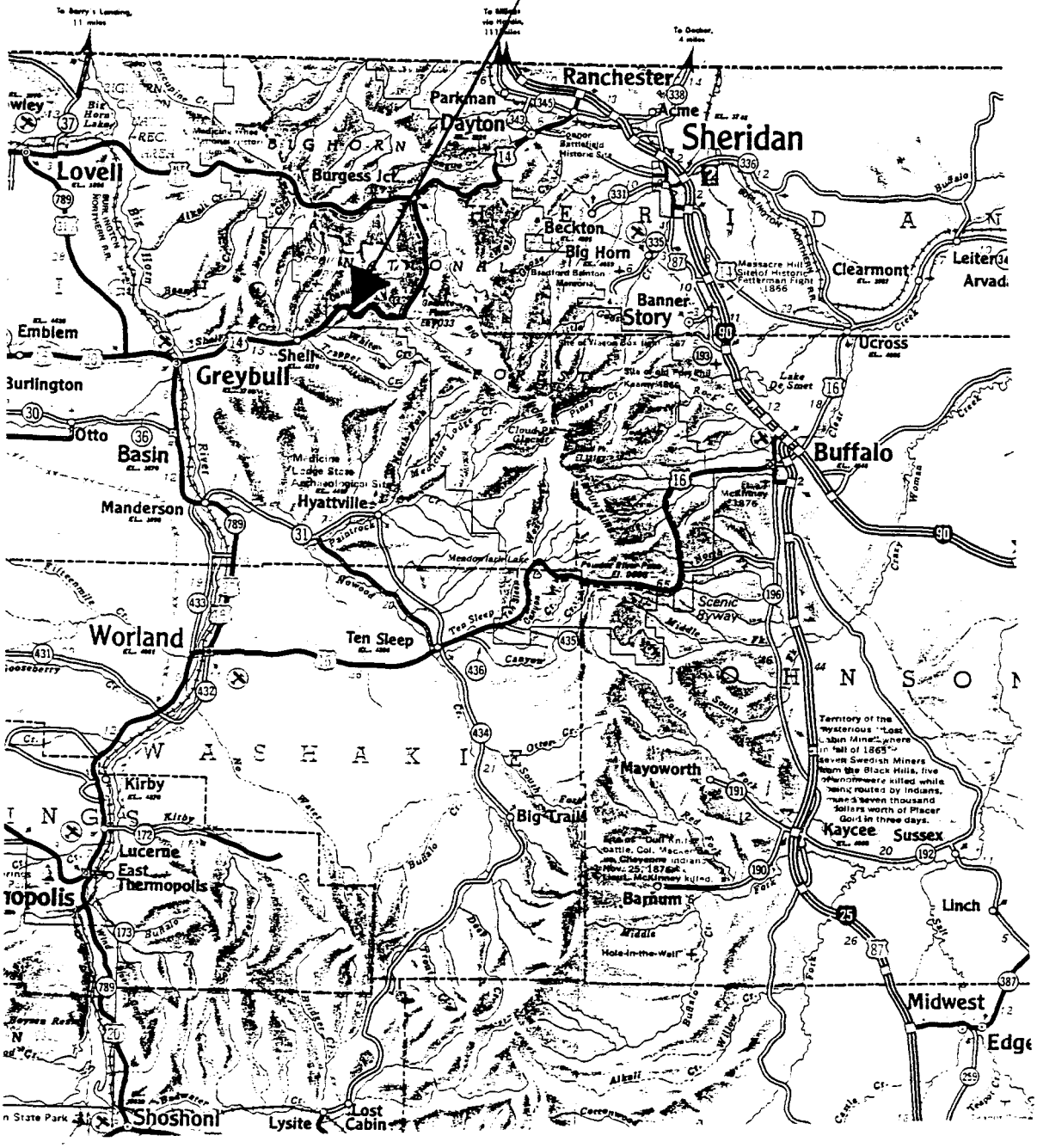
Johnson-Fermelia Company, Inc., (JFCo) of Rock Springs, Wyoming was contracted by the WWDC to investigate the instream flow segments for Shell Creek. This is a report of that investigation. The investigation of the instream flow requests includes an evaluation of Mean Monthly Flows, Dry Year Flows, Low Flows and a Daily Flow Exceedance analysis. The results of the investigation are summarized in the following sections.

Through the mean monthly flow analysis, it was shown that in Segment 1 of Shell Creek, the Instream Flow Request can be met by total flows in all months except April. Through the Dry Year Flow Analysis, it was once again shown that only the month of April shows a deficit in total flow for the Instream Flow Request. The Daily Flow Exceedance Analysis also shows that the 50% criterion will be met in all months except April.

For Segment 2, it was shown that the Instream Flow Request can be met by total flows in all months through the Mean Monthly Flow Analysis, the Dry Year Flow Analysis, and the Daily Flow Exceedance Analysis.

A vicinity map illustrating the general location of the instream flow segments is shown on Figure 1.

LOCATION OF SHELL CREEK
INSTREAM FLOW SEGMENTS 1 AND 2



JOHNSON–FERMELIA CO. INC. CONSULTING ENGINEERS, ARCHITECTS AND SURVEYORS (307) 362–7519	VICINITY MAP SHELL CREEK – SEGMENTS 1 AND 2 CENTRAL WYO. INSTREAM FLOWS	
	DWN BY: AMA DATE: 6 MAY 94	SCALE: NONE
		FIGURE 1

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II. Water Rights

Water rights and reservoir permits upstream from the downstream end of Segments 1 and 2 were analyzed to determine their effect on streamflow in the instream flow segment.

A. Water rights filed

A database of water rights information, including all Wyoming water rights and permits located upstream from the downstream end of the flow segment, are shown in Table A1 in Appendix A. The staff of the Wyoming State Engineer's Office (Phil Velez) provided information necessary to develop the data. Additional water rights information was provided by the US Department of Agriculture Forest Service (USFS) office in Golden, Colorado. These additional Forest Service rights were obtained by decree in 1982 and are not yet filed with the Wyoming State Engineer's Office. According to information obtained from the Forest Service, these rights have a priority date of 1898, which corresponds to the creation date of the Bighorn National Forest (see Appendix B-Description of USFS Forest Service Decree Rights).

Table A1 of Appendix A lists all diversion water rights and permits obtained from the Wyoming State Engineer's office that are located within or above the instream flow segments. Table A2 lists all of the water rights and permits for the reservoirs located within the drainage area upstream of the instream flow segments. The data in Table A3 was provided by the US Forest Service and is a summary of all of the USFS reservoir permits within the basin that are upstream from the instream flow segments. The total storage of these upstream reservoirs, including the Forest Service reservoir rights by decree, totals 6659 acre-feet. Since the average annual discharge for Shell Creek is almost 50000 acre-feet, this amount is considered to be insignificant in the estimation of water available for instream flow.

There are two large reservoirs upstream from the instream flow segments; Shell Reservoir, last enlarged in 1957, and Lake Adelaide, enlarged in 1987.

Two USFS instream flow water rights apply above the downstream end of the instream flow segments (see Table A4, Appendix A). One instream flow right applies above Shell Reservoir and one above Lake Adelaide. An additional instream flow right applies at the Bighorn National Forest Boundary, downstream of Instream Flow Segment 1, at the same point as the downstream end of Instream Flow Segment 2. The use and amount of these instream flow rights is discussed in Appendix B. These rights are measured at a point described in the legal descriptions in Table A4 of Appendix A. Even though the instream right is below Segment 1, it is assumed that the flow passes through Segment 1 and must be considered in this segment. Table 2 below describes the requested instream flow amounts for Segments 1 and 2 and the USFS instream flow right at the downstream end of Segment 2.

It is assumed that the streamflow gaging records in Section III of this report reflect the diversions of the upstream water rights listed in Appendix A. Since instream flow water rights are non-consumptive, they should not affect present and future diversions downstream of the segment.

Table 2. Instream Flows

Month	Instream Flow Request-Segment 1 (cfs)	Instream Flow Request-Segment 2 (cfs)	USDA Forest Service Instream Flow-Downstream End of Segment 2 (cfs)
October	19	23	11.5
November	19	23	7.0
December	19	23	7.0
January	19	23	10.5
February	19	23	7.5
March	19	23	9.8
April	70	23	10.9
May	70	23	92.7
June	70	23	126.4
July	40	40	11.5
August	40	40	11.5
September	40	40	10.9

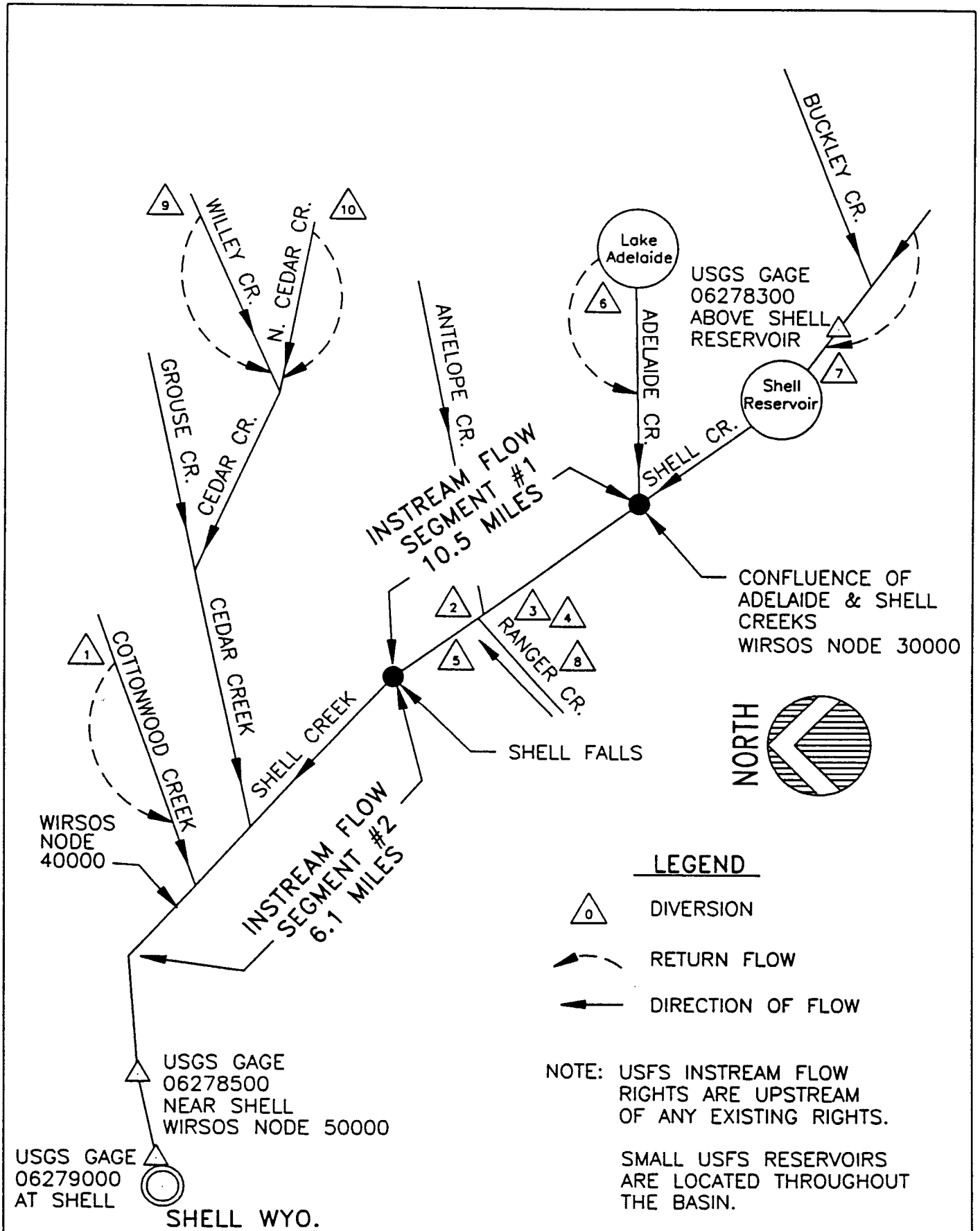
B. Diversion Analysis

A diversion analysis was performed on the instream flow segments based on the water rights information discussed in Section II, A. The spreadsheet for this analysis can be found in Appendix C - Summary of Diversions and Return Flows.

Irrigation diversion rights were applied during the months of May through September. Return flows for irrigation were applied during the same month with a return flow factor of 0.50. Reservoirs were assumed filled in the high water months of May through July and no return flows were assumed. All other uses (domestic, municipal, recreation) were applied every month of the year and were returned during the month of use with a factor of 0.55 of the original diversion.

USFS reservoirs in the area were applied during their month of use (see Appendix A) and no return flows were calculated.

The USFS instream flow rights are considered non-consumptive and were not included in the diversion analysis. All diversion locations are shown on Figure 2 - Flow Diagram of Instream Flow Segments 1 and 2.



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SCHEMATIC DIAGRAM
SHELL CREEK – SEGMENTS 1 & 2
CENTRAL WYO. INSTREAM FLOWS

DWN BY: GKK | DATE: 011 JUL 94 | SCALE: NONE | FIGURE 2

III. Streamflow Records

Streamflow records available to document the historic streamflow within Shell Creek Instream Flow Segments 1 and 2 are from three USGS gaging stations identified below:

Table 3. USGS Gaging Stations

Stream	USGS Gage No.	Location	Drainage Area, sq mi	Period of Record
Shell Creek	06278300	Above Shell Reservoir	23.1	1956-1992
Shell Creek	06278500	near Shell WY	145	1940-1992
Shell Creek	06279000	at Shell WY	256	1914-1924

All hydrologic data was obtained through Hydrodata, USGS Daily and Peak Values (CD-ROM, from Hydrosphere Data Products, Inc., Boulder, CO.) The first gage (06278300) is far upstream from the segment of interest and was not used in this study, but gages 06278500 and 06279000 could be used in the analysis. Streamflow data for these two gaging stations are contained in Appendices D and E, respectively.

A study was done in 1986 of the operating conditions for the proposed expansion of Lake Adelaide. This study was performed by ESA Consultants of Fort Collins, CO., for the Wyoming Water Development Commission, and the results of that work were made available to JFCo for use in this study. The Adelaide expansion was placed in service in 1986. The Adelaide study made use of the WIRSOS modeling program to perform operating studies of the stream and reservoir system, so the effect of water rights withdrawals and return flows were included along with historic streamflow data from the gaging stations. The study reported results for the years 1943 through 1982.

The Adelaide study used several analysis nodes in the Shell Creek stream system, and synthesized flow data was reported for each node. A list of the node locations is shown below, and the relationship of these nodes to the USGS gaging stations is shown in Figure 2.

Table 4. Analysis nodes used in the Lake Adelaide study

Node	Location	Drainage area sq mi
030000	Confluence of Shell and Adelaide Creeks	30.5
040000	Shell Canyon inflows	142
050000	Shell Creek gaging station near Shell	145

Node 030000 is located at the top of Shell Creek Instream Flow Segment 1. Node 040000 is located approximately 1 mile above the bottom of Instream Flow Segment 2. Node 050000 is located at the Shell Creek gaging station near Shell.

The historic flow records for the USGS gaging stations and the WIRSOS output for the nodes shown above are contained in Appendices D, E and F.

IV. Hydrology

A. General

The objective of the hydrologic analysis is to develop streamflow data to use in determining if the instream flow request can be met from unappropriated flows on a monthly basis. The downstream end of the segment was selected by the Wyoming Game and Fish Department as the point of measurement. A schematic diagram illustrating the relative locations of the gaging stations, tributaries and the proposed instream flow segment is shown on Figure 2. Exhibit 1 shows a detailed map of the area.

Natural streamflows are modified by withdrawals for water uses and return flows from these water uses. These water rights were discussed in Section II. In the case of Shell Creek, actual streamflows are also affected by the operation of two upstream reservoirs -- Shell Reservoir and Lake Adelaide. During expansion analysis of Lake Adelaide in the 1980s, a study was performed using extensive modeling of the stream system with the Wyoming Integrated River System Operations Study (WIRSOS) computer model. This model uses information about hydrology and water rights, coupled with reservoir operations, to predict downstream flows at various selected points. This information is similar to the information needed to perform the evaluation of instream flow requests.

B. Using the Lake Adelaide Study data

Because of the extensive hydrologic analyses already completed on Shell Creek during the Adelaide study, the information was incorporated into this Instream Flow Study. Discussions with WWDC and the State Engineer's Office staff indicated that, of the five scenarios studied in the Adelaide work, Case 3 most closely represents the conditions developed for the Lake Adelaide system. Case 3 assumes Lake Adelaide being enlarged to a capacity of 4500 acre-feet, and that a minimum instream flow of 1.6 cfs or the natural streamflow (whichever is smaller) was passed through Lake Adelaide.

Two analysis runs from the WIRSOS output apply to the current study; the results reported in Tape 8 model the system using natural flows without the inclusion of water rights withdrawals and return flows, and Tape 9 results model the same system with the inclusion of water rights withdrawals and return flows. Tape 9 results would most closely model current conditions, while Tape 8 would most closely correspond to computed hydrologic results. An evaluation of the Adelaide results was done to validate their use in this study. This evaluation was done in several steps, as follows:

- Compare Tape 8 (natural) flows with those predicted by the computed hydrology reported below.

- Compare Tape 9 flows (diversions included) with those reported for the USGS gages.

- Compare the differences between Tape 8 and Tape 9 results with the water right withdrawal and return flow analysis results reported in Section II, A.

C. Determination of Natural Flows

Regression equation techniques were applied to generate estimated monthly streamflow data at several points in the basin, using the approach described by "Streamflows in Wyoming", USGS, Water Resources Investigation Report 88-4405, (Lowham, 1988). These equations were based on gaged streams and may be applied to ungaged streams. The equations can be used with either area-elevation data or altitude-runoff data.

Total drainage area for Segment 1 was determined to be 93.3 square miles from topographic AutoCAD mapping produced in this study (Exhibit 1). The total drainage area for Segment 2 was determined to be 142.1 square miles.

The following regression equation was used (Mountainous region, average elevation determined by at least 26 equally spaced intersecting points within the drainage area):

Qa = average annual stream flow (cfs)
Elev = average basin elevation (ft)
A = drainage basin area (square miles)

$$Qa = 0.0015\ A^{1.01}(Elev/1000)^{2.88}$$

Table 5. Computed average annual streamflows based on Lowham, 1988.

Node/Analysis Point	Average Basin Elev (ft)	Drainage Basin Area A (square mile)	Computed average annual flow, Q cfs
030000	10419	30.8	41
Shell Falls (bottom of Segment 1)	8955	93.3	81
040000	8645	140.7	111
Bottom of Segment 2	8645	142.1	112
050000	8645	144.7	114

D. Comparison of computed natural streamflows with Lake Adelaide study data

Comparing the computed average annual discharge for several nodes with those generated in the Lake Adelaide study - Tape 8 (natural flows) shows that the WIRSOS natural flows varied from 6 to 16 percent of the regression analysis' natural flows. The comparison data is shown in Table 6 below.

Table 6. Comparison of computed average annual streamflows with Lake Adelaide study results

Node/Analysis Point	Computed average annual flow, cfs	Lake Adelaide study flow-Tape 8, cfs
030000	41	44
Shell Falls (bottom of Segment #1)	81	
040000	111	83
Bottom of Segment #2	112	
050000	114	125

The value of the mean of annual flows at node 50000 is 123, the standard deviation of the population is 22, and the standard error of the mean is 3. The average annual flow computed by the Lowham method is 114; since this is outside the standard error of the mean it means that the difference cannot be attributed to chance. The computed value is well within one standard deviation, which indicates a goodness of fit. This means that the WIRSOS model Tape 8 data is acceptable as a baseline natural flow for the instream flow segment analysis and should be acceptable to use as a database for this study.

E. Comparison of Lake Adelaide Tape 9 flows with USGS gaged flows

The location of the gage near Shell (gage 06278500) corresponds with node 050000 in the Lake Adelaide study, so a direct comparison can be made between the gage and the WIRSOS data at that point. A sampling of data from the two is shown in Table 7 below. The full dataset is shown in Appendix F.

Table 7. Comparison of Lake Adelaide study flows (Tape 9) with USGS gaged flows

Random Sample Month, Year	Lake Adelaide study flow, cfs	USGS gaged flow, cfs
June, 1950	572	363
October, 1963	56	47
August, 1976	110	79
January, 1943	39	35
May, 1955	330	394
May, 1964	238	131
October, 1971	50	60
December, 1968	49	60
August, 1945	96	86
July, 1949	151	173
September, 1957	67	7
February, 1944	36	37

The months with larger differences seem to fall during the summer irrigation period and may be explained by the irrigators using less or more than what was assumed in the Lake Adelaide Study. Winter month data seems consistent between the two. Also, the Lake Adelaide WIRSOS data for all years is adjusted for the Lake Adelaide enlargement that took place in 1986 but the gage data would not reflect the enlargement of the lake until 1986.

F. Comparing Tape 8 and Tape 9 differences with adjudicated water rights

The difference between the WIRSOS model runs output to Tape 8 and Tape 9 are the exclusion of water withdrawal and return flow considerations in Tape 8 and their inclusion in Tape 9. The difference should be fairly represented by the expected withdrawals described in Section II, A. A comparison is shown in Table 8 below.

Table 8. Comparison of Lake Adelaide study flows with withdraws and return flows

Month, Year	Lake Adelaide study flow, cfs			Difference of withdrawals and return flow, cfs*
	Tape 9	Tape 8	Difference	
June, 1950	572	400	172	20
October, 1963	56	47	9	0.1
August, 1976	110	71	39	8
January, 1943	39	39	0	0
May, 1955	290	415	-125	20
May, 1964	238	145	93	20
October, 1971	50	61	-11	0
December, 1968	49	61	-12	0
August, 1945	96	78	18	8
July, 1949	151	169	-18	20
September, 1957	67	70	-3	8
February, 1944	36	36	0	0

*based on adjudicated water rights of Section II, A.

This comparison shows that the calculated differences are comparable to the diversions discussed in Section II, A. This was proven through the comparison of the data generated by the Lake Adelaide Study (Tapes 8 and Tapes 9) to gage data and the estimated virgin flows using Lowham's (1988) method (Section IV, C through G). The Adelaide study data, through statistical means, proved to be within acceptable statistical variance from the data obtained from the gage. The only large variances between the study data and the gaged or calculated data appear in the high flow months of May through July and are probably due to differences in irrigation and reservoir operation.

G. Streamflow regime selected and adjusted

The results of the analyses and comparisons of Tape 8 and Tape 9 indicate that the Lake Adelaide study data adequately represent the situation in Shell Creek. This was proven by comparing the study data to flows generated by Lowham and gaged flows. The differences between the study data and the data generated or measured by other means proved not to be statistically different. Therefore, the WIRSOS data was shown to be an accurate representation of the streamflow regime and can be used for the Instream Flow analysis.

H. Translating node data

The spatial relationships of various gages, Lake Adelaide study nodes, and the instream flow segments are shown in Figure 2. Node 030000 is the upstream end of Segment 1, and Node 040000 is downstream from the downstream end of Segment 1. Node 050000 is downstream of Segment 2 (see Exhibit 1). Since the instream flow is to be evaluated at the downstream ends of the segments, a data set was synthesized for those locations.

Synthetic average annual flows for Nodes 030000 and 040000 and the downstream instream flow point were computed using the streamflow method described in Section II. These flows are shown in Table 9.

Table 9. Regression analysis-computed flows

Node/Analysis Point	Computed mean flow, cfs (1)	Adjustment factor (2)
030000	41	
Shell Falls (bottom of Segment #1)	81	0.711
040000	111	
Bottom of Segment #2	112	0.982
050000	114	

Notes:

(1) Computed using methods in "Streamflows in Wyoming", USGS, Water Resources Investigation Report 88-4405," (Lowham, 1988).

(2) Ratio of computed flow to flow at node 050000. i.e. Adj Fac.=81/114

The adjustment factor shown in Table 9 was used to multiply the data in the table of flows for Node 050000 to synthesize a dataset at the downstream end of Segments 1 and 2.

I. Monthly streamflow data

The adjustments described above were applied to the data shown in Appendix F to arrive at the streamflow data for this study. These results are shown in Tables 10 and 11. The remainder of the analyses will use the data in these tables.

Gage data for the station Near Shell (06278500) exists from the years 1940 through 1990. However the WIRSOS model Tape 8 and Tape 9 data exists only through the year 1982. Therefore, data for these years was derived from gage data. A known dry year occurred in 1985, so there was concern that this might be a critical year for analysis. For this reason, the Lake Adelaide data was extended from 1970 to 1990 using an estimating technique. In addition, the Near Shell gage data does not include the months of October through March since 1971, so the data extension process also included the missing months.

After synthesizing the data for the segments through the 1980s, the synthetic data did not appear in any of the extremes (driest or wettest years). This study, therefore, chose to use only the real data (years 1940 through 1970) and did not incorporate any of the synthesized data (years 1971 through 1990) into the following analysis. The synthetic data is shown for informational purposes only.

Table 10

Monthly Flows | **Shell Creek, Bottom of Segment 1** | Adjusted from Node 050000

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Ave. Annual Flow, cfs	Annual Discharge, ac-ft
1943	36	33	31	28	27	27	49	147	496	148	53	50	94	67,746
1944	36	33	27	25	25	24	27	270	477	155	53	54	100	72,774
1945	40	35	28	27	26	25	25	164	453	216	68	75	99	71,370
1946	51	40	35	30	30	34	99	219	455	109	55	70	102	73,967
1947	58	46	38	32	32	29	33	274	408	177	64	60	104	75,670
1948	48	44	40	35	31	29	32	289	245	108	54	38	83	60,057
1949	35	33	30	27	24	24	38	280	360	108	46	46	88	63,540
1950	36	31	27	25	24	22	32	118	406	120	62	54	80	57,651
1951	49	37	29	24	23	23	28	252	284	142	75	50	85	61,605
1952	40	33	29	28	26	24	65	276	296	108	62	42	86	62,278
1953	33	29	27	27	26	26	25	86	511	108	57	43	83	60,008
1954	32	31	30	27	26	24	30	234	220	108	43	30	69	50,484
1955	26	23	24	21	22	24	27	206	405	108	49	35	81	58,531
1956	31	30	28	26	29	28	31	292	282	108	40	32	80	57,869
1957	27	26	25	22	22	22	24	116	154	108	59	47	54	39,488
1958	36	31	28	25	24	24	24	322	183	108	67	49	77	55,896
1959	32	30	28	25	23	23	27	82	417	108	63	51	76	54,679
1960	38	29	27	23	24	21	31	130	208	99	49	35	60	43,169
1961	34	24	23	21	19	18	21	211	178	81	43	36	59	42,971
1962	39	35	30	24	24	23	66	228	404	120	55	50	92	66,301
1963	40	37	31	25	25	24	28	226	505	108	55	42	95	68,999
1964	34	32	27	25	25	24	24	169	556	207	70	63	105	75,807
1965	48	36	34	30	27	25	31	101	688	187	70	66	112	80,827
1966	49	35	31	27	26	26	26	218	125	93	36	27	60	43,633
1967	32	26	25	20	20	23	25	156	580	205	56	65	103	74,286
1968	58	44	35	30	28	26	27	91	746	155	91	99	119	85,933
1969	68	55	43	33	30	30	66	346	202	149	63	51	95	68,867
1970	45	29	32	28	27	25	26	174	526	123	64	53	96	69,870
1971	36	31	29	28	26	26	29	214	486	108	73	50	94	68,358
1972	43	30	27	24	23	30	33	188	489	121	83	64	96	69,696
1973	40	36	33	28	28	29	30	245	462	108	61	55	96	69,775
1974	41	36	33	28	28	27	39	209	483	111	74	61	98	70,602
1975	39	35	31	27	27	26	26	68	541	354	77	69	110	79,605
1976	44	39	36	31	30	29	33	220	505	135	78	61	103	74,912
1977	42	37	33	29	28	27	52	242	223	108	51	39	76	55,121
1978	34	30	27	24	23	22	31	157	553	247	89	80	110	79,543
1979	46	40	36	32	31	30	39	269	349	122	106	85	99	71,566
1980	39	34	31	27	26	26	40	227	281	108	61	53	79	57,575
1981	38	34	30	26	26	25	51	245	315	108	64	46	84	60,943
1982	39	35	31	27	27	26	24	138	443	183	57	66	91	66,134
1983	*68*	*55*	*43*	*33*	*30*	*30*	*66*	*346*	*202*	*149*	*63*	*51*	*95*	*68,557*
1984	*45*	*29*	*32*	*28*	*27*	*25*	*26*	*174*	*526*	*123*	*64*	*53*	*96*	*41,617*
1985	*36*	*31*	*29*	*28*	*26*	*26*	*29*	*214*	*486*	*108*	*73*	*50*	*94*	*71,623*
1986	*43*	*30*	*27*	*24*	*23*	*30*	*33*	*188*	*489*	*121*	*83*	*64*	*96*	*47,059*
1987	*40*	*36*	*33*	*28*	*28*	*29*	*30*	*245*	*462*	*108*	*61*	*55*	*96*	*59,860*
1988	*41*	*36*	*33*	*28*	*28*	*27*	*39*	*209*	*483*	*111*	*74*	*61*	*98*	*46,474*
1989	*39*	*35*	*31*	*27*	*27*	*26*	*26*	*68*	*541*	*354*	*77*	*69*	*110*	*66,802*
1990	*44*	*39*	*36*	*31*	*30*	*29*	*33*	*220*	*505*	*135*	*78*	*61*	*103*	*60,375*
Synthetic Mean	41	34	31	27	26	26	35	203	408	139	64	54	91	63,551
Max	68	55	43	35	32	34	99	346	746	354	106	99	119	85,933
Min	26	23	23	20	19	18	21	68	125	81	36	27	54	39,488
USFS	11.5	7.0	7.0	10.5	7.5	9.8	10.9	92.7	126.4	11.5	11.5	10.9		
ISF	19.0	19.0	19.0	19.0	19.0	19.0	70.0	70.0	70.0	40.0	40.0	40.0		
Diff 1	22.0	15.4	11.9	8.1	7.2	6.9	-34.7	133.4	338.3	99.4	23.8	14.3		
Diff 2	10.5	8.4	4.9	-2.4	-0.3	-2.9	-45.6	40.7	211.9	87.9	12.3	3.4		
Diff 3	7.1	4.0	4.2	1.3	0.2	-0.5	-49.3	-2.3	55.3	41.1	-3.9	-12.7		
Diff 4	-4.4	-3.0	-2.8	-9.2	-7.3	-10.3	-60.2	-95.0	-71.1	29.6	-15.4	-23.6		

Table 10

Monthly Flows | **Shell Creek, Bottom of Segment 1** | Adjusted from Node 050000

Ranked by Annual Flow

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Ave. Annual Flow, cfs	Annual Discharge, ac-ft
1957	27	26	25	22	22	22	24	116	154	108	59	47	54	39,488
1961	34	24	23	21	19	18	21	211	178	81	43	36	59	42,971
1960	38	29	27	23	24	21	31	130	208	99	49	35	60	43,169
1966	49	35	31	27	26	26	26	218	125	93	36	27	60	43,633
1954	32	31	30	27	26	24	30	234	220	108	43	30	69	50,484
1959	32	30	28	25	23	23	27	82	417	108	63	51	76	54,679
1977	42	37	33	29	28	27	52	242	223	108	51	39	76	55,121
1958	36	31	28	25	24	24	24	322	183	108	67	49	77	55,896
1980	39	34	31	27	26	26	40	227	281	108	61	53	79	57,575
1956	31	30	28	26	29	28	31	292	282	108	40	32	80	57,869
1950	36	31	27	25	24	22	32	118	406	120	62	54	80	57,651
1955	26	23	24	21	22	24	27	206	405	108	49	35	81	58,531
1948	48	44	40	35	31	29	32	289	245	108	54	38	83	60,057
1953	33	29	27	27	26	26	25	86	511	108	57	43	83	60,008
1981	38	34	30	26	26	25	51	245	315	108	64	46	84	60,943
1951	49	37	29	24	23	23	28	252	284	142	75	50	85	61,605
1952	40	33	29	28	26	24	65	276	296	108	62	42	86	62,278
1949	35	33	30	27	24	24	38	280	360	108	46	46	88	63,540
1982	39	35	31	27	27	26	24	138	443	183	57	66	91	66,134
1962	39	35	30	24	24	23	66	228	404	120	55	50	92	66,301
1943	36	33	31	28	27	27	49	147	496	148	53	50	94	67,746
1971	36	31	29	28	26	26	29	214	486	108	73	50	94	68,358
1985	*36*	*31*	*29*	*28*	*26*	*26*	*29*	*214*	*486*	*108*	*73*	*50*	*94*	*71,623*
1969	68	55	43	33	30	30	66	346	202	149	63	51	95	68,867
1983	*68*	*55*	*43*	*33*	*30*	*30*	*66*	*346*	*202*	*149*	*63*	*51*	*95*	*68,557*
1963	40	37	31	25	25	24	28	226	505	108	55	42	95	68,999
1970	45	29	32	28	27	25	26	174	526	123	64	53	96	69,870
1984	*45*	*29*	*32*	*28*	*27*	*25*	*26*	*174*	*526*	*123*	*64*	*53*	*96*	*41,617*
1972	43	30	27	24	23	30	33	188	489	121	83	64	96	69,696
1986	*43*	*30*	*27*	*24*	*23*	*30*	*33*	*188*	*489*	*121*	*83*	*64*	*96*	*47,059*
1973	40	36	33	28	28	29	30	245	462	108	61	55	96	69,775
1987	*40*	*36*	*33*	*28*	*28*	*29*	*30*	*245*	*462*	*108*	*61*	*55*	*96*	*59,860*
1974	41	36	33	28	28	27	39	209	483	111	74	61	98	70,602
1988	*41*	*36*	*33*	*28*	*28*	*27*	*39*	*209*	*483*	*111*	*74*	*61*	*98*	*46,474*
1945	40	35	28	27	26	25	25	164	453	216	68	75	99	71,370
1979	46	40	36	32	31	30	39	269	349	122	106	85	99	71,566
1944	36	33	27	25	25	24	27	270	477	155	53	54	100	72,774
1946	51	40	35	30	30	34	99	219	455	109	55	70	102	73,967
1967	32	26	25	20	20	23	25	156	580	205	56	65	103	74,286
1976	44	39	36	31	30	29	33	220	505	135	78	61	103	74,912
1990	*44*	*39*	*36*	*31*	*30*	*29*	*33*	*220*	*505*	*135*	*78*	*61*	*103*	*60,375*
1947	58	46	38	32	32	29	33	274	408	177	64	60	104	75,670
1964	34	32	27	25	25	24	24	169	556	207	70	63	105	75,807
1978	34	30	27	24	23	22	31	157	553	247	89	80	110	79,543
1975	39	35	31	27	27	26	26	68	541	354	77	69	110	79,605
1989	*39*	*35*	*31*	*27*	*27*	*26*	*26*	*68*	*541*	*354*	*77*	*69*	*110*	*66,802*
1965	48	36	34	30	27	25	31	101	688	187	70	66	112	80,827
1968	58	44	35	30	28	26	27	91	746	155	91	99	119	85,933
Synthetic Mean	41	34	31	27	26	26	35	203	408	139	64	54	91	63,551
Max	68	55	43	35	32	34	99	346	746	354	106	99	119	85,933
Min	26	23	23	20	19	18	21	68	125	81	36	27	54	39,488
USFS	11.5	7.0	7.0	10.5	7.5	9.8	10.9	92.7	126.4	11.5	11.5	10.9		
ISF	19.0	19.0	19.0	19.0	19.0	19.0	70.0	70.0	70.0	40.0	40.0	40.0		
Diff 1	22.0	15.4	11.9	8.1	7.2	6.9	-34.7	133.4	338.3	99.4	23.8	14.3		
Diff 2	10.5	8.4	4.9	-2.4	-0.3	-2.9	-45.6	40.7	211.9	87.9	12.3	3.4		
Diff 3	7.1	4.0	4.2	1.3	0.2	-0.5	-49.3	-2.3	55.3	41.1	-3.9	-12.7		
Diff 4	-4.4	-3.0	-2.8	-9.2	-7.3	-10.3	-60.2	-95.0	-71.1	29.6	-15.4	-23.6		

Table 11

Monthly Flows **Shell Creek, Bottom of Segment #2** Adjusted from Node 050000

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Average Annual Flow, cfs	Annual Discharge, ac-ft
1943	50	46	43	38	37	37	68	203	686	204	73	69	130	93,673
1944	50	45	37	35	35	34	37	373	659	214	74	74	139	100,626
1945	55	48	39	38	36	34	35	227	626	299	94	103	136	98,684
1946	70	55	49	42	42	47	136	302	629	151	77	96	141	102,275
1947	80	64	53	45	44	40	46	379	564	245	88	83	144	104,630
1948	67	60	55	48	43	40	44	400	339	149	74	53	114	83,042
1949	49	45	42	37	33	33	53	387	498	149	63	64	121	87,857
1950	50	44	37	34	33	31	44	163	562	166	85	74	110	79,715
1951	68	51	41	33	32	32	39	349	393	197	103	69	117	85,182
1952	55	46	41	38	36	33	90	382	410	150	85	58	119	86,112
1953	46	40	37	38	36	36	35	119	706	149	79	59	115	82,974
1954	44	42	42	38	35	33	41	324	304	149	59	42	96	69,804
1955	36	32	33	29	31	33	38	285	560	149	68	49	112	80,932
1956	43	41	39	37	40	38	43	403	391	149	55	44	110	80,016
1957	37	37	34	30	30	31	34	161	213	150	81	66	75	54,600
1958	50	43	39	34	33	34	33	445	252	149	92	68	106	77,288
1959	45	41	38	35	32	32	37	113	577	149	87	70	105	75,606
1960	52	40	38	32	33	29	43	180	288	137	68	48	82	59,691
1961	46	34	32	28	27	26	29	291	246	112	60	50	82	59,416
1962	54	49	41	33	33	32	91	315	559	166	77	70	127	91,675
1963	55	51	43	35	35	33	39	312	698	149	76	58	132	95,406
1964	46	44	37	35	34	33	34	234	769	287	97	87	145	104,819
1965	67	49	46	41	37	35	43	140	951	259	96	92	155	111,761
1966	68	48	42	38	35	36	36	301	173	128	50	38	83	60,333
1967	44	36	34	28	28	32	34	216	801	283	77	90	142	102,717
1968	81	60	48	41	39	36	37	126	1,031	215	126	137	165	118,821
1969	94	76	60	46	41	41	91	478	280	205	87	70	131	95,224
1970	62	40	44	39	38	35	36	241	728	170	88	73	133	96,611
1971	49	42	41	38	36	35	40	295	672	149	101	69	131	94,519
1972	60	41	37	33	32	42	46	259	677	167	115	89	133	96,370
1973	55	50	46	39	38	41	42	339	639	149	84	77	133	96,479
1974	57	50	45	39	38	37	54	290	668	154	102	84	135	97,623
1975	54	48	43	38	37	36	36	94	748	490	106	95	152	110,071
1976	61	54	49	43	42	41	45	304	698	187	108	85	143	103,581
1977	58	51	46	40	39	38	71	334	308	149	70	54	105	76,216
1978	48	42	38	33	32	31	43	217	765	342	122	111	152	109,986
1979	63	56	50	44	42	41	53	372	483	168	146	117	136	98,955
1980	54	48	43	37	36	35	55	314	388	149	84	74	110	79,609
1981	53	47	42	36	36	34	71	339	436	149	88	64	116	84,267
1982	54	48	43	38	37	36	33	190	613	254	79	91	126	91,445
1983	*94*	*76*	*60*	*46*	*41*	*41*	*91*	*478*	*280*	*205*	*87*	*70*	*131*	*94,794*
1984	*62*	*40*	*44*	*39*	*38*	*35*	*36*	*241*	*728*	*170*	*88*	*73*	*133*	*57,545*
1985	*49*	*42*	*41*	*38*	*36*	*35*	*40*	*295*	*672*	*149*	*101*	*69*	*131*	*99,035*
1986	*60*	*41*	*37*	*33*	*32*	*42*	*46*	*259*	*677*	*167*	*115*	*89*	*133*	*65,069*
1987	*55*	*50*	*46*	*39*	*38*	*41*	*42*	*339*	*639*	*149*	*84*	*77*	*133*	*82,769*
1988	*57*	*50*	*45*	*39*	*38*	*37*	*54*	*290*	*668*	*154*	*102*	*84*	*135*	*64,261*
1989	*54*	*48*	*43*	*38*	*37*	*36*	*36*	*94*	*748*	*490*	*106*	*95*	*152*	*92,369*
1990	*61*	*54*	*49*	*43*	*42*	*41*	*45*	*304*	*698*	*187*	*108*	*85*	*143*	*83,481*
Synthetic Mean	57	48	43	37	36	36	49	281	564	193	88	75	126	76,216
Max	94	76	60	48	44	47	136	478	1,031	490	146	137	232	109,986
Min	36	32	32	28	27	26	29	94	173	112	50	38	56	98,955
BHNF	11.5	7.0	7.0	10.5	7.5	9.8	10.9	92.7	126.4	11.5	11.5	10.9		
ISF	23	23	23	23	23	23	23	23	23	40	40	40		

Table 11

Monthly Flows | **Shell Creek, Bottom of Segment #2** | Adjusted from Node 050000

Ranked by Annual Flow

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Average Annual Flow, cfs	Annual Discharge, ac-ft
1957	37	37	34	30	30	31	34	161	213	150	81	66	75	54,600
1961	46	34	32	28	27	26	29	291	246	112	60	50	82	59,416
1960	52	40	38	32	33	29	43	180	288	137	68	48	82	59,691
1966	68	48	42	38	35	36	36	301	173	128	50	38	83	60,333
1954	44	42	42	38	35	33	41	324	304	149	59	42	96	69,804
1959	45	41	38	35	32	32	37	113	577	149	87	70	105	75,606
1977	58	51	46	40	39	38	71	334	308	149	70	54	105	76,216
1958	50	43	39	34	33	34	33	445	252	149	92	68	106	77,288
1980	54	48	43	37	36	35	55	314	388	149	84	74	110	79,609
1956	43	41	39	37	40	38	43	403	391	149	55	44	110	80,016
1950	50	44	37	34	33	31	44	163	562	166	85	74	110	79,715
1955	36	32	33	29	31	33	38	285	560	149	68	49	112	80,932
1948	67	60	55	48	43	40	44	400	339	149	74	53	114	83,042
1953	46	40	37	38	36	36	35	119	706	149	79	59	115	82,974
1981	53	47	42	36	36	34	71	339	436	149	88	64	116	84,267
1951	68	51	41	33	32	32	39	349	393	197	103	69	117	85,182
1952	55	46	41	38	36	33	90	382	410	150	85	58	119	86,112
1949	49	45	42	37	33	33	53	387	498	149	63	64	121	87,857
1982	54	48	43	38	37	36	33	190	613	254	79	91	126	91,445
1962	54	49	41	33	33	32	91	315	559	166	77	70	127	91,675
1943	50	46	43	38	37	37	68	203	686	204	73	69	130	93,673
1971	49	42	41	38	36	35	40	295	672	149	101	69	131	94,519
1985	*49*	*42*	*41*	*38*	*36*	*35*	*40*	*295*	*672*	*149*	*101*	*69*	*131*	*99,035*
1969	94	76	60	46	41	41	91	478	280	205	87	70	131	95,224
1983	*94*	*76*	*60*	*46*	*41*	*41*	*91*	*478*	*280*	*205*	*87*	*70*	*131*	*94,794*
1963	55	51	43	35	35	33	39	312	698	149	76	58	132	95,406
1970	62	40	44	39	38	35	36	241	728	170	88	73	133	96,611
1984	*62*	*40*	*44*	*39*	*38*	*35*	*36*	*241*	*728*	*170*	*88*	*73*	*133*	*57,545*
1972	60	41	37	33	32	42	46	259	677	167	115	89	133	96,370
1986	*60*	*41*	*37*	*33*	*32*	*42*	*46*	*259*	*677*	*167*	*115*	*89*	*133*	*65,069*
1973	55	50	46	39	38	41	42	339	639	149	84	77	133	96,479
1987	*55*	*50*	*46*	*39*	*38*	*41*	*42*	*339*	*639*	*149*	*84*	*77*	*133*	*82,769*
1974	57	50	45	39	38	37	54	290	668	154	102	84	135	97,623
1988	*57*	*50*	*45*	*39*	*38*	*37*	*54*	*290*	*668*	*154*	*102*	*84*	*135*	*64,261*
1945	55	48	39	38	36	34	35	227	626	299	94	103	136	98,684
1979	63	56	50	44	42	41	53	372	483	168	146	117	136	98,955
1944	50	45	37	35	35	34	37	373	659	214	74	74	139	100,626
1946	70	55	49	42	42	47	136	302	629	151	77	96	141	102,275
1967	44	36	34	28	28	32	34	216	801	283	77	90	142	102,717
1976	61	54	49	43	42	41	45	304	698	187	108	85	143	103,581
1990	*61*	*54*	*49*	*43*	*42*	*41*	*45*	*304*	*698*	*187*	*108*	*85*	*143*	*83,481*
1947	80	64	53	45	44	40	46	379	564	245	88	83	144	104,630
1964	46	44	37	35	34	33	34	234	769	287	97	87	145	104,819
1978	48	42	38	33	32	31	43	217	765	342	122	111	152	109,986
1975	54	48	43	38	37	36	36	94	748	490	106	95	152	110,071
1989	*54*	*48*	*43*	*38*	*37*	*36*	*36*	*94*	*748*	*490*	*106*	*95*	*152*	*92,369*
1965	67	49	46	41	37	35	43	140	951	259	96	92	155	111,761
1968	81	60	48	41	39	36	37	126	1,031	215	126	137	165	118,821
Synthetic Mean	57	48	43	37	36	36	49	281	564	193	88	75	126	76,216
Max	94	76	60	48	44	47	136	478	1,031	490	146	137	232	109,986
Min	36	32	32	28	27	26	29	94	173	112	50	38	56	98,955
BHNF	11.5	7.0	7.0	10.5	7.5	9.8	10.9	92.7	126.4	11.5	11.5	10.9		
ISF	23	23	23	23	23	23	23	23	23	40	40	40		

J. Daily streamflow data

The daily exceedance analysis used adjusted daily stream gage data from the Near Shell (0678500) gage. The instream flow segments' data was created by applying the adjustment factors shown in Table 9 to the daily gage data. Only the data from 1940 through 1970 was used since the datasets for each month had several data points and no synthetic data was needed (1971 through 1990).

SECTION 1
Analysis of Segment 1

V. Mean Monthly Flow Analysis-Segment 1

A comparison of the estimated total mean monthly flows (from Table 15) with the flows requested for Segment 1 by the Wyoming Game and Fish Department is shown at the foot of Table 12.

Table 12. Comparison of Mean Monthly Flow and Instream Flow Request, Shell Segment 1

Desc	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Mean	40.0	34.0	30.0	27.0	26.0	26 .0	35.0	202 .0	398.0	137 .0	62.0	54 .0
IFR-1	19.0	19.0	19.0	19.0	19.0	19.0	70.0	70.0	70.0	40.0	40.0	40.0
Diff	**21.0**	**15.0**	**11.0**	**8.0**	**17.0**	**17.0**	**-35.0**	**132.0**	**328.0**	**97.0**	**22.0**	**14.0**

The mean monthly flow values are for the period 1943 through 1982, and are synthesized from Lake Adelaide study results at Node 050000, adjusted to the bottom of the Instream Flow Segment 1. The row labeled IFR-1 refers to the Instream Flow Request for Segment 1 made by Wyoming Game and Fish Department, the focus of this study. The row labeled Diff shows the difference between the Wyoming Game and Fish Department Instream Flow Request and the mean monthly flow. The relationship between mean monthly flows and the requested amount is also shown in Figure 3.

Table 12 shows that, for all months except April, the Instream Flow Request can be met under mean monthly flow conditions.

The USFS has an Instream Flow Right in Shell Creek, as reported in Section II. Since this flow must pass through Segment 1, the water is available to satisfy the request of WGFD. Table 13 shows a similar comparison between the USFS right and WGFD request.

Table 13. Comparison of Instream Flow Request and USFS Instream Flow Right, Shell Segment 1

Desc	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
USFS	11.5	7.0	7.0	10.5	7.5	9.8	10.9	92.7	126.4	11.5	11.5	10.9
IFR-1	19.0	19.0	19.0	19.0	19.0	19.0	70.0	70.0	70.0	40.0	40.0	40.0
Diff	**-7.5**	**-12.0**	**-12.0**	**-8.5**	**-11.5**	**-9.2**	**-59.1**	**22.7**	**56.4**	**-28.5**	**-28.5**	**-29.1**

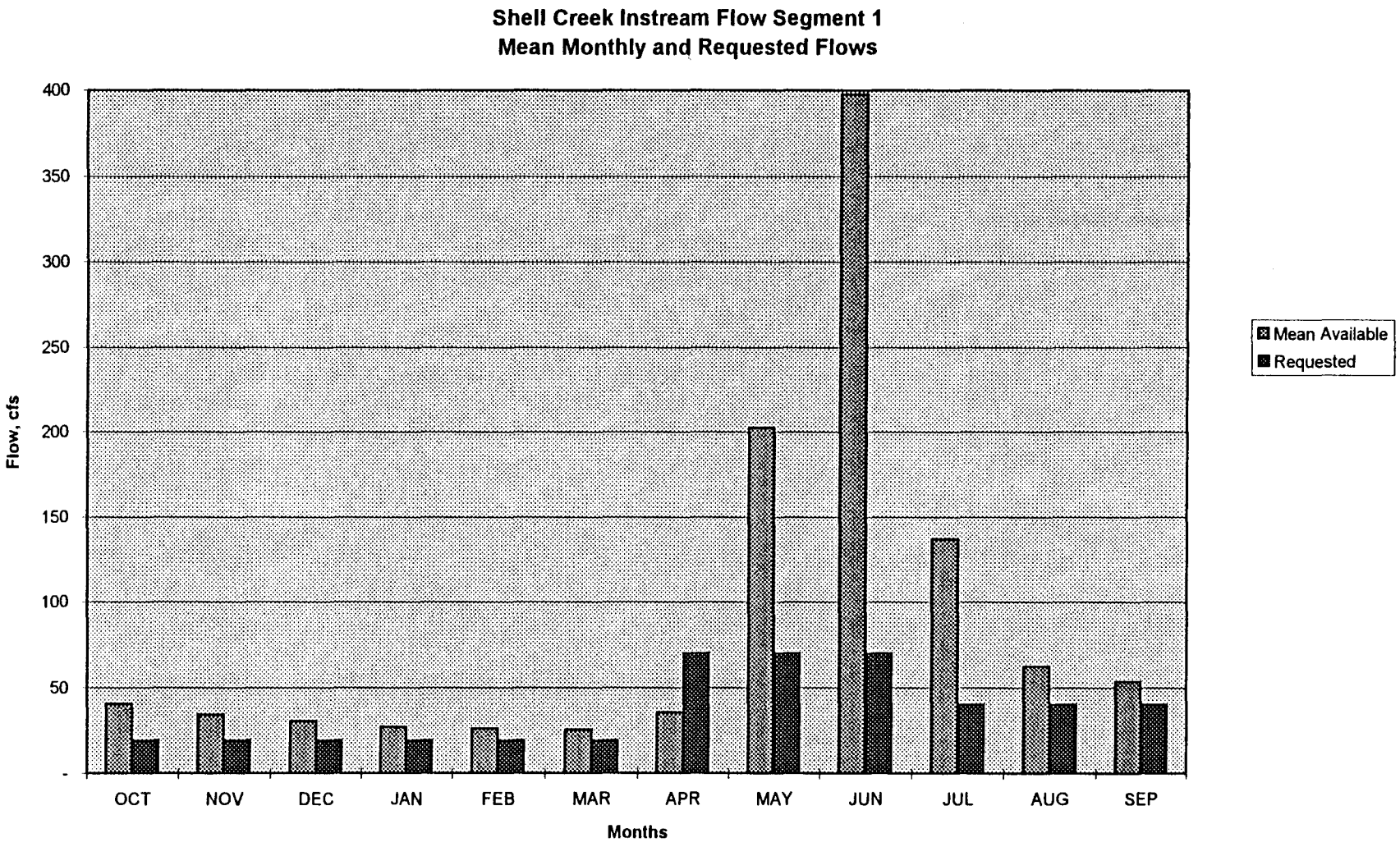
Shell Creek Instream Flow Segment 1
Mean Monthly and Requested Flows
400
350
300
250
200
150
100
50
-
Flow, cfs
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
Months
Mean Available
Requested

FIGURE 3

VI. Dry Year Flow Analysis-Segment 1

A dry year flow analysis was performed on the instream flow segment data to determine if the stream is capable of providing the instream flow requests during a dry year. The dry year total flow analysis was based on the driest year of record, 1957.

Table 14. Comparison of Dry Year Flow (1957) and Instream Flow Request, Shell Creek, Segment 1

Desc	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Average Annual Flow, cfs	Annual Discharge, (ac-ft)
Min	27.0	26.0	25.0	22.0	22.0	22.0	24.0	116.0	154.0	108.0	59.0	47.0	54	39488
IFR-1	19.0	19.0	19.0	19.0	19.0	19.0	70.0	70.0	70.0	40.0	40.0	40.0		
Diff	**8.0**	**7.0**	**6.0**	**3.0**	**3.0**	**3.0**	**-46.0**	**46.0**	**84.0**	**68.0**	**19.0**	**7.0**		

The row labeled IFR-1 refers to the Instream Flow Request made by Wyoming Game and Fish Department, the focus of this study. The row labeled Diff shows the difference between the Wyoming Game and Fish Department Instream Flow Request and the monthly dry year flow.

Table 15 shows the Segment 1 flows ranked in order of annual flow.

Figure 4 shows the relationship of driest period on record (October through March of 1961, April through June of 1957, and July through September of 1966) to the requested flows. The only deficit shown is in the month of April.

Figure 5 shows the relationship of the total flows of the driest year on record (1957) to the requested flows. The only deficit is in the month of April.

Figure 6 shows the relationship of the average of the driest three years on record (1957, 1961, 1962) to the requested flows. Once again, April is the only month to show a deficit.

TABLE 15

Monthly Flows | **Shell Creek, Bottom of Segment 1** | Adjusted from Node 050000

RANKED BY ANNUAL FLOW

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Average Annual Flow, cfs	Annual Discharge, ac-ft
1957	27	26	25	22	22	22	24	116	154	108	59	47	54	39,488
1961	34	24	23	21	19	18	21	211	178	81	43	36	59	42,971
1960	38	29	27	23	24	21	31	130	208	99	49	35	60	43,169
1966	49	35	31	27	26	26	26	218	125	93	36	27	60	43,633
1954	32	31	30	27	26	24	30	234	220	108	43	30	69	50,484
1959	32	30	28	25	23	23	27	82	417	108	63	51	76	54,679
1977	42	37	33	29	28	27	52	242	223	108	51	39	76	55,121
1958	36	31	28	25	24	24	24	322	183	108	67	49	77	55,896
1980	39	34	31	27	26	26	40	227	281	108	61	53	79	57,575
1956	31	30	28	26	29	28	31	292	282	108	40	32	80	57,869
1950	36	31	27	25	24	22	32	118	406	120	62	54	80	57,651
1955	26	23	24	21	22	24	27	206	405	108	49	35	81	58,531
1948	48	44	40	35	31	29	32	289	245	108	54	38	83	60,057
1953	33	29	27	27	26	26	25	86	511	108	57	43	83	60,008
1981	38	34	30	26	26	25	51	245	315	108	64	46	84	60,943
1951	49	37	29	24	23	23	28	252	284	142	75	50	85	61,605
1952	40	33	29	28	26	24	65	276	296	108	62	42	86	62,278
1949	35	33	30	27	24	24	38	280	360	108	46	46	88	63,540
1982	39	35	31	27	27	26	24	138	443	183	57	66	91	66,134
1962	39	35	30	24	24	23	66	228	404	120	55	50	92	66,301
1943	36	33	31	28	27	27	49	147	496	148	53	50	94	67,746
1971	36	31	29	28	26	26	29	214	486	108	73	50	94	68,358
1969	68	55	43	33	30	30	66	346	202	149	63	51	95	68,867
1963	40	37	31	25	25	24	28	226	505	108	55	42	95	68,999
1970	45	29	32	28	27	25	26	174	526	123	64	53	96	69,870
1972	43	30	27	24	23	30	33	188	489	121	83	64	96	69,696
1973	40	36	33	28	28	29	30	245	462	108	61	55	96	69,775
1974	41	36	33	28	28	27	39	209	483	111	74	61	98	70,602
1945	40	35	28	27	26	25	25	164	453	216	68	75	99	71,370
1979	46	40	36	32	31	30	39	269	349	122	106	85	99	71,566
1944	36	33	27	25	25	24	27	270	477	155	53	54	100	72,774
1946	51	40	35	30	30	34	99	219	455	109	55	70	102	73,967
1967	32	26	25	20	20	23	25	156	580	205	56	65	103	74,286
1976	44	39	36	31	30	29	33	220	505	135	78	61	103	74,912
1947	58	46	38	32	32	29	33	274	408	177	64	60	104	75,670
1964	34	32	27	25	25	24	24	169	556	207	70	63	105	75,807
1978	34	30	27	24	23	22	31	157	553	247	89	80	110	79,543
1975	39	35	31	27	27	26	26	68	541	354	77	69	110	79,605
1965	48	36	34	30	27	25	31	101	688	187	70	66	112	80,827
1968	58	44	35	30	28	26	27	91	746	155	91	99	119	85,933
Mean	40	34	30	27	26	26	35	202	398	137	62	54	89	64,703
Max	68	55	43	35	32	34	99	346	746	354	106	99	168	85,933
Min	26	23	23	20	19	18	21	68	125	81	36	27	41	39,488
USFS	11.5	7.0	7.0	10.5	7.5	9.8	10.9	92.7	126.4	11.5	11.5	10.9		
ISF	19.0	19.0	19.0	19.0	19.0	19.0	70.0	70.0	70.0	40.0	40.0	40.0		

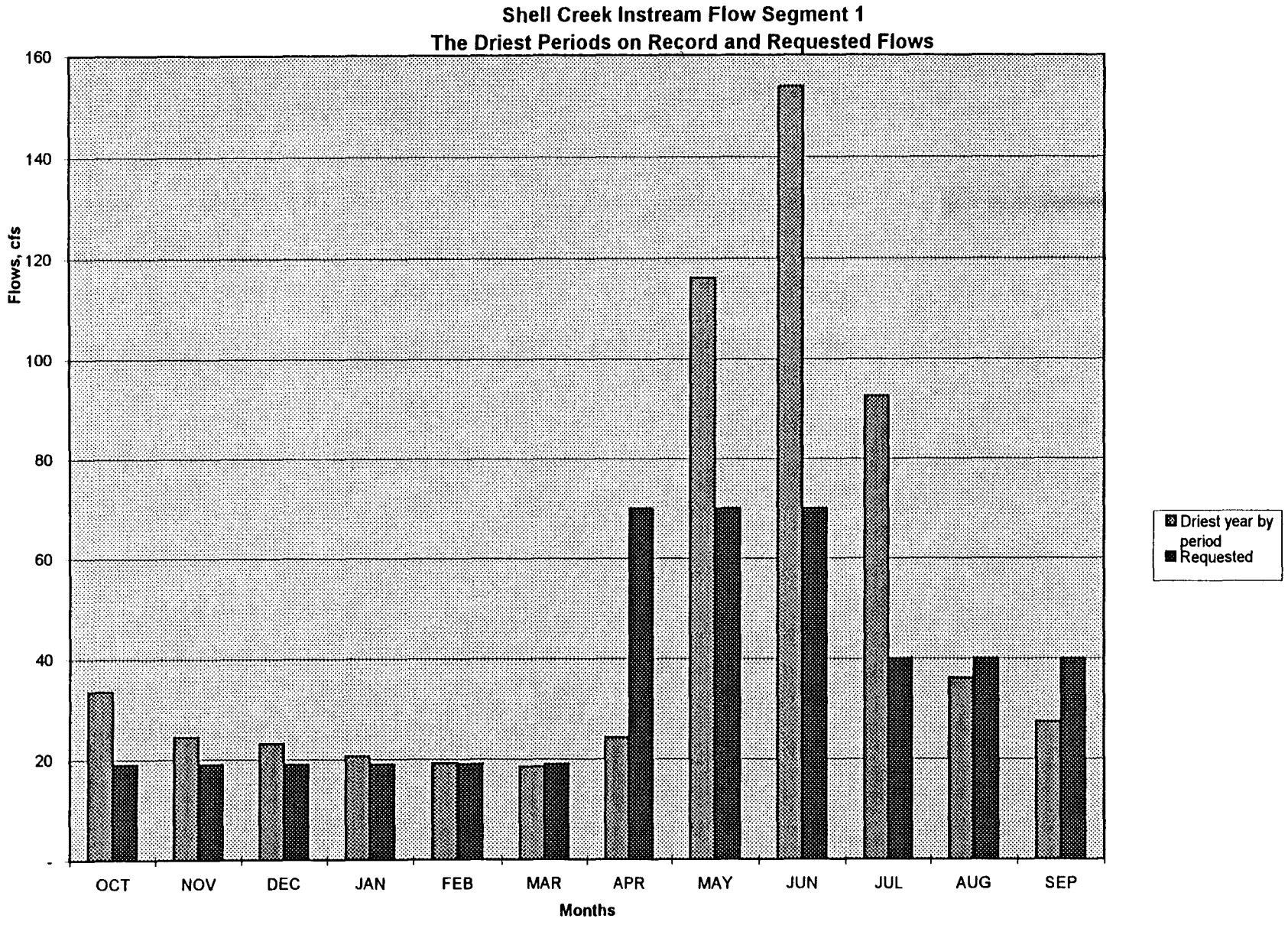
Shell Creek Instream Flow Segment 1
The Driest Periods on Record and Requested Flows
Flows, cfs
160
140
120
100
80
60
40
20
-
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
Months
Driest year by period
Requested

FIGURE 4

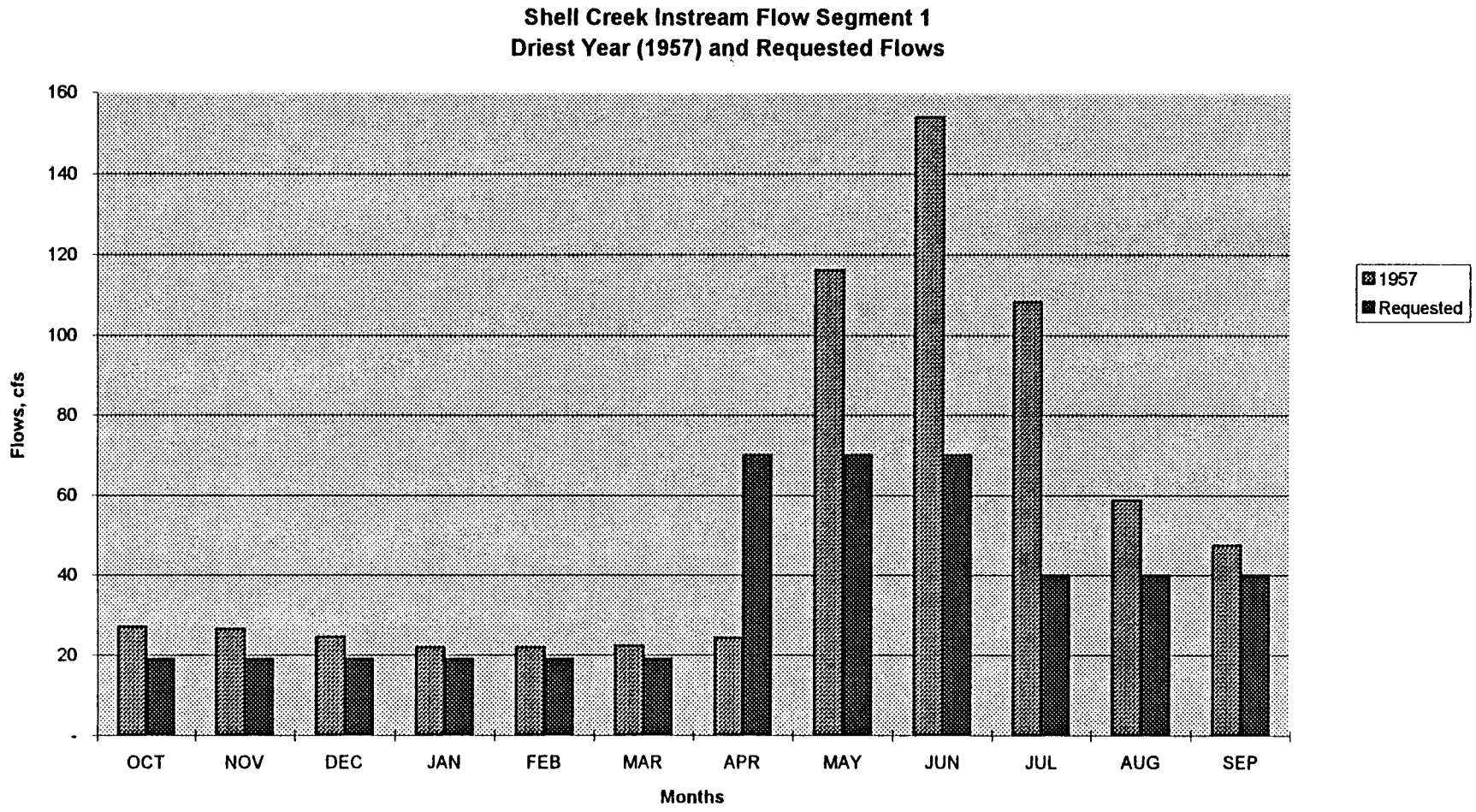
Shell Creek Instream Flow Segment 1
Driest Year (1957) and Requested Flows
Flows, cfs
160
140
120
100
80
60
40
20
-
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
Months
1957
Requested

FIGURE 5

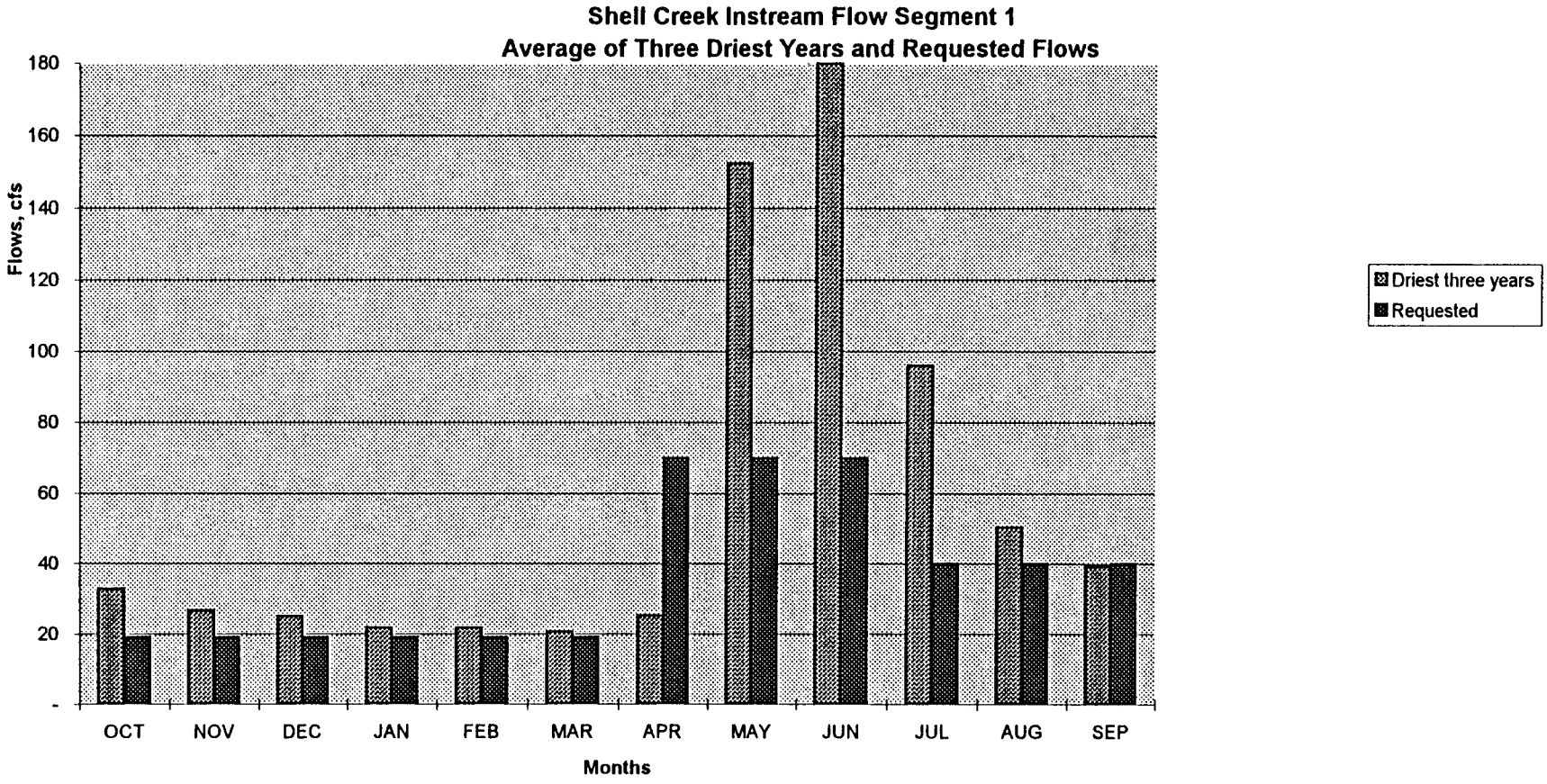
Shell Creek Instream Flow Segment 1
Average of Three Driest Years and Requested Flows
Flows, cfs
180
160
140
120
100
80
60
40
20
-
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
Months
Driest three years
Requested

FIGURE 6

VII. Reservoir Operation Study-Segment 1

Since the instream flow request cannot be met from available flows expected during April in Shell Creek at the downstream end of Segment 1, augmentation of flow storage was analyzed as required by statute 41-3-1004. In the case of Shell Creek two upstream reservoirs already exist, Shell Reservoir and Lake Adelaide, both are for irrigation purposes.

The shortfall occurs only in April. Sufficient flow occurs in the summer months during which the upstream reservoirs are most likely to be releasing flows to satisfy downstream irrigation demands. During the winter and spring, when downstream demands are lower, such reservoirs are operated to store runoff from snowmelt for summer use, but the instream flow demands can be met. To satisfy the instream flow demand in April, approximately 2800 acre-feet of storage would be required. Therefore, a reservoir with a capacity of 3000 acre-feet is proposed. It appears from other reports that Lake Adelaide is operated by opening the gates in May and closing them in September. Perhaps the gates could be opened partially during April to provide some of the additional flow needed. Total storage capacity of Lake Adelaide is 4675 acre-feet, and Shell Reservoir is 1948 acre-feet.

Table 16 below shows a rough estimate of the volume needed to be released in the shorted month to meet the instream flow request. The low flows are from the driest year on record, 1957.

Table 16. Rough Estimate of Reservoir Storage and Releases To Meet Instream Flow Request, Driest Year on Record, 1957 Shell Segment 1.

Desc	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Low Flows (cfs)	27	26	25	22	22	22	24	116	154	108	59	47
IFR (cfs)	19	19	19	19	19	19	70	70	70	40	40	40
Diff (cfs)	**8**	**7**	**6**	**3**	**3**	**3**	**-46**	**46**	**84**	**68**	**19**	**7**
Excess or Deficit (Ac-Ft)	**492**	**417**	**369**	**184**	**167**	**184**	**-2737**	**2828**	**4999**	**4181**	**1168**	**417**
Reservoir Operation (Ac-Ft) 1st Year	**492**	**909**	**1278**	**1462**	**1629**	**1813**	**-924**	**1904**	**3000**	**3000**	**3000**	**3000**
Reservoir Operation (Ac-Ft) Subsequent years	**3000**	**3000**	**3000**	**3000**	**3000**	**3000**	**263**	**3000**	**3000**	**3000**	**3000**	**3000**

VIII. Daily Flow Exceedance Analysis-Segment 1

A daily flow exceedance analysis was performed to determine the feasibility of maintaining the criteria established by the Wyoming Water Development Commission. The WWDC reviews instream flow hydrologic feasibility on a monthly basis. The WWDC also considers the instream flow request feasible if the requested flow is available 50% of the time during the month for each month of the year. Therefore, the exceedance analysis was performed for the year on a monthly basis.

The daily flow exceedance analysis was done by building a table of all daily flows for the period of record for the months in question, then ranking those flow values in descending order. For each month all data points were used.

Each value in each of the twelve sets was assigned an order index expressed as a percent, where the order was calculated by dividing the rank position by the total number of values and multiplying by 100. The daily flow exceedance curves for Shell Creek Instream Flow Segment 1 are shown in Figures 7 through 18, which were developed by plotting the flow values as ordinates and the order as abscissa values.

To use the daily flow exceedance curve, the chart is entered at the desired exceedance criterion -- 50% in this instance -- and the corresponding flow is read from the curve.

For Shell Creek Instream Flow Segment 1, the 50% exceedance values are summarized in Table 17. The requested instream flow values of 19 cfs (October through March), 70 cfs (April through June), and 40 cfs (July through September) are also shown in Figures 7 through 18.

Shell CK.

Table 17. Daily Flow Exceedance Summary - Segment 1

Period	Instream Flow Request (cfs)	% Exceedance of Requested Flow	Estimated 50% exceedance criteria (cfs)
October	19	97	38
November	19	95	35
December	19	97	32
January	19	96	27
February	19	95	27
March	19	94	26
April	70	7	30
May	70	72	175
June	70	99	350
July	40	98	125
August	40	96	70
September	40	80	55

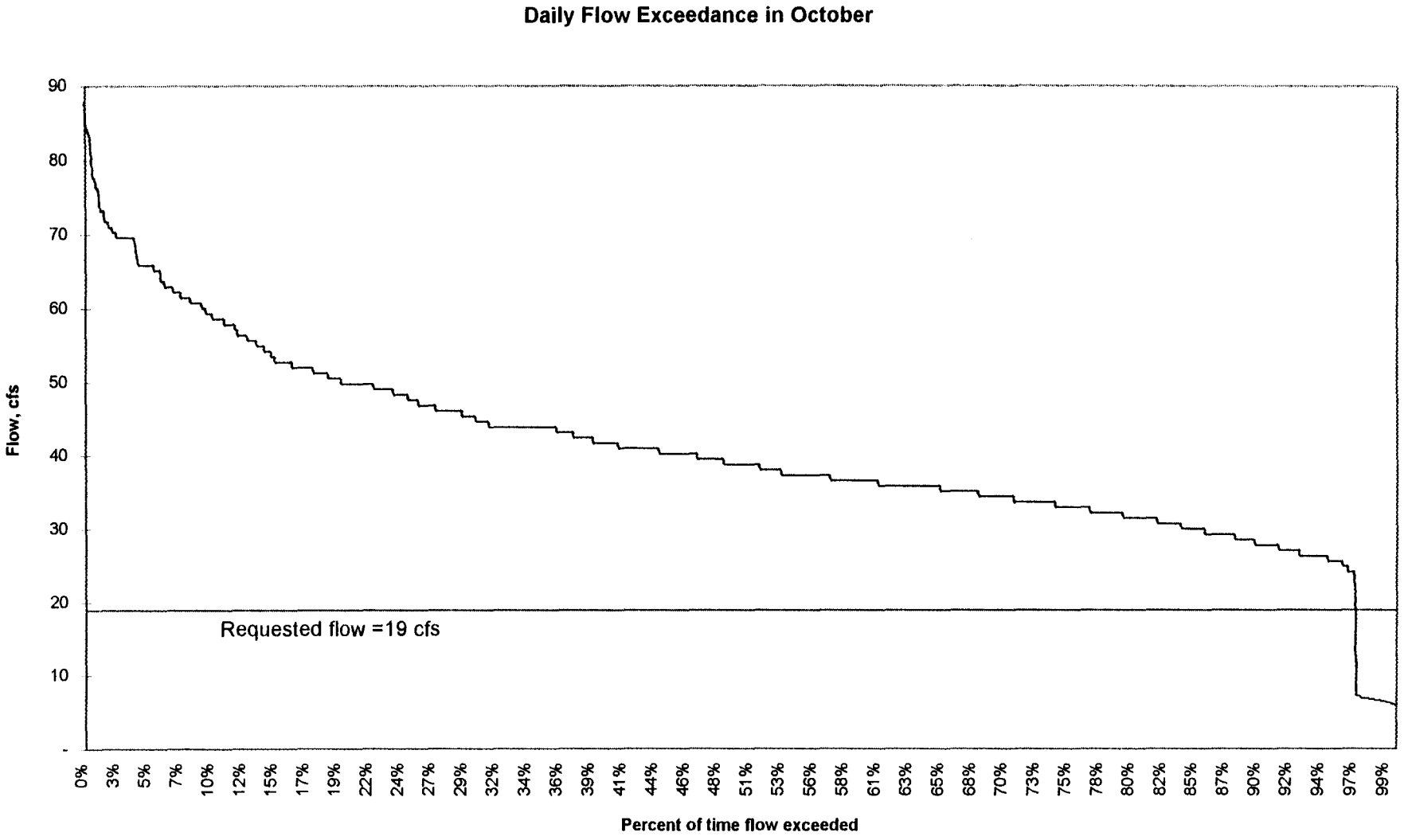
Daily Flow Exceedance in October
Flow, cfs
90
80
70
60
50
40
30
20
10
-
Requested flow =19 cfs
0%
3%
5%
7%
10%
12%
15%
17%
19%
22%
24%
27%
29%
32%
34%
36%
39%
41%
44%
46%
48%
51%
53%
56%
58%
61%
63%
65%
68%
70%
73%
75%
78%
80%
82%
85%
87%
90%
92%
94%
97%
99%
Percent of time flow exceeded

FIGURE 7

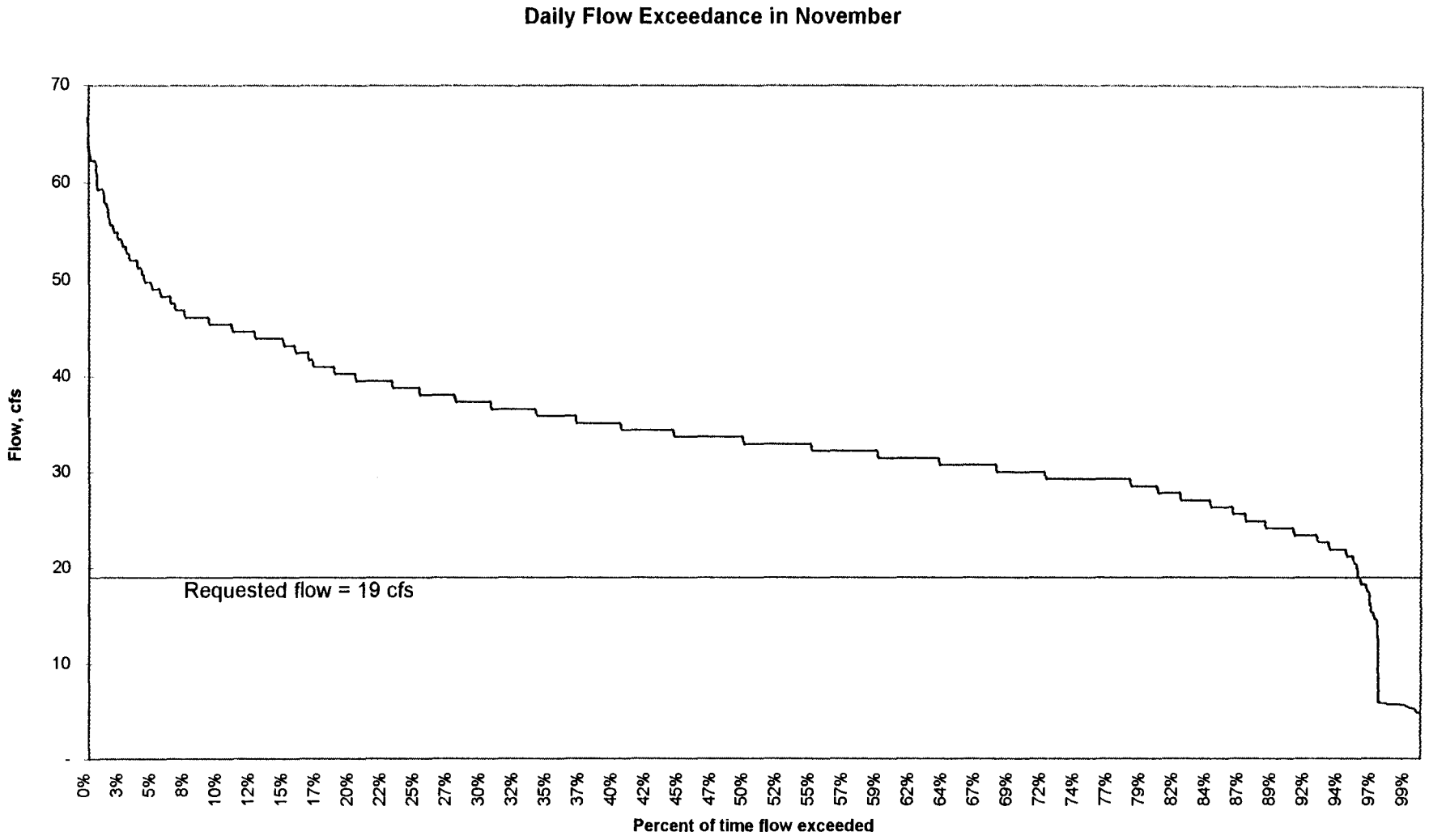
Daily Flow Exceedance in November
Flow, cfs
70
60
50
40
30
20
10
-
Requested flow = 19 cfs
0%
3%
5%
8%
10%
12%
15%
17%
20%
22%
25%
27%
30%
32%
35%
37%
40%
42%
45%
47%
50%
52%
55%
57%
59%
62%
64%
67%
69%
72%
74%
77%
79%
82%
84%
87%
89%
92%
94%
97%
99%
Percent of time flow exceeded

FIGURE 8

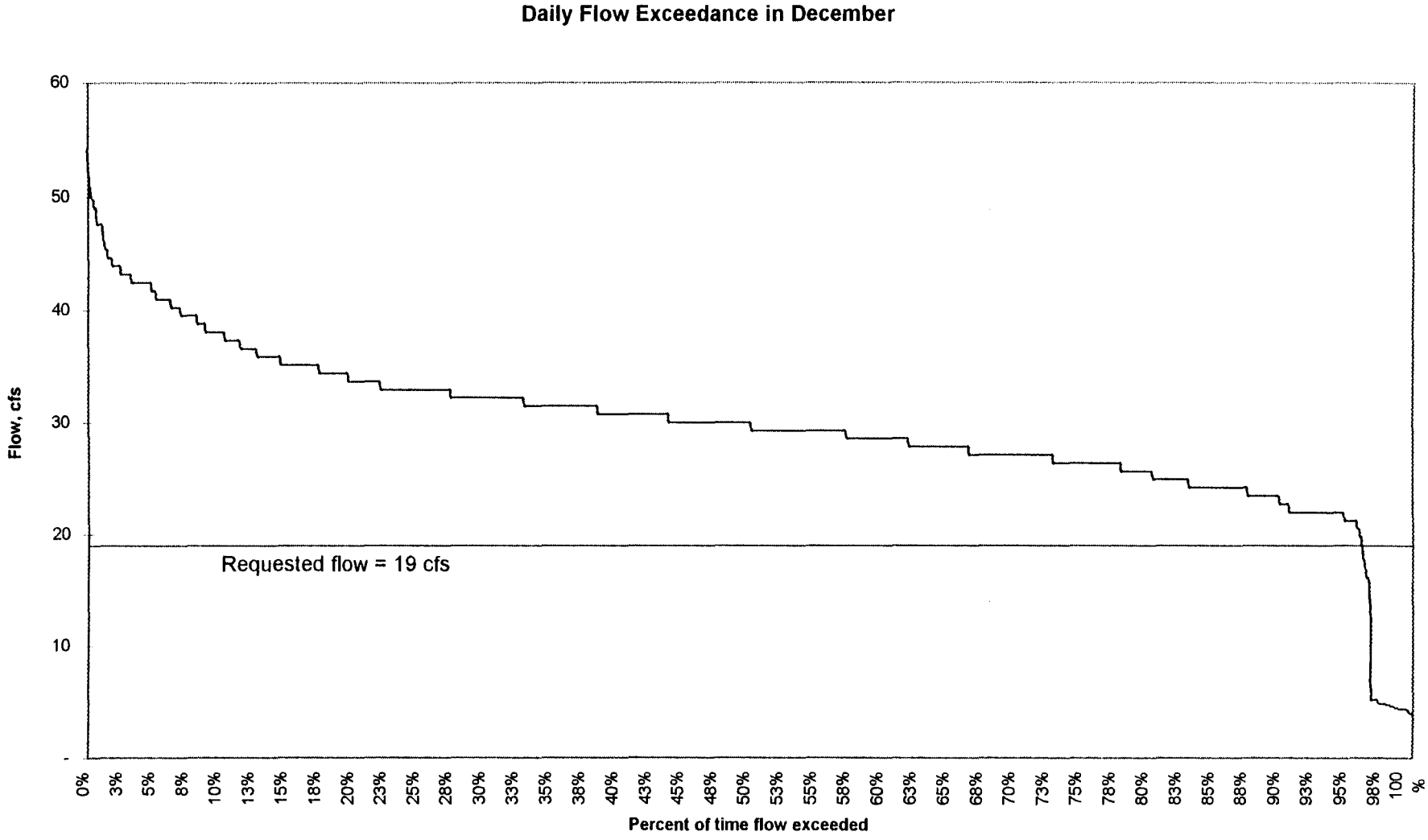
Daily Flow Exceedance in December
Flow, cfs
60
50
40
30
20
10
-
Requested flow = 19 cfs
0%
3%
5%
8%
10%
13%
15%
18%
20%
23%
25%
28%
30%
33%
35%
38%
40%
43%
45%
48%
50%
53%
55%
58%
60%
63%
65%
68%
70%
73%
75%
78%
80%
83%
85%
88%
90%
93%
95%
98%
100
%
Percent of time flow exceeded

FIGURE 9

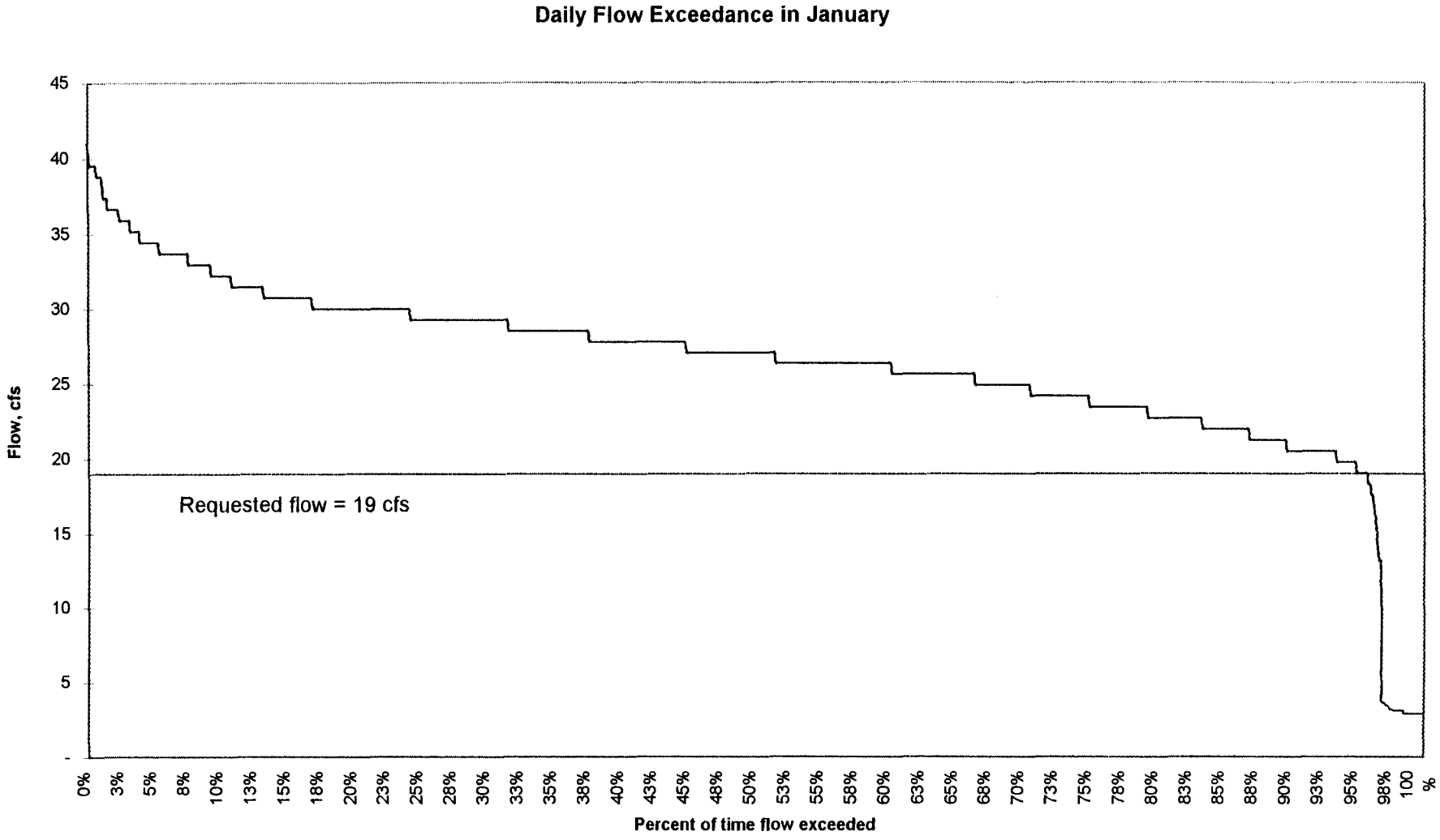
Daily Flow Exceedance in January
Flow, cfs
45
40
35
30
25
20
15
10
5
-
Requested flow = 19 cfs
0%
3%
5%
8%
10%
13%
15%
18%
20%
23%
25%
28%
30%
33%
35%
38%
40%
43%
45%
48%
50%
53%
55%
58%
60%
63%
65%
68%
70%
73%
75%
78%
80%
83%
85%
88%
90%
93%
95%
98%
100
%
Percent of time flow exceeded

FIGURE 10

Shell Creek Instream Flow Segment 1

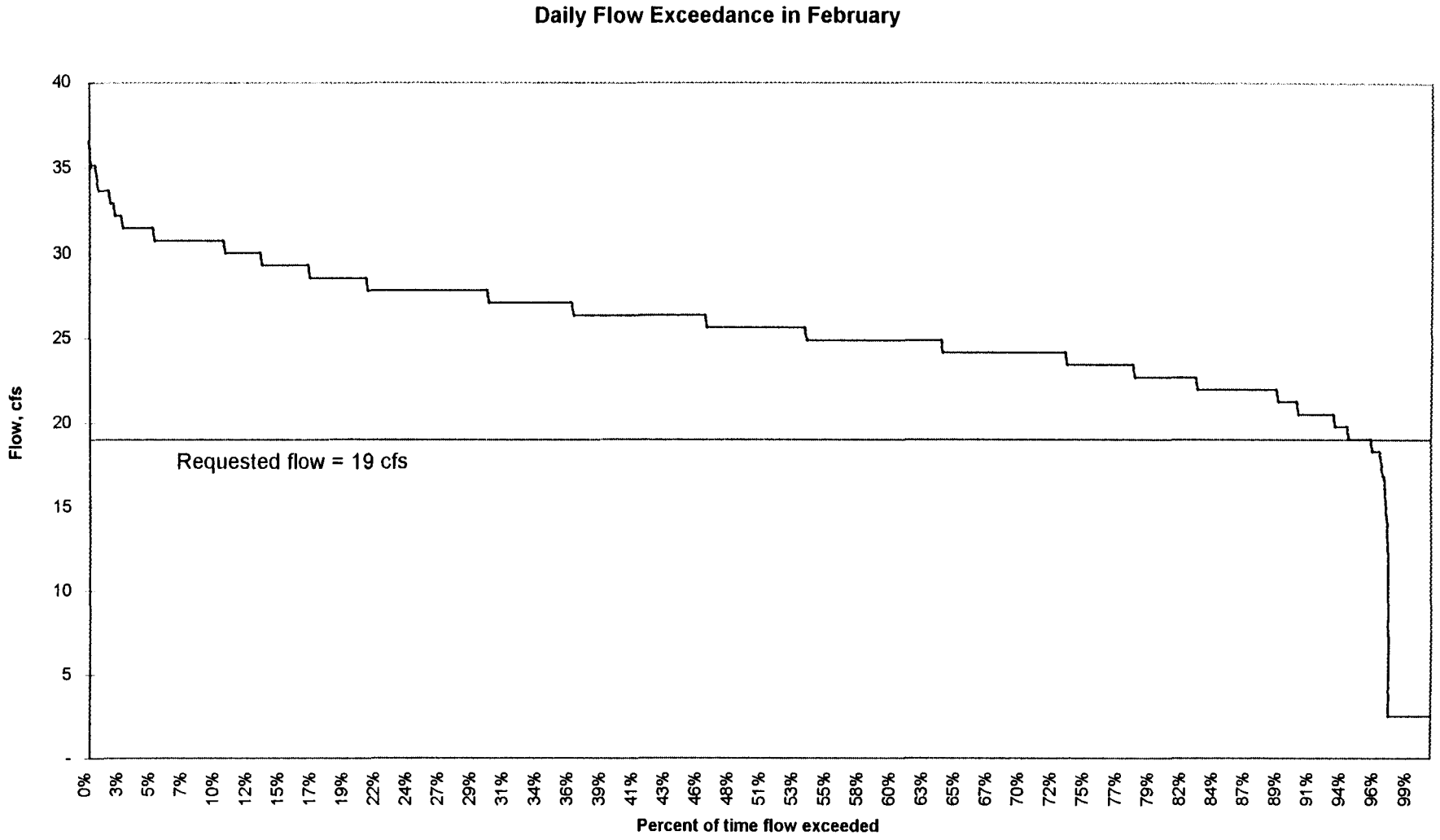

FIGURE 11

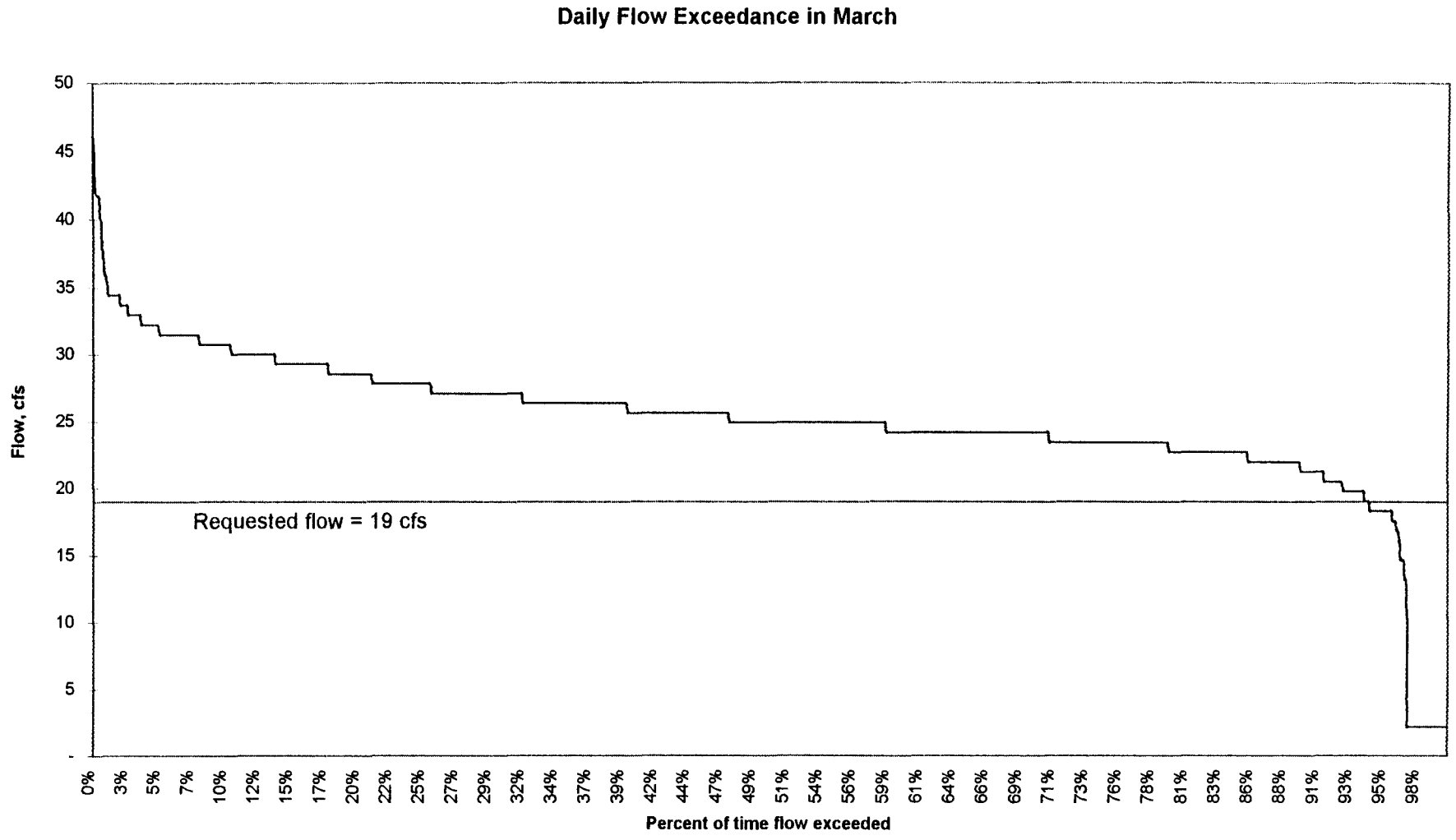
Daily Flow Exceedance in March
Flow, cfs
50
45
40
35
30
25
20
15
10
5
-
Requested flow = 19 cfs
0%
3%
5%
7%
10%
12%
15%
17%
20%
22%
25%
27%
29%
32%
34%
37%
39%
42%
44%
47%
49%
51%
54%
56%
59%
61%
64%
66%
69%
71%
73%
76%
78%
81%
83%
86%
88%
91%
93%
95%
98%
Percent of time flow exceeded

FIGURE 12

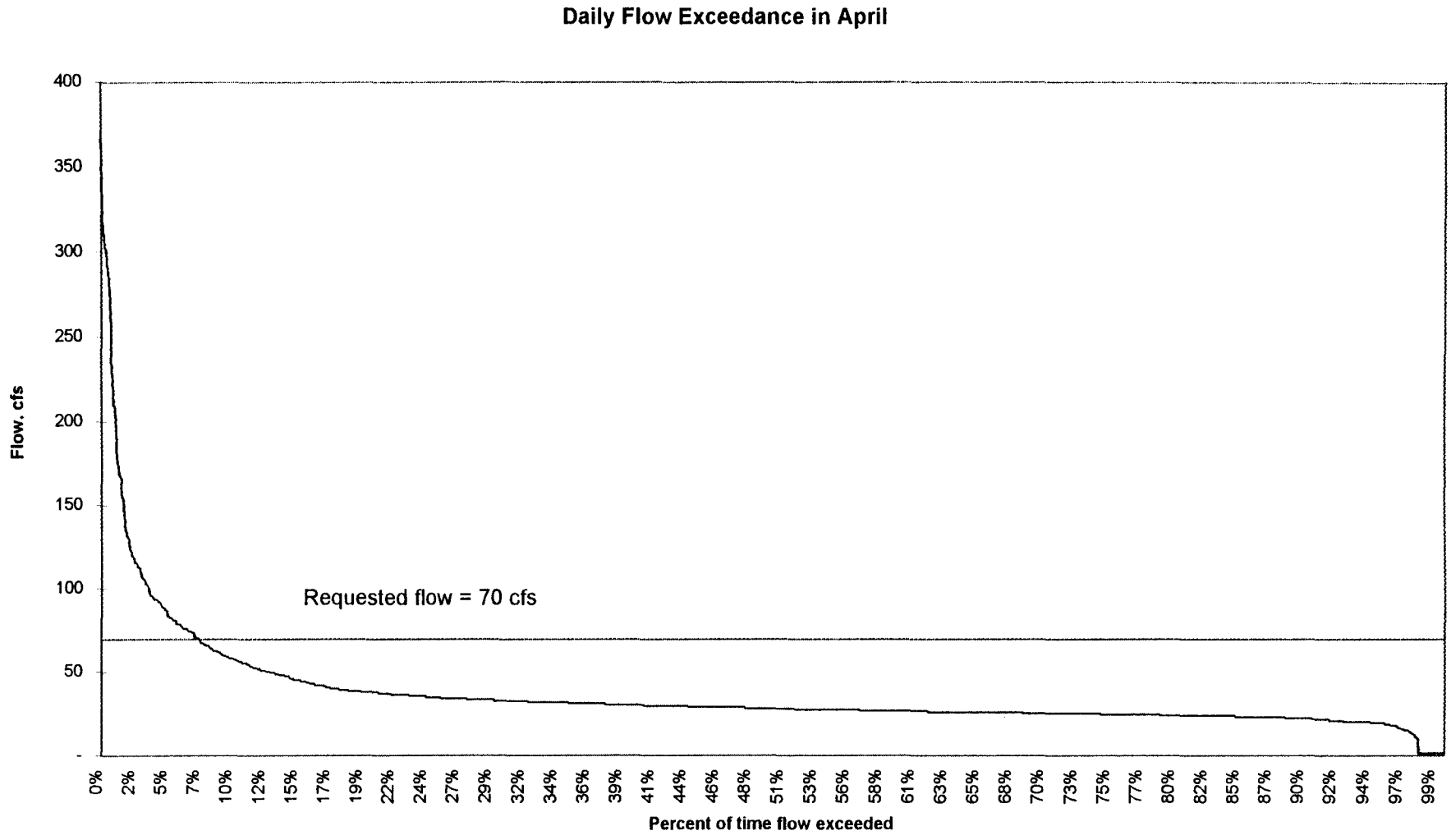
Daily Flow Exceedance in April
Flow, cfs
400
350
300
250
200
150
100
50
-
Requested flow = 70 cfs
0%
2%
5%
7%
10%
12%
15%
17%
19%
22%
24%
27%
29%
32%
34%
36%
39%
41%
44%
46%
48%
51%
53%
56%
58%
61%
63%
65%
68%
70%
73%
75%
77%
80%
82%
85%
87%
90%
92%
94%
97%
99%
Percent of time flow exceeded

FIGURE 13

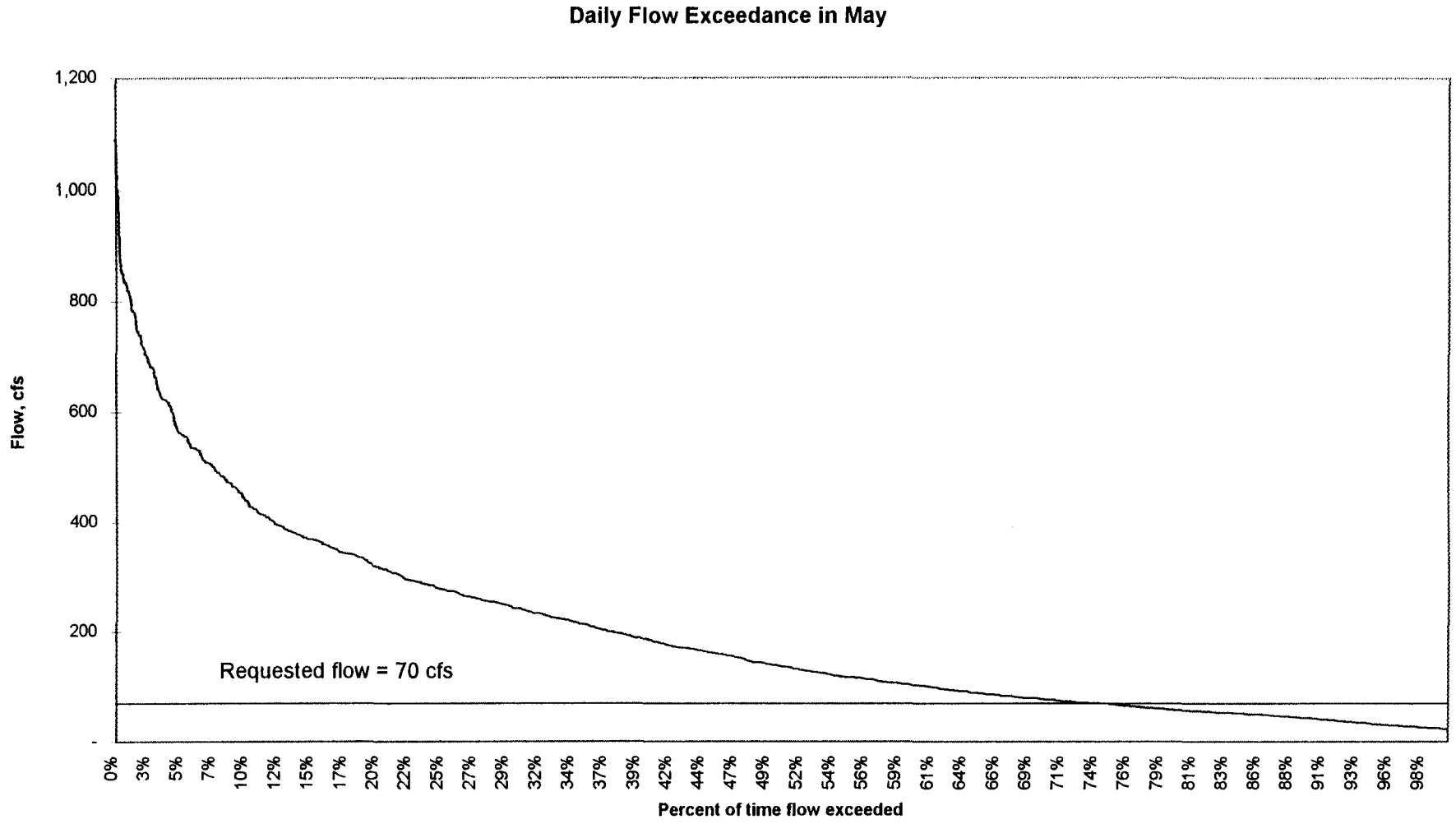
Daily Flow Exceedance in May
Flow, cfs
1,200
1,000
800
600
400
200
-
Requested flow = 70 cfs
0%
3%
5%
7%
10%
12%
15%
17%
20%
22%
25%
27%
29%
32%
34%
37%
39%
42%
44%
47%
49%
52%
54%
56%
59%
61%
64%
66%
69%
71%
74%
76%
79%
81%
83%
86%
88%
91%
93%
96%
98%
Percent of time flow exceeded

FIGURE 14

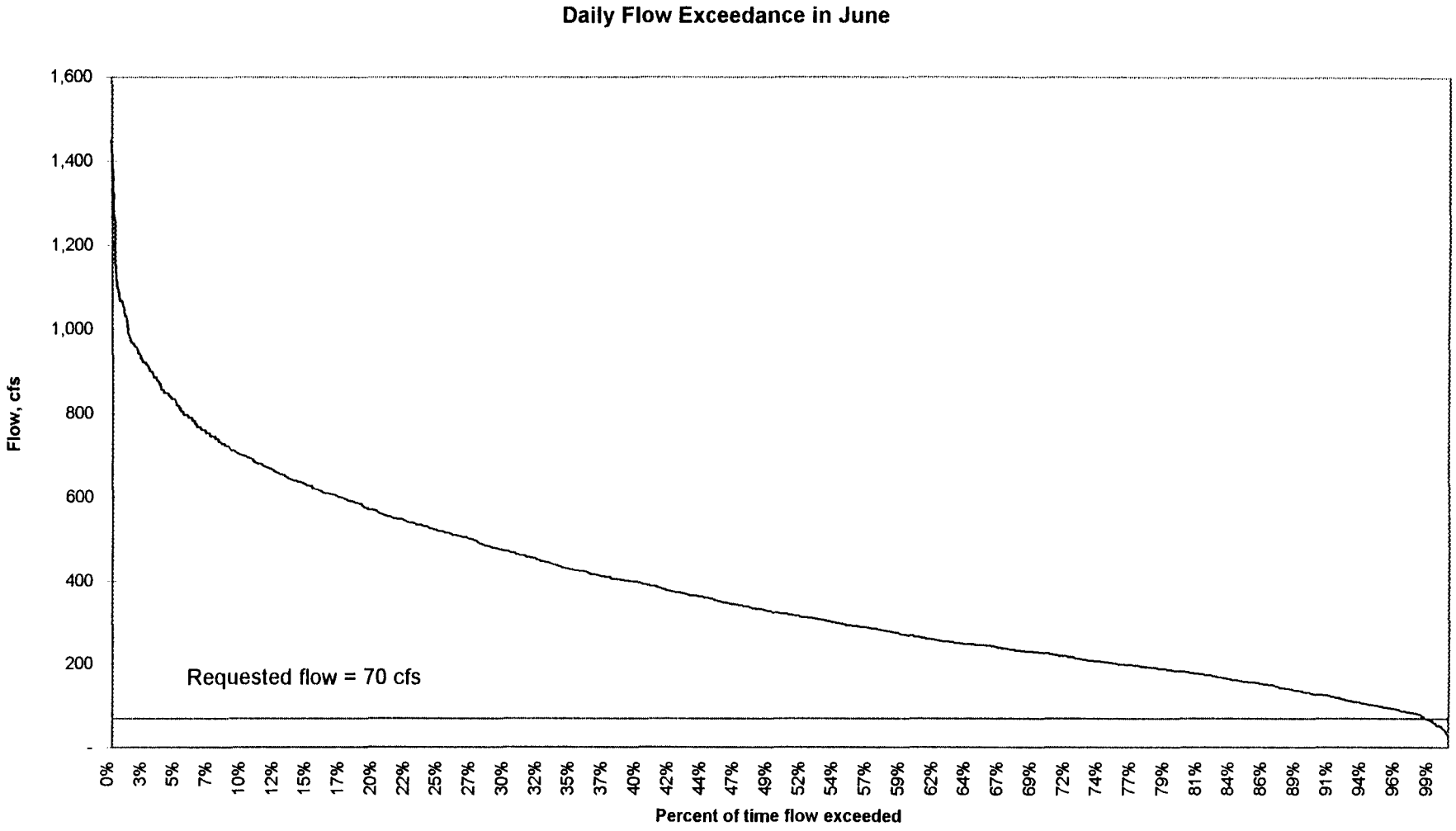
Daily Flow Exceedance in June
Flow, cfs
1,600
1,400
1,200
1,000
800
600
400
200
-
Requested flow = 70 cfs
0%
3%
5%
7%
10%
12%
15%
17%
20%
22%
25%
27%
30%
32%
35%
37%
40%
42%
44%
47%
49%
52%
54%
57%
59%
62%
64%
67%
69%
72%
74%
77%
79%
81%
84%
86%
89%
91%
94%
96%
99%
Percent of time flow exceeded

FIGURE 15

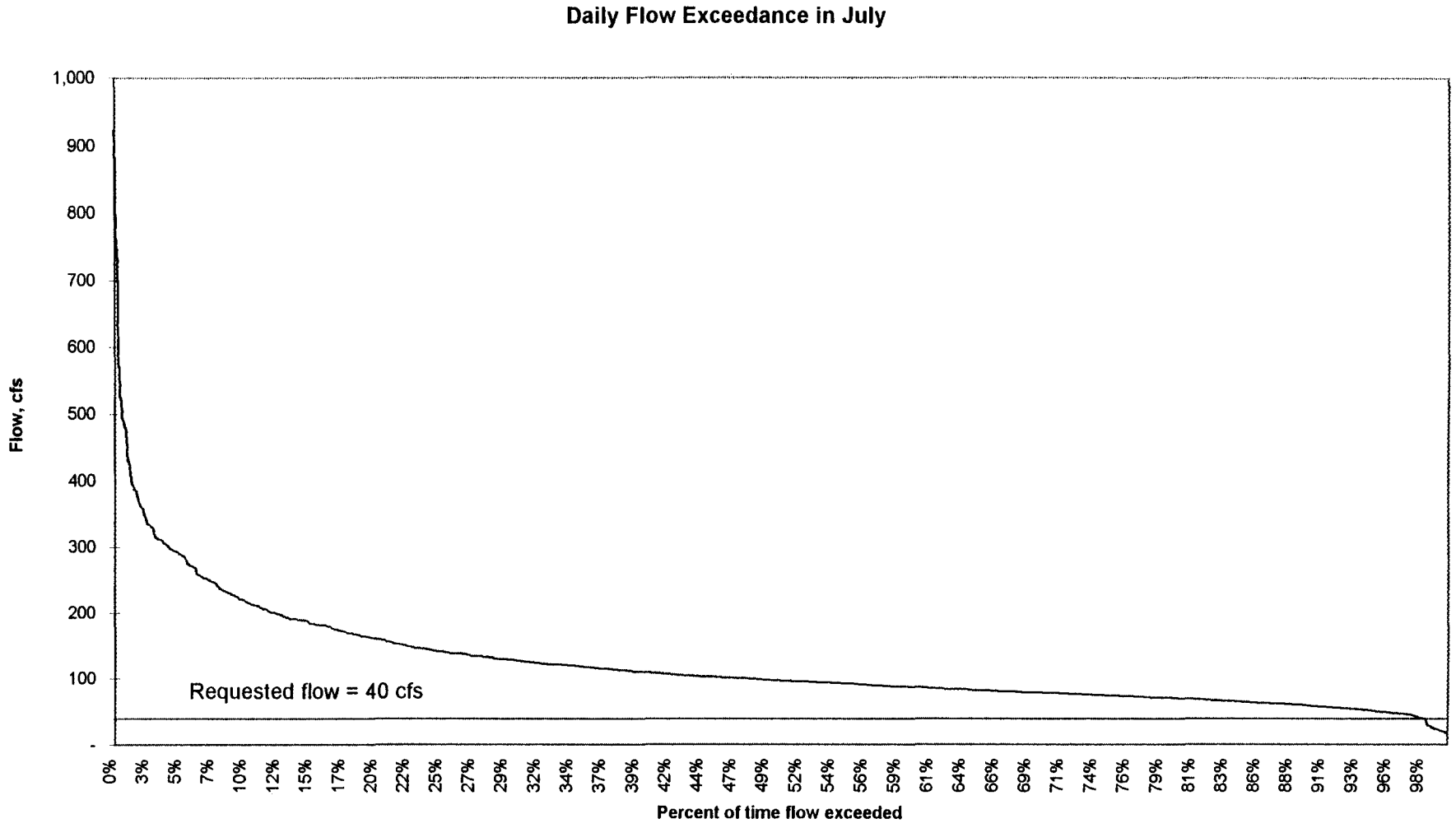
Daily Flow Exceedance in July
Flow, cfs
1,000
900
800
700
600
500
400
300
200
100
-
Requested flow = 40 cfs
0%
3%
5%
7%
10%
12%
15%
17%
20%
22%
25%
27%
29%
32%
34%
37%
39%
42%
44%
47%
49%
52%
54%
56%
59%
61%
64%
66%
69%
71%
74%
76%
79%
81%
83%
86%
88%
91%
93%
96%
98%
Percent of time flow exceeded

FIGURE 16

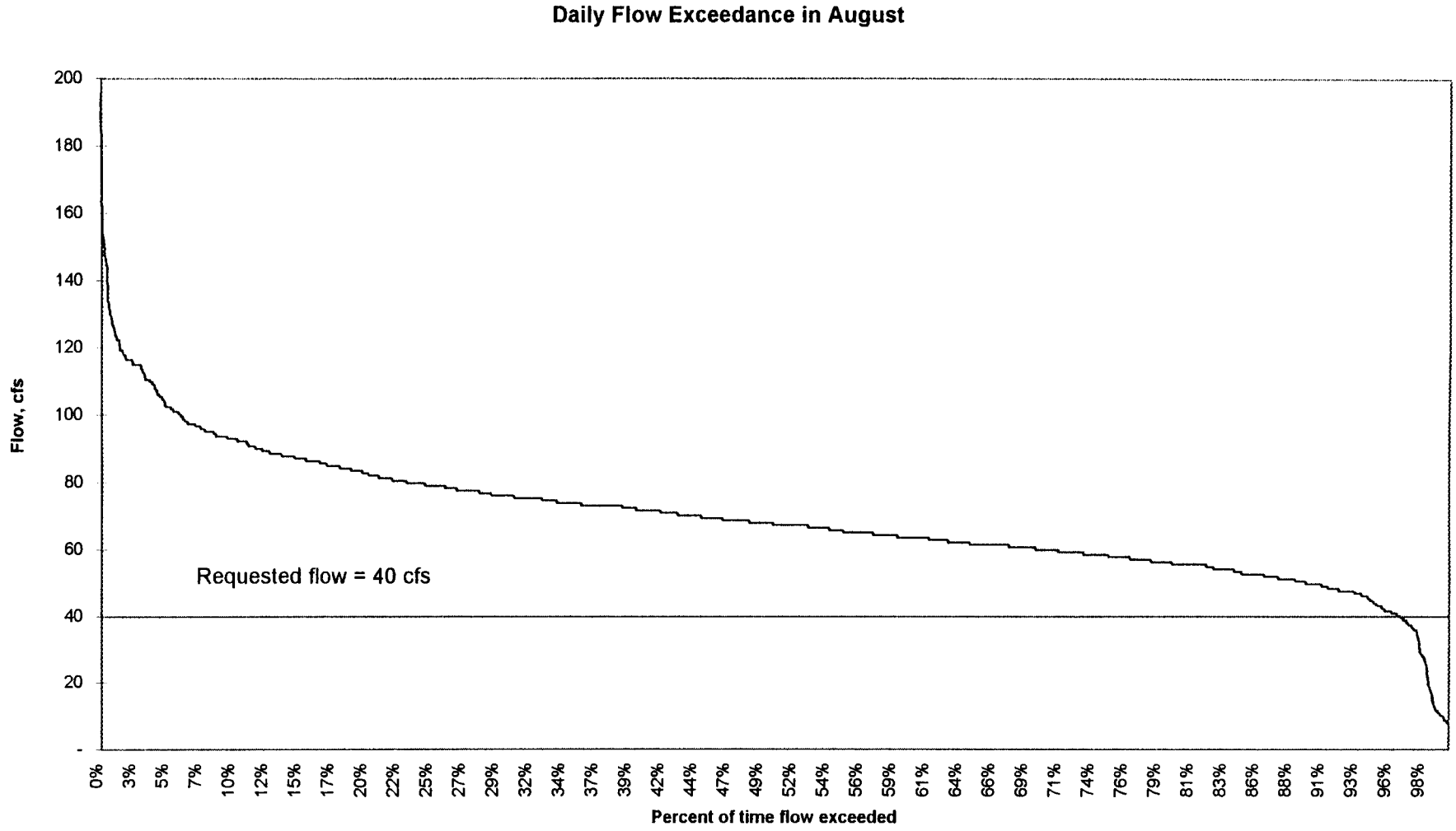
Daily Flow Exceedance in August
Flow, cfs
200
180
160
140
120
100
80
60
40
20
-
Requested flow = 40 cfs
0%
3%
5%
7%
10%
12%
15%
17%
20%
22%
25%
27%
29%
32%
34%
37%
39%
42%
44%
47%
49%
52%
54%
56%
59%
61%
64%
66%
69%
71%
74%
76%
79%
81%
83%
86%
88%
91%
93%
96%
98%
Percent of time flow exceeded

FIGURE 17

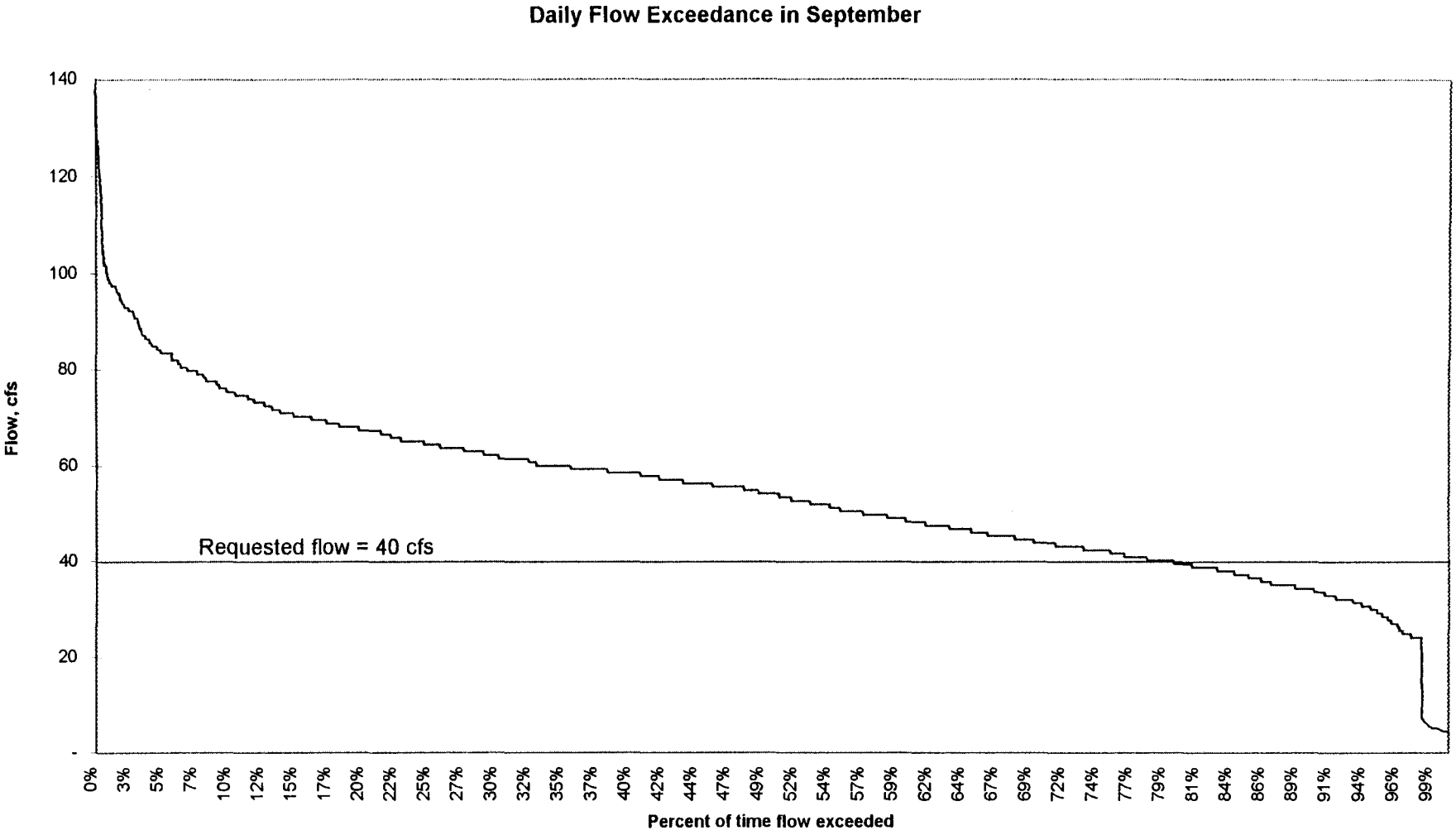
Daily Flow Exceedance in September
Flow, cfs
140
120
100
80
60
40
20
-
Requested flow = 40 cfs
0%
3%
5%
7%
10%
12%
15%
17%
20%
22%
25%
27%
30%
32%
35%
37%
40%
42%
44%
47%
49%
52%
54%
57%
59%
62%
64%
67%
69%
72%
74%
77%
79%
81%
84%
86%
89%
91%
94%
96%
99%
Percent of time flow exceeded

FIGURE 18

IX. Conclusions-Segment 1

A. Mean Monthly Flow Analysis

Table 12 shows that, for all months except April, the Instream Flow Request can be met under mean monthly total flow conditions. Table 13 shows that, while the USFS right is larger than the mean flow in some months, the USFS instream flow right remains smaller than the WGFD for all months but May and June.

B. Dry Year Flow Analysis

Figure 4 shows that, for the three driest periods of record, only April shows a deficit between total flows and the Instream Flow request. This is also true in Figure 5, the driest year (1957), and in Figure 6, the average of the three driest years of record.

C. Daily Flow Exceedance Analysis

When considering daily flow duration the Wyoming Water Development Commission's 50% criterion will be met in all months except April by a substantial margin.

SECTION 2
Analysis of Segment 2

X. Mean Monthly Flow Analysis-Segment 2

A comparison of the estimated total mean monthly flows (from Table 21) with the flows requested for Segment 2 by the Wyoming Game and Fish Department is shown at the foot of Table 18.

Table 18. Comparison of Mean Monthly Flow and Instream Flow Request, Shell Segment 2

Desc	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Mean	56.0	47.0	42.0	37.0	36.0	35.0	49.0	280.0	550.0	190.0	86.0	74.0
IFR-2	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	40.0	40.0	40.0
Diff	**33.0**	**24.0**	**19.0**	**14.0**	**13.0**	**18.0**	**26.0**	**192.0**	**527.0**	**250.0**	**46.0**	**34.0**

The mean monthly flow values are for the period 1943 through 1982, and are synthesized from Lake Adelaide study results at Node 050000, adjusted to the bottom of Instream Flow Segment 2. The row labeled IFR-2 refers to the Instream Flow Request made by Wyoming Game and Fish Department, the focus of this study. The row labeled Diff shows the difference between the Wyoming Game and Fish Department Instream Flow Request and the mean monthly flow. The relationship between mean monthly flows and the requested amount is also shown in Figure 19.

Table 18 shows that, for all months, the Instream Flow Request is met under mean monthly flow conditions.

The USFS has an Instream Flow Right in Shell Creek, as reported in Section II. Table 19 shows a similar comparison between the USFS right and WGFD request.

Table 19. Comparison of Instream Flow Request and USFS Instream Flow Right, Shell Segment 2

Desc	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
USFS	11.5	7.0	7.0	10.5	7.5	9.8	10.9	92.7	126.4	11.5	11.5	10.9
IFR-2	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	40.0	40.0	40.0
Diff	**-11.5**	**-16.0**	**-16.0**	**-12.5**	**-15.5**	**-13.2**	**-12.1**	**58.7**	**103.4**	**-28.5**	**-28.5**	**-29.1**

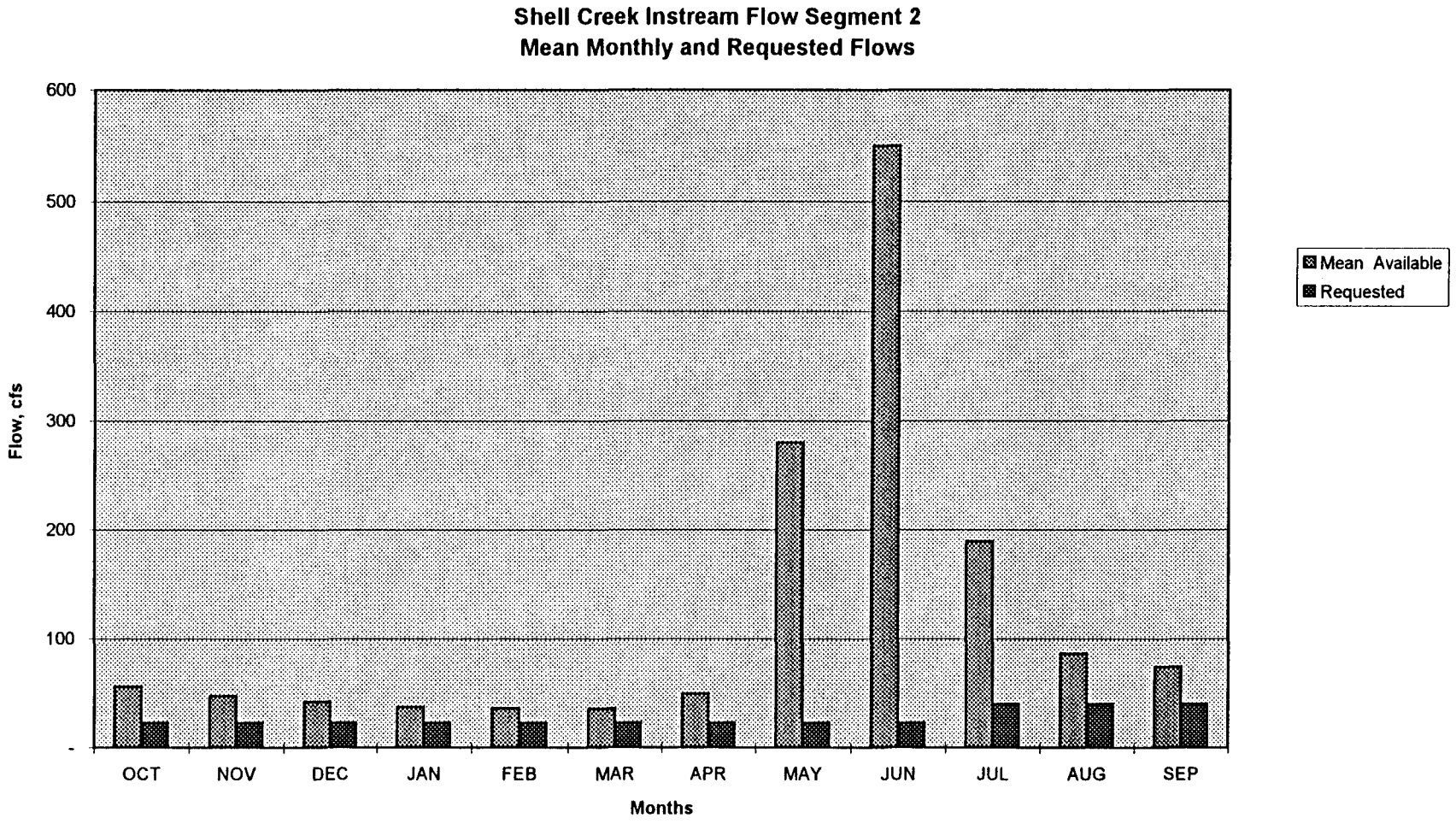
Shell Creek Instream Flow Segment 2
Mean Monthly and Requested Flows
600
500
400
300
200
100
-
Flow, cfs
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
Months
Mean Available
Requested

FIGURE 19

XI. Dry Year Flow Analysis-Segment 2

A dry year flow analysis was performed on the instream flow segment data to determine if the stream is capable of providing the instream flow requests during a dry year. The dry year flow analysis was based on the driest year of record, 1957.

Table 20. Comparison of Dry Year Flow (1957) and Instream Flow Request, Shell Creek, Segment 2

Desc	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Average Annual Flow, cfs	Annual Discharge, ac-ft
Min	37	37	34	30	30	31	34	161	213	150	81	66	75	54600
IFR-2	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	40.0	40.0	40.0		
Diff	**14.0**	**14.0**	**11.0**	**7.0**	**7.0**	**8.0**	**11.0**	**138.0**	**190.0**	**110.0**	**41.0**	**26.0**		

The row labeled IFR-2 refers to the Instream Flow Request made by the Wyoming Game and Fish Department, the focus of this study. The row labeled Diff shows the difference between the Wyoming Game and Fish Department Instream Flow Request and the monthly flow.

Table 21 shows the Segment 2 flows ranked in order of annual flows.

Figure 20 shows the relationship of driest period on record (October through March of 1961, April through June of 1957, and July through September of 1966) to the requested flows. No deficits are shown for the instream flow requests.

Figure 21 shows the relationship of total flows of the driest year on record (1957) to the requested flows. No deficits are shown for the instream flow requests.

Figure 22 shows the relationship of the average of the driest three years on record (1957, 1961, 1962) to the requested flows. Once again, no deficits are shown for the requested flows each month.

TABLE 21

Monthly Flows | **Shell Creek, Bottom of Segment #2** | Adjusted from Node 050000

RANKED BY ANNUAL FLOW

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Average Annual Flow, cfs	Annual Discharge, ac-ft
1957	37	37	34	30	30	31	34	161	213	150	81	66	75	54,600
1961	46	34	32	28	27	26	29	291	246	112	60	50	82	59,416
1960	52	40	38	32	33	29	43	180	288	137	68	48	82	59,691
1966	68	48	42	38	35	36	36	301	173	128	50	38	83	60,333
1954	44	42	42	38	35	33	41	324	304	149	59	42	96	69,804
1959	45	41	38	35	32	32	37	113	577	149	87	70	105	75,606
1977	58	51	46	40	39	38	71	334	308	149	70	54	105	76,216
1958	50	43	39	34	33	34	33	445	252	149	92	68	106	77,288
1980	54	48	43	37	36	35	55	314	388	149	84	74	110	79,609
1956	43	41	39	37	40	38	43	403	391	149	55	44	110	80,016
1950	50	44	37	34	33	31	44	163	562	166	85	74	110	79,715
1955	36	32	33	29	31	33	38	285	560	149	68	49	112	80,932
1948	67	60	55	48	43	40	44	400	339	149	74	53	114	83,042
1953	46	40	37	38	36	36	35	119	706	149	79	59	115	82,974
1981	53	47	42	36	36	34	71	339	436	149	88	64	116	84,267
1951	68	51	41	33	32	32	39	349	393	197	103	69	117	85,182
1952	55	46	41	38	36	33	90	382	410	150	85	58	119	86,112
1949	49	45	42	37	33	33	53	387	498	149	63	64	121	87,857
1982	54	48	43	38	37	36	33	190	613	254	79	91	126	91,445
1962	54	49	41	33	33	32	91	315	559	166	77	70	127	91,675
1943	50	46	43	38	37	37	68	203	686	204	73	69	130	93,673
1971	49	42	41	38	36	35	40	295	672	149	101	69	131	94,519
1969	94	76	60	46	41	41	91	478	280	205	87	70	131	95,224
1963	55	51	43	35	35	33	39	312	698	149	76	58	132	95,406
1970	62	40	44	39	38	35	36	241	728	170	88	73	133	96,611
1972	60	41	37	33	32	42	46	259	677	167	115	89	133	96,370
1973	55	50	46	39	38	41	42	339	639	149	84	77	133	96,479
1974	57	50	45	39	38	37	54	290	668	154	102	84	135	97,623
1945	55	48	39	38	36	34	35	227	626	299	94	103	136	98,684
1979	63	56	50	44	42	41	53	372	483	168	146	117	136	98,955
1944	50	45	37	35	35	34	37	373	659	214	74	74	139	100,626
1946	70	55	49	42	42	47	136	302	629	151	77	96	141	102,275
1967	44	36	34	28	28	32	34	216	801	283	77	90	142	102,717
1976	61	54	49	43	42	41	45	304	698	187	108	85	143	103,581
1947	80	64	53	45	44	40	46	379	564	245	88	83	144	104,630
1964	46	44	37	35	34	33	34	234	769	287	97	87	145	104,819
1978	48	42	38	33	32	31	43	217	765	342	122	111	152	109,986
1975	54	48	43	38	37	36	36	94	748	490	106	95	152	110,071
1965	67	49	46	41	37	35	43	140	951	259	96	92	155	111,761
1968	81	60	48	41	39	36	37	126	1,031	215	126	137	165	118,821
Mean	56	47	42	37	36	35	49	280	550	190	86	74	123	89,465
Max	94	76	60	48	44	47	136	478	1,031	490	146	137	165	118,821
Min	36	32	32	28	27	26	29	94	173	112	50	38	75	54,600
BHNF	11.5	7.0	7.0	10.5	7.5	9.8	10.9	92.7	126.4	11.5	11.5	10.9		
ISF	23	23	23	23	23	23	23	23	23	40	40	40		

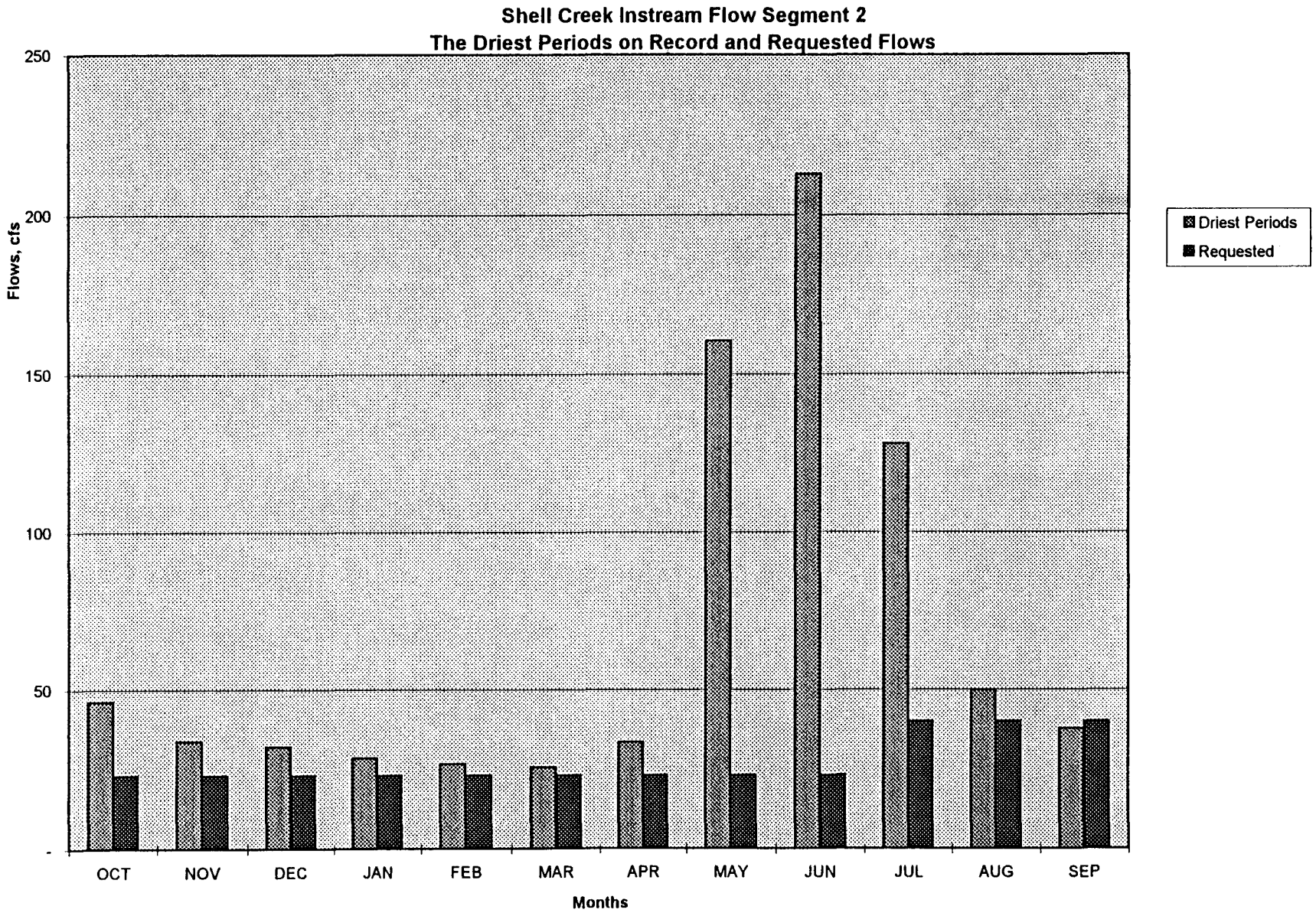
Shell Creek Instream Flow Segment 2
The Driest Periods on Record and Requested Flows
250
200
150
100
50
-
Flows, cfs
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
Months
Driest Periods
Requested

FIGURE 20

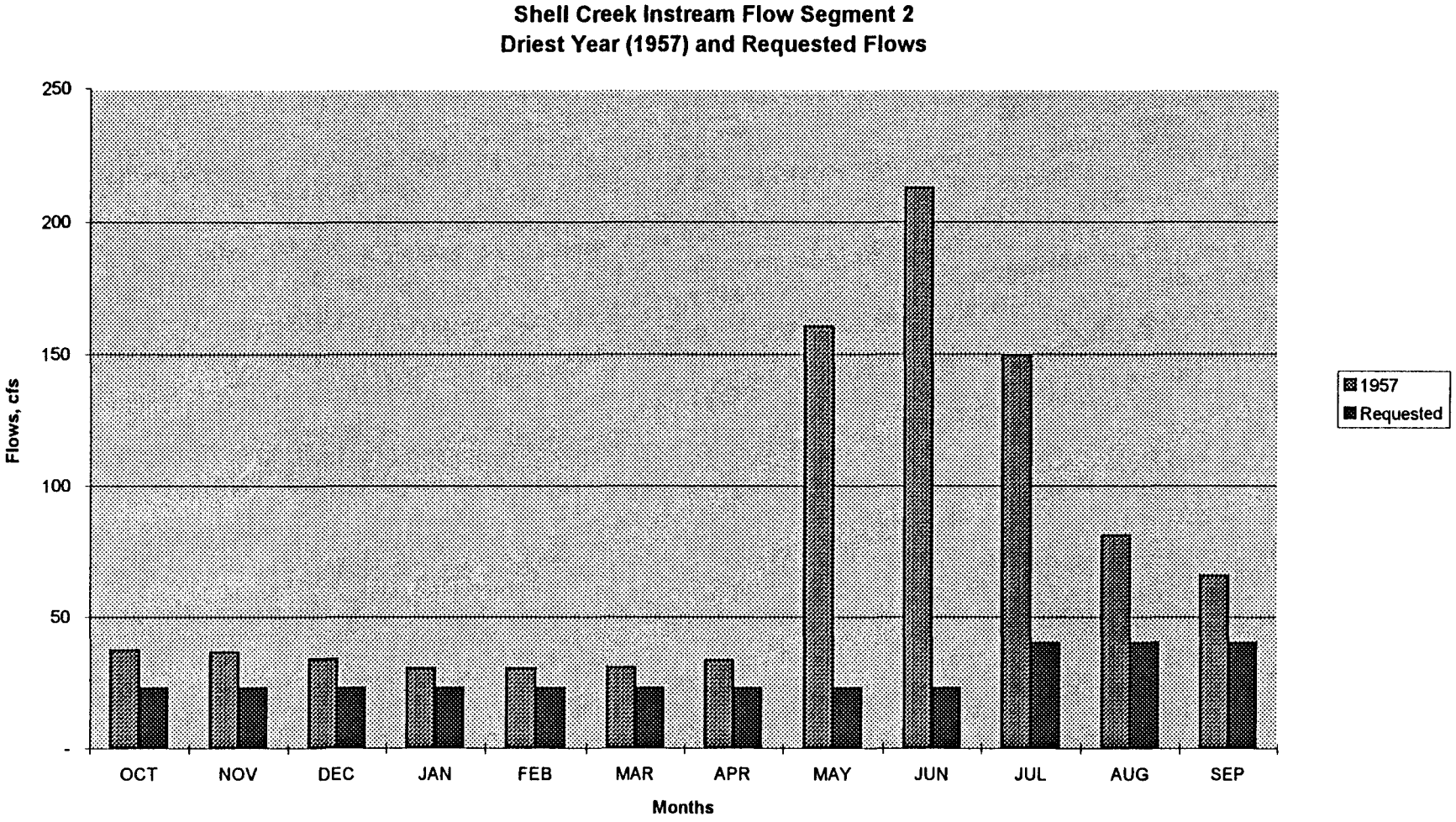
Shell Creek Instream Flow Segment 2
Driest Year (1957) and Requested Flows
250
200
150
100
50
-
Flows, cfs
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
Months
1957
Requested

FIGURE 21

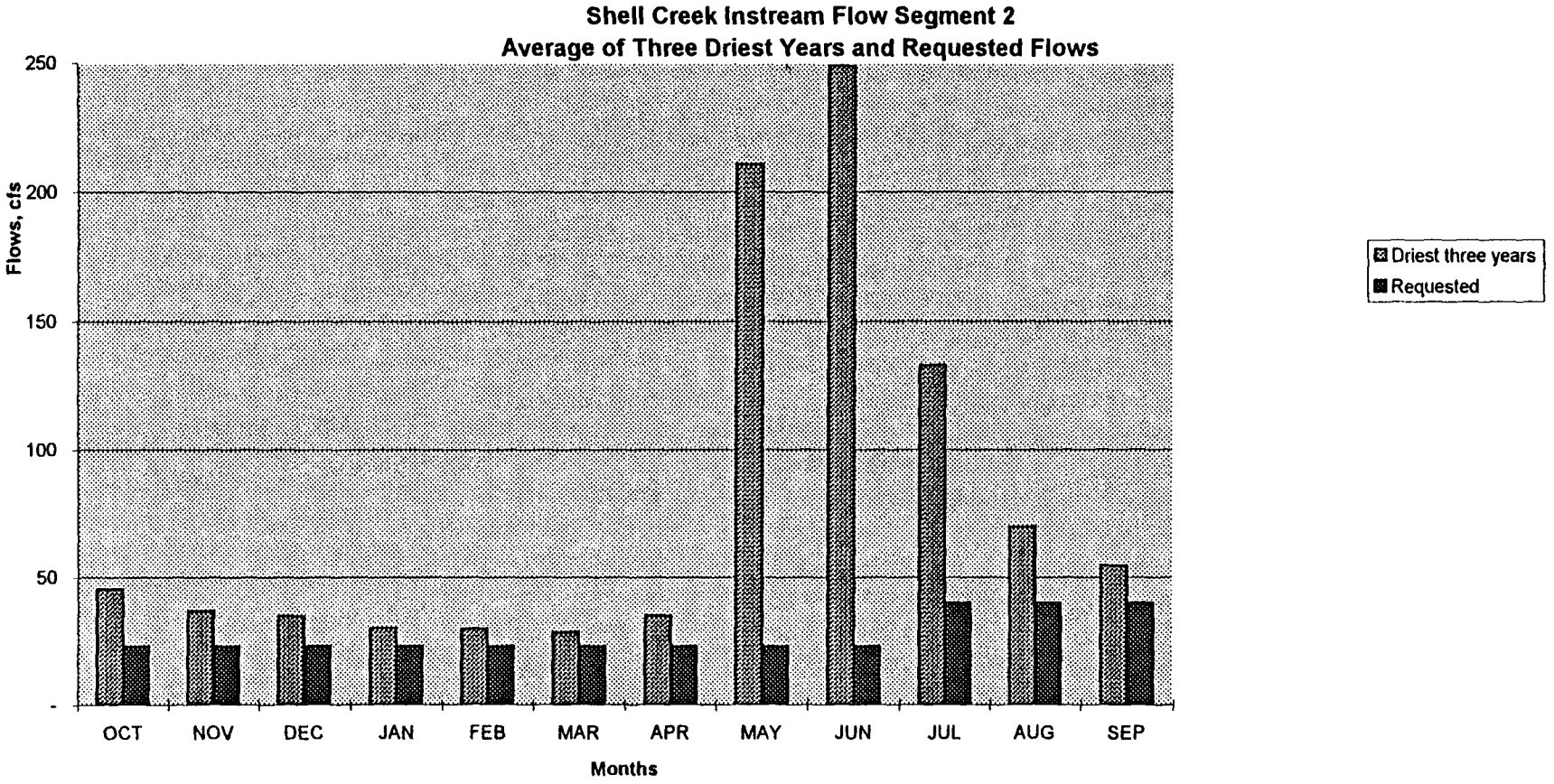
Shell Creek Instream Flow Segment 2
Average of Three Driest Years and Requested Flows
Flows, cfs
250
200
150
100
50
-
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
Months
Driest three years
Requested

FIGURE 22

XII. Reservoir Operation Study-Segment 2

Since the Instream Flow Request is met for all months, a reservoir operations study will not be presented. However Segment 1 exists upstream from Segment 2 and a Reservoir Operations Study was performed (see Section VII) for Segment 1.

XIII. Daily Flow Exceedance Analysis-Segment 2

A daily flow exceedance analysis was performed to determine the feasibility of maintaining the criteria established by the Wyoming Water Development Commission. The WWDC reviews instream flow hydrologic feasibility on a monthly basis. The WWDC also considers the instream flow request feasible if the requested flow is available 50% of the time during the month for each month of the year. Therefore, the exceedance analysis was performed for the year on a monthly basis.

The daily flow exceedance analysis was done by building a table of all daily flows for the period of record for the months in question, then ranking those flow values in descending order. All data points during the month of analysis were used for the exceedance analysis.

Each value in each of the twelve sets was assigned an order index expressed as a percent, where the order was calculated by dividing the rank position by the total number of values and multiplying by 100. The daily flow exceedance curves for Shell Creek Instream Flow Segment 2 are shown in Figures 23 through 34 which were developed by plotting the flow values as ordinates and the order as abscissa values.

To use the daily flow exceedance curve, the chart is entered at the desired exceedance criterion -- 50% in this instance -- and the corresponding flow is read from the curve.

For Shell Creek Instream Flow Segment 2, the 50% exceedance values are summarized in Table 22. The requested instream flow values of 23 cfs (October through June) and 40 cfs (July through September) are also shown in Figures 23 and 34.

Shell Ck

Table 22. Daily Flow Exceedance Summary: Segment 2

Period	Instream Flow Request (cfs)	% Exceedance of Requested Flow	Estimated 50% exceedance criteria (cfs)
October	23	97	50
November	23	96	45
December	23	97	40
January	23	97	36
February	23	96	34
March	23	96	33
April	23	96	40
May	23	99	210
June	23	99	450
July	40	99	150
August	40	98	90
September	40	94	75

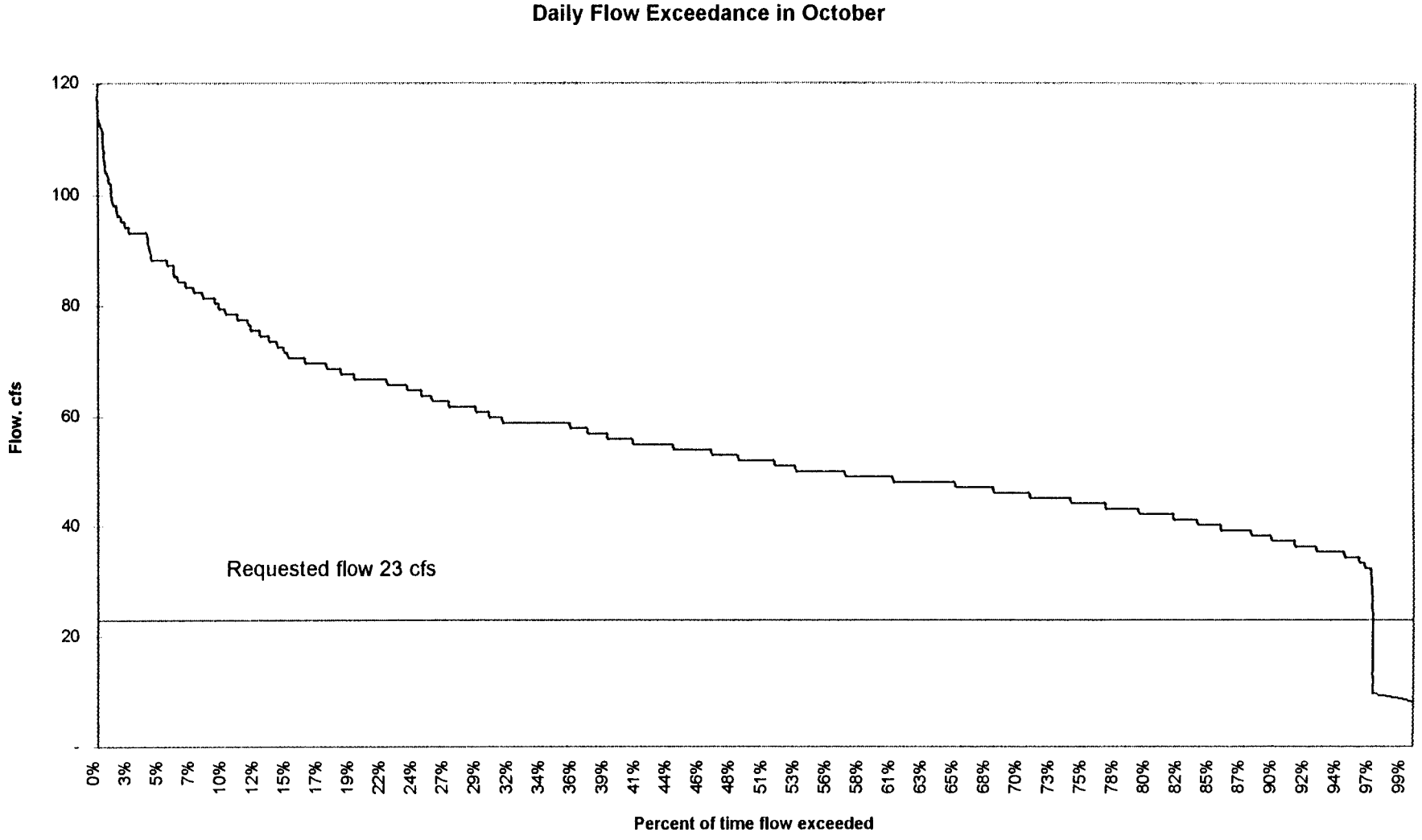
Daily Flow Exceedance in October
Flow, cfs
120
100
80
60
40
20
-
Requested flow 23 cfs
0%
3%
5%
7%
10%
12%
15%
17%
19%
22%
24%
27%
29%
32%
34%
36%
39%
41%
44%
46%
48%
51%
53%
56%
58%
61%
63%
65%
68%
70%
73%
75%
78%
80%
82%
85%
87%
90%
92%
94%
97%
99%
Percent of time flow exceeded

FIGURE 23

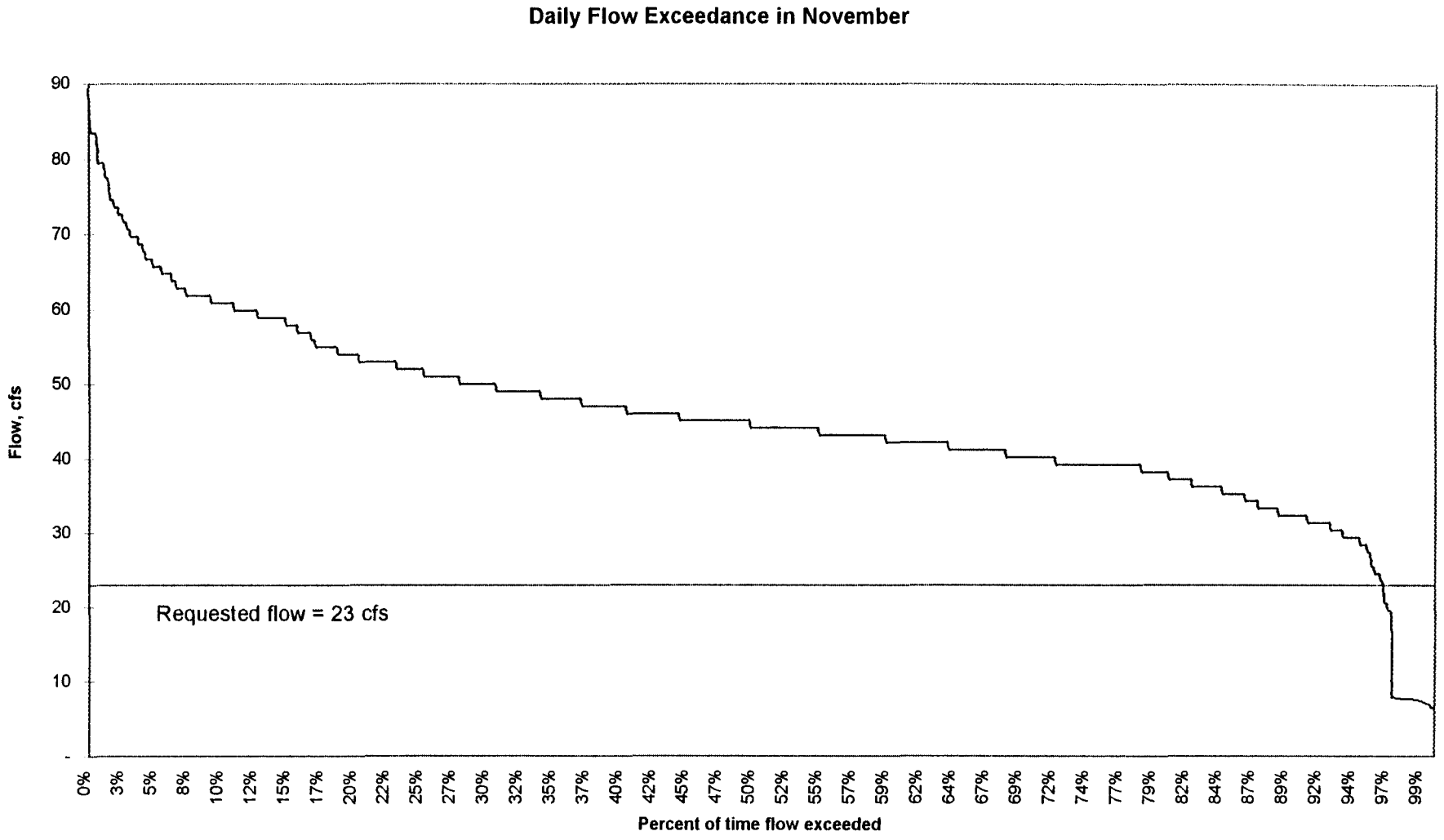
Daily Flow Exceedance in November
Flow, cfs
90
80
70
60
50
40
30
20
10
-
Requested flow = 23 cfs
0%
3%
5%
8%
10%
12%
15%
17%
20%
22%
25%
27%
30%
32%
35%
37%
40%
42%
45%
47%
50%
52%
55%
57%
59%
62%
64%
67%
69%
72%
74%
77%
79%
82%
84%
87%
89%
92%
94%
97%
99%
Percent of time flow exceeded

FIGURE 24

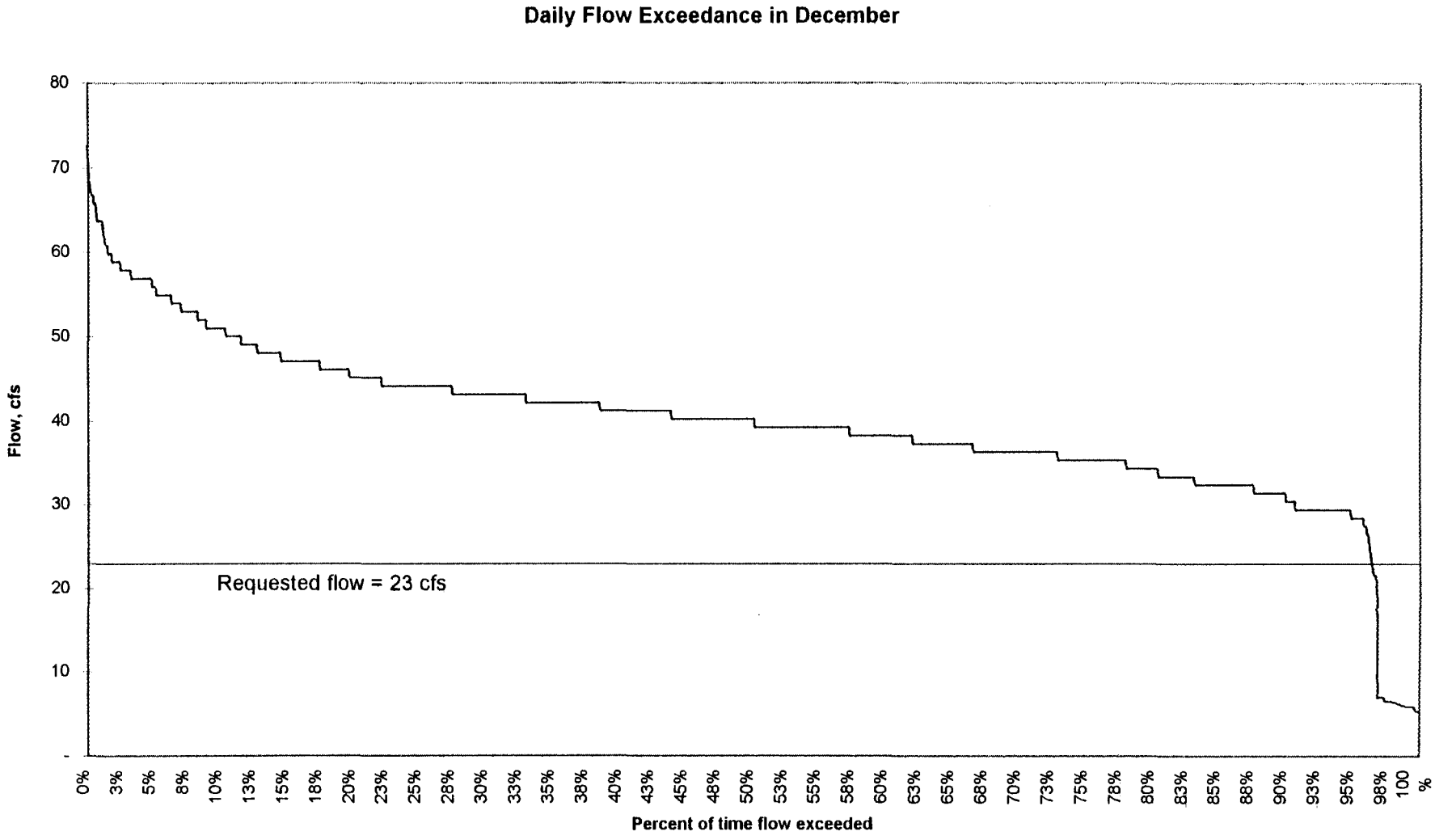
Daily Flow Exceedance in December
Flow, cfs
80
70
60
50
40
30
20
10
-
Requested flow = 23 cfs
0%
3%
5%
8%
10%
13%
15%
18%
20%
23%
25%
28%
30%
33%
35%
38%
40%
43%
45%
48%
50%
53%
55%
58%
60%
63%
65%
68%
70%
73%
75%
78%
80%
83%
85%
88%
90%
93%
95%
98%
100
%
Percent of time flow exceeded

FIGURE 25

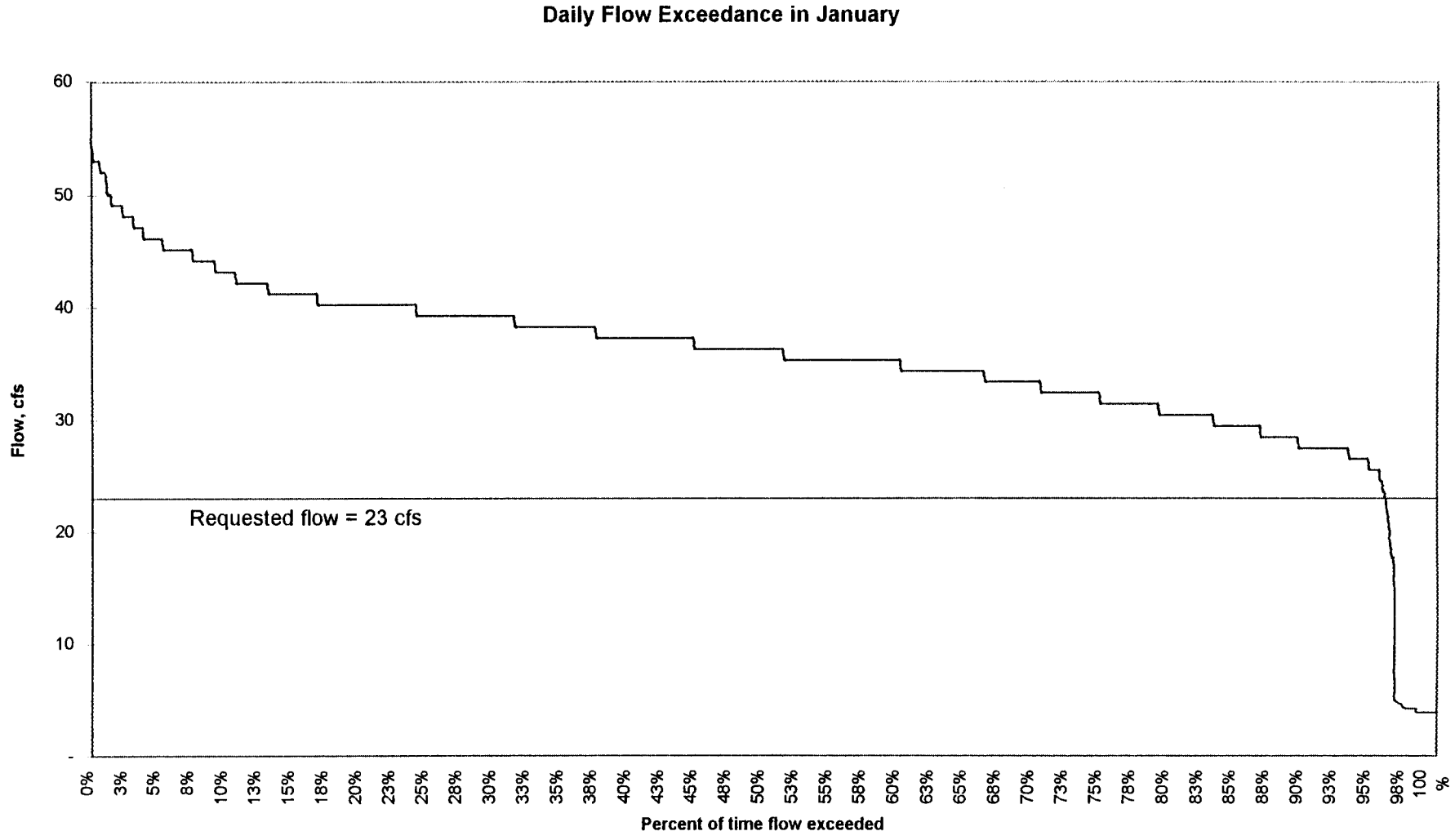
Daily Flow Exceedance in January
Flow, cfs
60
50
40
30
20
10
-
Requested flow = 23 cfs
0%
3%
5%
8%
10%
13%
15%
18%
20%
23%
25%
28%
30%
33%
35%
38%
40%
43%
45%
48%
50%
53%
55%
58%
60%
63%
65%
68%
70%
73%
75%
78%
80%
83%
85%
88%
90%
93%
95%
98%
100
%
Percent of time flow exceeded

FIGURE 26

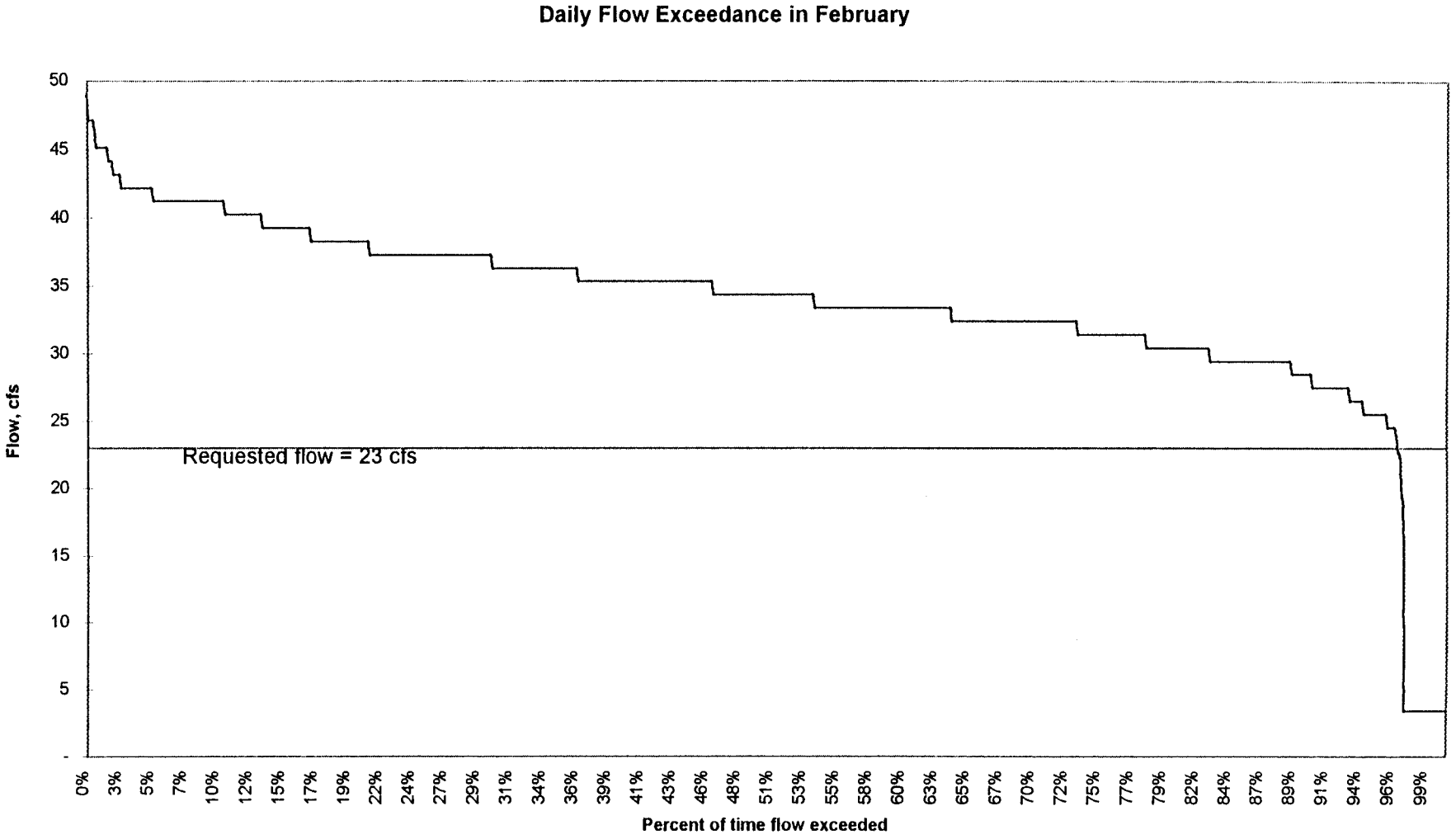
Daily Flow Exceedance in February
Flow, cfs
50
45
40
35
30
25
20
15
10
5
-
Requested flow = 23 cfs
0%
3%
5%
7%
10%
12%
15%
17%
19%
22%
24%
27%
29%
31%
34%
36%
39%
41%
43%
46%
48%
51%
53%
55%
58%
60%
63%
65%
67%
70%
72%
75%
77%
79%
82%
84%
87%
89%
91%
94%
96%
99%
Percent of time flow exceeded

FIGURE 27

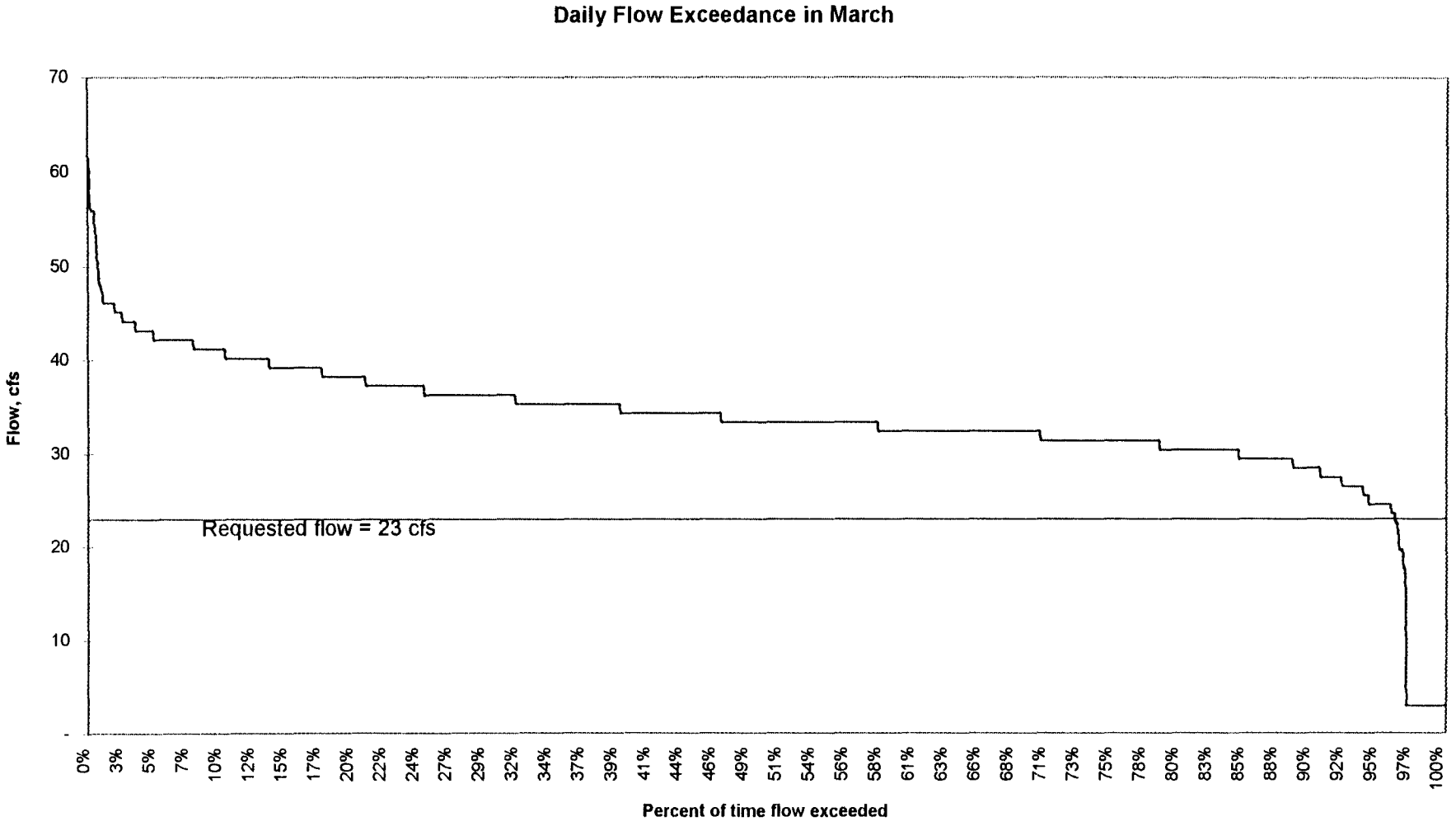
Daily Flow Exceedance in March
Flow, cfs
70
60
50
40
30
20
10
-
Requested flow = 23 cfs
0%
3%
5%
7%
10%
12%
15%
17%
20%
22%
24%
27%
29%
32%
34%
37%
39%
41%
44%
46%
49%
51%
54%
56%
58%
61%
63%
66%
68%
71%
73%
75%
78%
80%
83%
85%
88%
90%
92%
95%
97%
100%
Percent of time flow exceeded

FIGURE 28

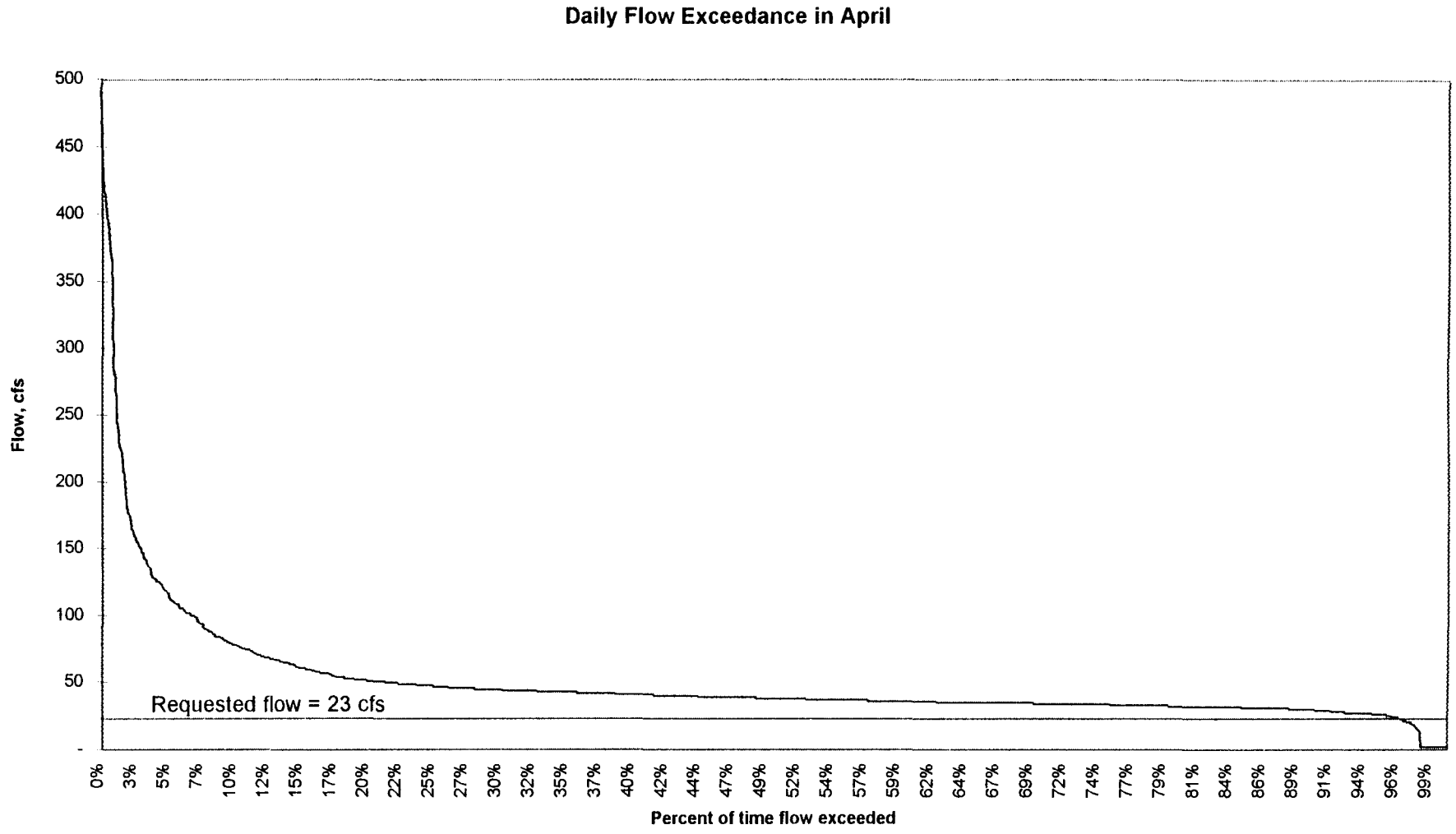
Daily Flow Exceedance in April
Flow, cfs
500
450
400
350
300
250
200
150
100
50
-
Requested flow = 23 cfs
0%
3%
5%
7%
10%
12%
15%
17%
20%
22%
25%
27%
30%
32%
35%
37%
40%
42%
44%
47%
49%
52%
54%
57%
59%
62%
64%
67%
69%
72%
74%
77%
79%
81%
84%
86%
89%
91%
94%
96%
99%
Percent of time flow exceeded

FIGURE 29

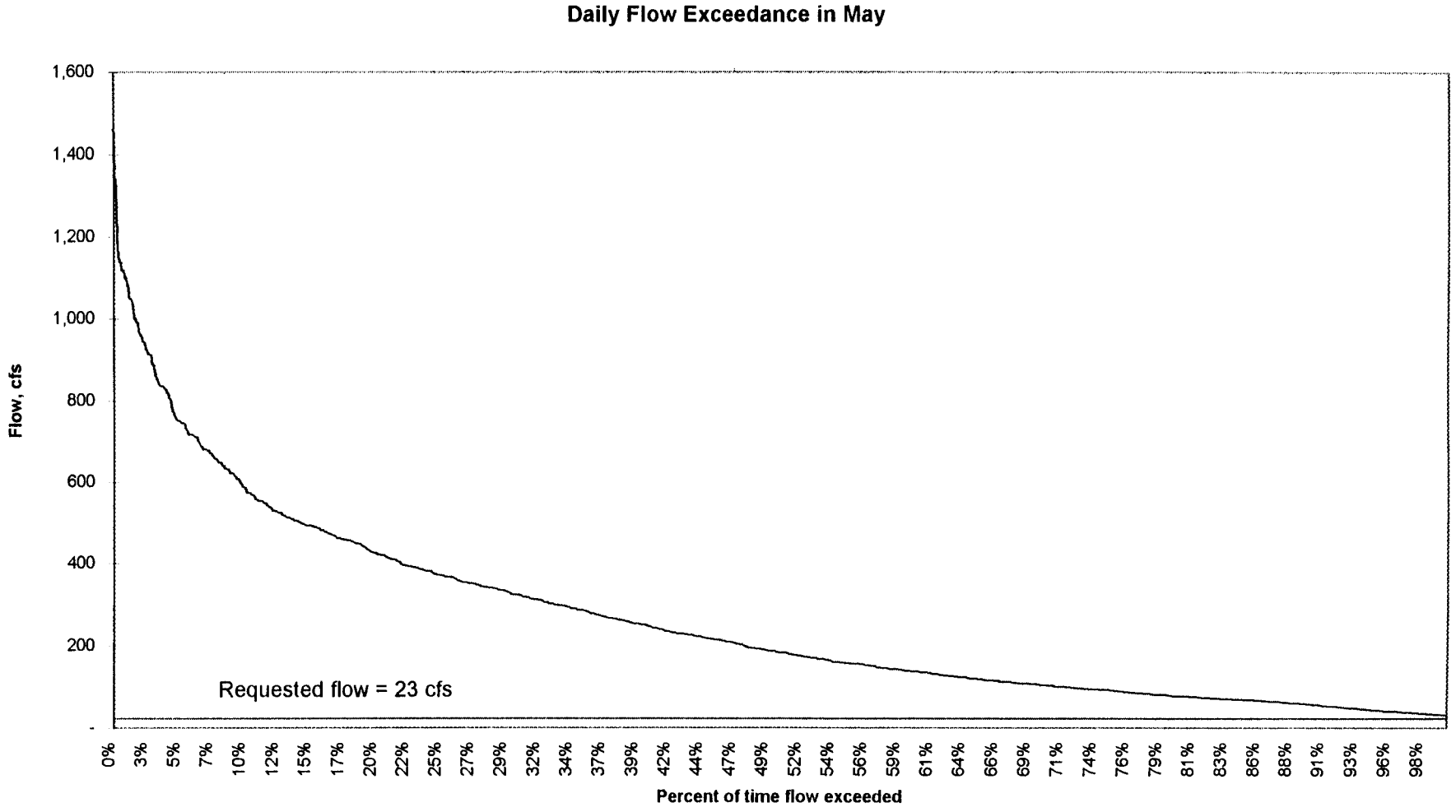
Daily Flow Exceedance in May
Flow, cfs
1,600
1,400
1,200
1,000
800
600
400
200
-
Requested flow = 23 cfs
0%
3%
5%
7%
10%
12%
15%
17%
20%
22%
25%
27%
29%
32%
34%
37%
39%
42%
44%
47%
49%
52%
54%
56%
59%
61%
64%
66%
69%
71%
74%
76%
79%
81%
83%
86%
88%
91%
93%
96%
98%
Percent of time flow exceeded

FIGURE 30

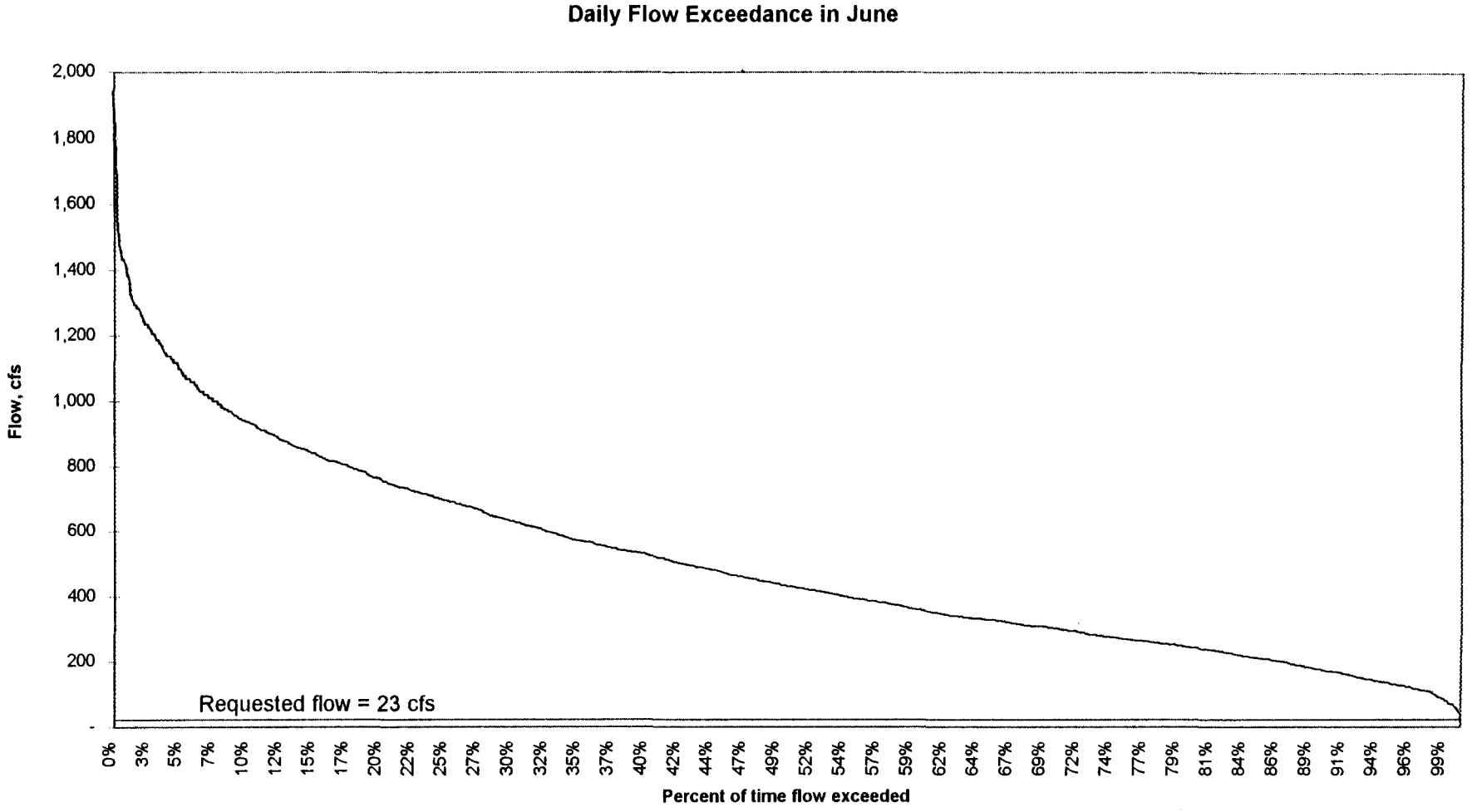
Daily Flow Exceedance in June
Flow, cfs
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
-
Requested flow = 23 cfs
0%
3%
5%
7%
10%
12%
15%
17%
20%
22%
25%
27%
30%
32%
35%
37%
40%
42%
44%
47%
49%
52%
54%
57%
59%
62%
64%
67%
69%
72%
74%
77%
79%
81%
84%
86%
89%
91%
94%
96%
99%
Percent of time flow exceeded

FIGURE 31

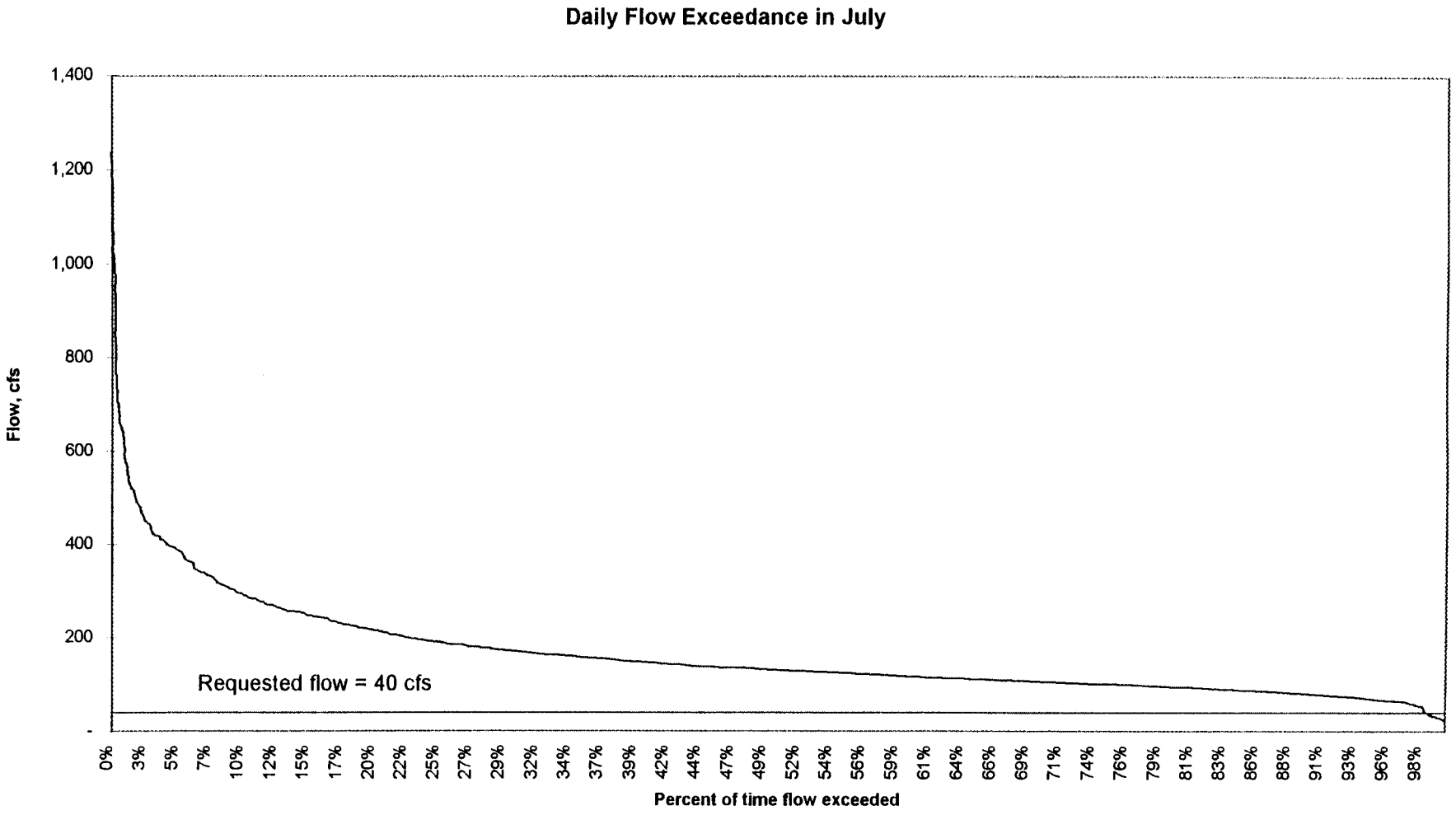
Daily Flow Exceedance in July
Flow, cfs
1,400
1,200
1,000
800
600
400
200
-
Requested flow = 40 cfs
0%
3%
5%
7%
10%
12%
15%
17%
20%
22%
25%
27%
29%
32%
34%
37%
39%
42%
44%
47%
49%
52%
54%
56%
59%
61%
64%
66%
69%
71%
74%
76%
79%
81%
83%
86%
88%
91%
93%
96%
98%
Percent of time flow exceeded

FIGURE 32

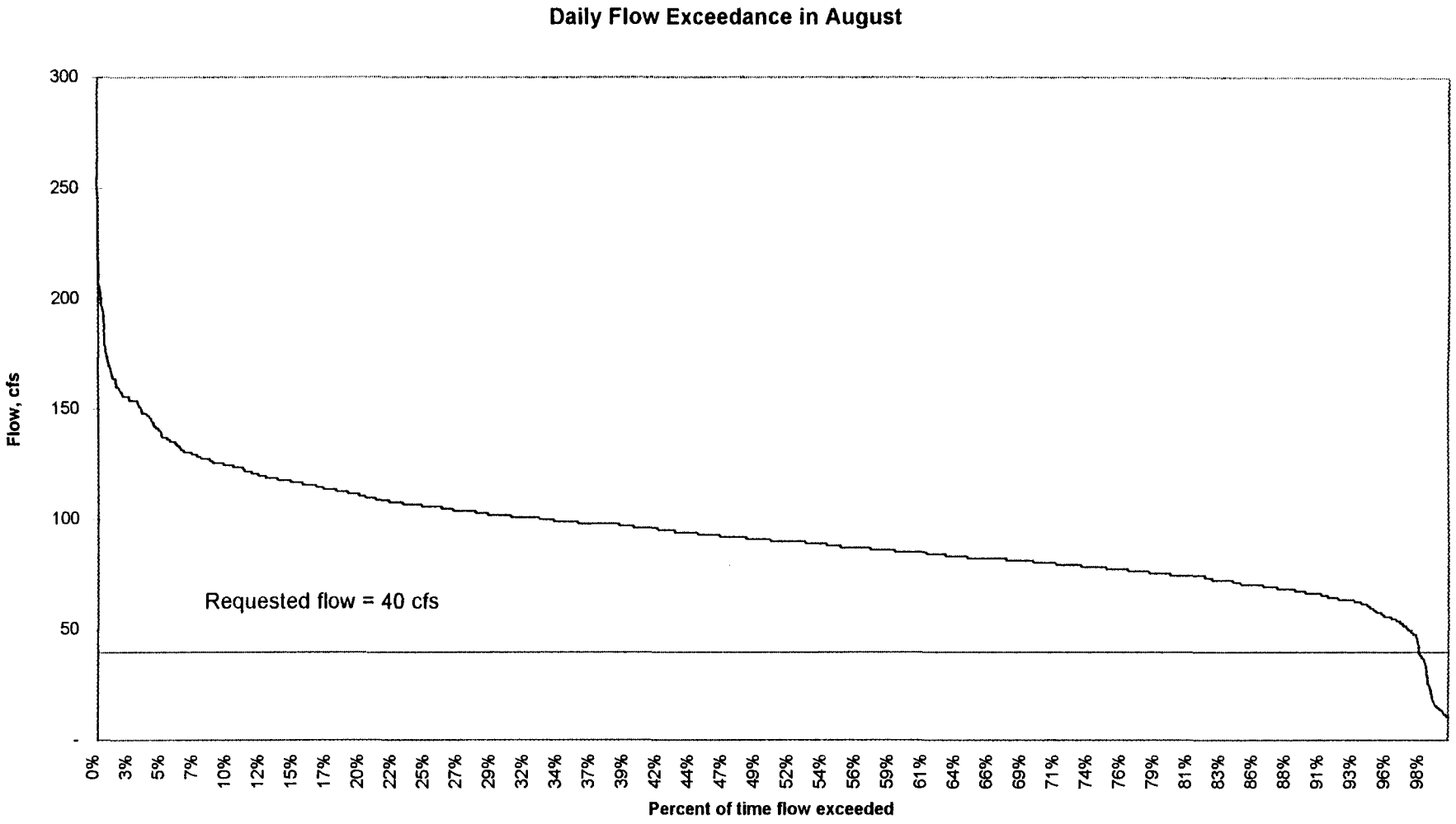
Daily Flow Exceedance in August
Flow, cfs
300
250
200
150
100
50
-
Requested flow = 40 cfs
0%
3%
5%
7%
10%
12%
15%
17%
20%
22%
25%
27%
29%
32%
34%
37%
39%
42%
44%
47%
49%
52%
54%
56%
59%
61%
64%
66%
69%
71%
74%
76%
79%
81%
83%
86%
88%
91%
93%
96%
98%
Percent of time flow exceeded

FIGURE 33

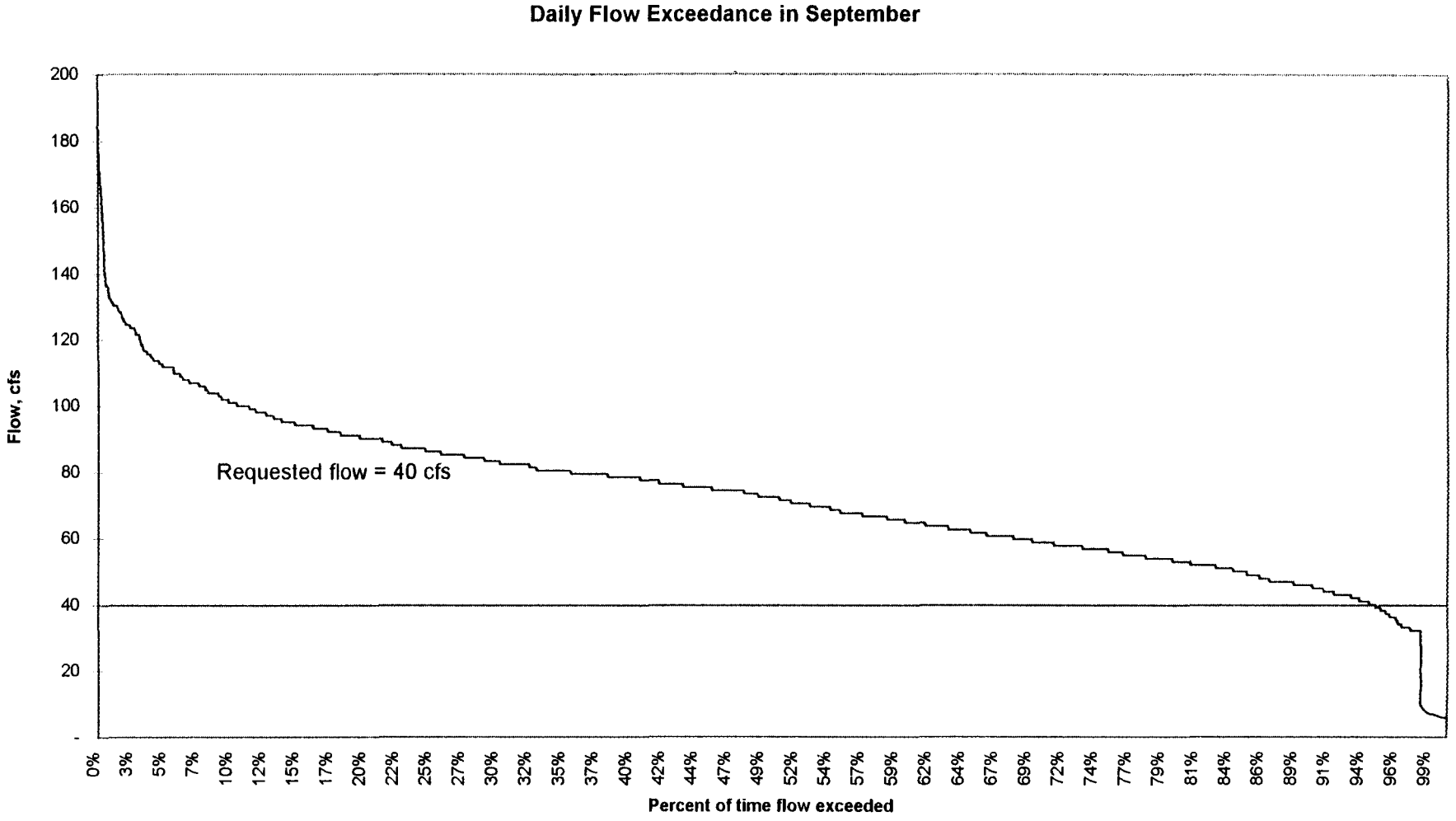
Daily Flow Exceedance in September
Flow, cfs
200
180
160
140
120
100
80
60
40
20
-
Requested flow = 40 cfs
0%
3%
5%
7%
10%
12%
15%
17%
20%
22%
25%
27%
30%
32%
35%
37%
40%
42%
44%
47%
49%
52%
54%
57%
59%
62%
64%
67%
69%
72%
74%
77%
79%
81%
84%
86%
89%
91%
94%
96%
99%
Percent of time flow exceeded

FIGURE 34

XIV. Conclusions-Segment 2

A. Mean Monthly Flow Analysis

Table 18 shows that, for all months, the Instream Flow Request is met under total mean monthly flow conditions. Table 19 shows that the USFS instream flow right remains smaller than the WGFD for all months but May and June.

B. Dry Year Flow Analysis

Figure 20 shows that during the driest periods on record, for all months, the instream flow request is met under total flow conditions. Figures 21 and 22 show that during the driest year (1957) and the average of the three driest years, the request is met by total flows in all months.

C. Daily Flow Exceedance Analysis

When considering daily flow duration, the Wyoming Water Development Commissions 50% criterion will be met in the two periods by a substantial margin.

Appendix A-Water Rights

Table A1. Direct Flow Water Rights

Diversion No.	Permit No.	T	R	S	QQ	Priority Date	Facility Name	Source	Amount (CFS)	Use Code	Adj-Unadj	2 Times Pre-3/1/1985 Rights	Non-Irrig Diversions	Permit Acres	Notes
1	P17878D	54	90	15		1/12/31	Cottonwood Supplemental Supply Ditch	Cottonwood Creek	2.07	IRR	adj	4.14		145*	
									8.34		adj	16.68		584	
2	P18893D	53	88	19	SESE	2/26/38	Shell Ranger Station Irrigation Ditch	Antelope Creek	0.02	IRR	adj	0.04		1.17	
3	P18907D	53	88	30	NENE	2/26/38	Shell Ranger Station Pipe Line	Ranger Creek	0.03	DOM	adj		0.03	0	
4	P19669D	53	88	19	SWSE	7/3/41		Shell Creek	1.20	RES	adj			0	P5437R
5	P19803D	53	88	19	NWSE	7/23/43	Shell Ranger Station Pipe Line #2	Shell Ranger Station		STO IRR DOM	adj			1*	See P19802D
5	P19802D	53	88	19	NESE	7/23/43	Shell Ranger Station Pipe Line #1	Shell Ranger Station	0.02	STO	adj		0.02	1	
6	P23285D	52	87	6	SENW	10/30/69	Adelaide	Buckley Creek	14.70	RES	adj		14.7	0	P1921R
	*Supplemental Supply										Total	20.86	14.75		

Table A2. Reservoir and Storage

	Permit No.	T	R	S		Priority Date	Facility	Source	Use	Amount (AF) IRR	Amount (AF) Other	Adj/Unadj
6	P1921R	53	88	36	SWNE	8/8/10	Adelaide	Adelaide Creek	IRR	1449**		Adj
7	P2200R	53	88	36	SWSW	10/20/11	Shell	Shell Creek	IRR	1949**		Adj
7	P4838R	53	88	36	SWSW	3/3/38	ENL Shell	Shell Creek	IRR, MUN, DOM	1948		Adj
4	P5437R	53	88	19	SWSE	7/3/41	Shell Creek Ranger Station and Rearing Pond	Shell Creek	STO, DOM,FIS		0.58	Adj
8	P5470R	53	88	30	SENE	11/14/41	Ranger Creek Fish Pond	Ranger Creek	REC,FIS		25.2	Adj
9	P2855S	54	89	11	SESW	11/2/59	Wiley Creek	Wiley Creek	STO	0.04		Adj
10	P9871S	54	89	16	SWNE	1/27/86	North Cedar Creek	N Cedar Creek	STO	0.77		Adj
6	P9308R	53	88	36	SWNE	6/5/86	ENL Adelaide	Adelaide Creek Buckley Creek	IRR FIS	4675		Adj
									Total	6624	26	

**Amount included in enlargement

Table A3. USFS Reservoir Permits-Adjudicated by Court Award
Priority Date-1898

Facility Name	Use	T	R	S	Use	Amount of Use AF	Amount of Use CFS	Months of Use
WLY CR TR	Storage	54	89	5	Stock	0.1 AF		Jun-Sep
WLY CR TR	Storage	54	89	7	Stock	0.1 AF		Jun-Sep
WILEY CR	Storage	54	89	10	Stock	0.1 AF		Jun-Sep
CEDR CR TR	Storage	54	89	16	Stock	0.3 AF		Jun-Sep
COTTONWOOD	Direct Flow	54	90	11	Stock		0.002 cfs	Jun-Oct
GC DIV S	Direct Flow	54	90	14	Stock		0.002 cfs	Jun-Oct
FNGR CR DR	Storage	54	89	6	Stock	0.1 AF		Jun-Sep
WILEY CR	Storage	54	89	5	Stock	0.1 AF		Jul-Oct
HARRIS SPR	Direct Flow	54	89	8	Stock		0.003 cfs	Jun-Oct
WILEY CR	Storage	54	89	10	Stock	0.1 AF		Jun-Sep
THREE SPR	Direct Flow	54	89	8	Stock		0.003 cfs	Jun-Sep
NEVILLE SP	Direct Flow	54	89	9	Stock		0.003 cfs	Jun-Sep
LONG PK SP	Direct Flow	54	90	23	Stock		0.002 cfs	Jun-Oct
W COTWD CR	Direct Flow	54	90	27	Stock		0.002 cfs	Jun-Oct
COTTNWD CR	Direct Flow	54	90	15	Stock		0.002 cfs	Jun-Sep
WILEY CR	Storage	54	89	18	Stock	0.1 AF		Jun-Oct
COW CP SPG	Direct Flow	54	90	10	Stock		0.001 cfs	Jun-Oct
SUNDWN SPG	Storage	54	89	22	Stock	0.1 AF		Jun-Oct
SNOWBANK SP	Storage	54	90	2	Stock	0.1 AF		Jul-Oct
CABIN CR S	Direct Flow	53	89	14	Domestic		0.001 cfs	Jun-Oct
GRANITE SP	Direct Flow	53	89	15	Domestic		0.001 cfs	Jun-Oct
POST SP	Direct Flow	53	90	10	Domestic		0.001 cfs	Jun-Oct
SHELL F SP	Direct Flow	53	89	7	Domestic		0.008 cfs	Jun-Nov
RANGER C S	Direct Flow	53	88	20	Domestic		0.002 cfs	May-Oct
HOBO SPR	Direct Flow	53	89	15	Stock		0.004 cfs	May-Nov

Table A3. USFS Reservoir Permits-Adjudicated by Court Award
Priority Date-1898

Facility Name	Use	T	R	S	Use	Amount of Use AF	Amount of Use CFS	Months of Use
GRANITE C	Direct Flow	54	89	27	Stock		0.004 cfs	Jul-Sep
BRINDLE CR	Storage	54	89	29	Stock	0.4 AF		Jul-Sep
BRINDLE CR	Storage	54	89	29	Stock	0.4 AF		Jul-Sep
GROUS C S1	Direct Flow	54	89	33	Stock		0.004 cfs	Jul-Sep
GROUS C S2	Direct Flow	54	89	33	Stock		0.004 cfs	Jul-Sep
RESERVE S2	Storage	53	90	14	Stock	0.2 AF		May-Oct
RATTLSNK S	Storage	53	90	14	Stock	0.2 AF		May-Oct
SHELL R SP	Direct Flow	53	89	11	Domestic		0.001 cfs	May-Oct
GRANITE S3	Direct Flow	54	88	31	Domestic		0.001 cfs	Jan-Dec
BRINDLE CR	Storage	54	89	30	Stock	0.3 AF		Jul-Oct
N SNOSHE S	Direct Flow	53	88	30	Stock		0.008 cfs	May-Oct
S SNSHE S	Direct Flow	53	88	31	Stock		0.003 cfs	May-Oct
SPRING	Direct Flow	53	88	17	Stock		0.006 cfs	Jun-Oct
SPRING	Direct Flow	53	89	10	Stock		0.006 cfs	Jun-Oct
SC SPRNG	Direct Flow	53	88	5	Stock		0.005 cfs	Jun-Oct
SHELL SP 1	Direct Flow	53	88	29	Domestic		0.001 cfs	May-Nov
MASONIC SP	Direct Flow	53	89	15	Domestic		0.001 cfs	Jan-Dec
RUBLE S1	Direct Flow	53	89	14	Domestic		0.001 cfs	Jun-Oct
WILLIAMS SP	Direct Flow	54	88	31	Domestic		0.001 cfs	Jan-Dec
RANGR C SP	Direct Flow	53	88	29	Domestic		0.001 cfs	May-Nov
RUBLE S 2	Direct Flow	53	89	14	Domestic		0.001 cfs	May-Nov
RIALTO SPR	Direct Flow	53	89	23	Domestic		0.001 cfs	May-Nov
MILDREN SP	Direct Flow	54	88	30	Domestic		0.001 cfs	May-Nov
ASP SPRING	Direct Flow	54	88	31	Domestic		0.018 cfs	Nov-Apr
ASP SPRING	Direct Flow	54	88	31	Domestic		0.001 cfs	Jan-Dec

Table A3. USFS Reservoir Permits-Adjudicated by Court Award
Priority Date-1898

Facility Name	Use	T	R	S	Use	Amount of Use AF	Amount of Use CFS	Months of Use
RANCH SPR	Direct Flow	53	88	30	Domestic		0.003 cfs	Jan-Dec
RESERVE SP	Direct Flow	53	90	13	Stock		0.003 cfs	May-Oct
BULL SPR	Direct Flow	53	89	7	Stock		0.004 cfs	Jun-Oct
CEDAR SPR	Direct Flow	54	89	22	Stock		0.005 cfs	Jun-Oct
N GRANIT S	Storage	54	89	26	Stock	0.5 AF		Jun-Oct
CEDAR CR	Storage	54	89	14	Stock	0.4 AF		Jul-Oct
GRANITE CR	Storage	54	89	34	Stock	0.4 AF		Jul-Oct
CRKED SP 2	Storage	53	88	33	Stock	0.1 AF		Jul-Oct
S ANTELP S	Direct Flow	53	88	18	Stock		0.008 cfs	Jul-Sep
N ANTELP S	Direct Flow	53	88	5	Stock		0.003 cfs	Jul-Sep
SEEP SPRG	Storage	53	89	18	Stock	0.1 AF		May-Oct
L POINT SP	Storage	53	89	18	Stock	0.1 AF		May-Oct
MCNAY C SP	Storage	53	89	17	Stock	0.1 AF		May-Oct
BRINDLE S	Direct Flow	54	89	29	Stock		0.003 cfs	Jul-Sep
BRINDLE SP	Direct Flow	54	89	32	Stock		0.003 cfs	Jun-Oct
BIG SPR	Direct Flow	54	88	30	Stock		0.004 cfs	Jun-Oct
MYRE SPR	Direct Flow	54	88	31	Domestic		0.001 cfs	Jan-Dec
ASP SPRING	Direct Flow	54	88	31	Domestic		0.001 cfs	Jan-Dec
HAGER SP	Direct Flow	53	88	20	Domestic		0.001 cfs	May-Nov
JOHNSON SP	Direct Flow	53	88	20	Domestic		0.001 cfs	Jun-Oct
BARTHELL S	Direct Flow	53	88	20	Domestic		0.001 cfs	May-Nov
BOOKER SPR	Direct Flow	53	88	20	Domestic		0.001 cfs	May-Nov
BOYLE SP	Direct Flow	53	88	20	Domestic		0.001 cfs	May-Nov
SHERARD SP	Direct Flow	53	88	29	Domestic		0.001 cfs	Jun-Oct
HAMILTON S	Direct Flow	53	89	14	Domestic		0.001 cfs	Jun-Oct

Table A3. USFS Reservoir Permits-Adjudicated by Court Award
Priority Date-1898

Facility Name	Use	T	R	S	Use	Amount of Use AF	Amount of Use CFS	Months of Use
WOODS SP	Direct Flow	53	89	14	Domestic		0.001 cfs	Jun-Oct
WILSON SP	Direct Flow	53	89	13	Domestic		0.001 cfs	Jun-Oct
FLITNER SP	Direct Flow	54	88	31	Domestic		0.001 cfs	Jan-Dec
ASP SPR	Direct Flow	54	88	31	Domestic		0.001 cfs	Jan-Dec
HORN SPR	Direct Flow	54	88	31	Domestic		0.001 cfs	Jan-Dec
PERKINS SP	Direct Flow	54	88	32	Domestic		0.001 cfs	Jan-Dec
ANTELOPE S	Direct Flow	53	88	8	Stock		0.004 cfs	Jun-Oct
N GRANITE	Direct Flow	54	89	26	Stock		0.004 cfs	Jun-Oct
OVERGAS SP	Direct Flow	53	89	22	Domestic		0.001 cfs	Jan-Dec
EMMETT SP	Direct Flow	53	89	15	Domestic		0.001 cfs	Jan-Dec
MASONIC SP	Direct Flow	53	89	15	Domestic		0.001 cfs	Jan-Dec
WILIAMS SP	Direct Flow	54	88	31	Domestic		0.001 cfs	Jan-Dec
WILIAMS SP	Direct Flow	54	88	31	Domestic		0.001 cfs	Jan-Dec
RTLSNK SPR	Direct Flow	53	90	14	Stock		0.004 cfs	May-Oct
RESRV SP 3	Storage	53	90	13	Stock	0.1 AF		May-Oct
RESERV S 4	Storage	53	90	14	Stock	0.1 AF		May-Oct
FUZZY SP	Storage	53	90	14	Stock	0.2 AF		May-Oct
RANGER CR	Storage	53	88	31	Stock	0.1 AF		Jul-Oct

Table A4. USFS Instream Flow Rights-Adjudicated by Court Award
Priority Date-1898
Point of Diversion: Above any other existing Water Rights

Stream	Use	T	R	S	Month	Amount of Use (cfs)
Shell Creek (17)	Flow	53	90	17	Jan	10.50
					Feb	7.50
					Mar	9.80
					Apr	10.90
					May	92.70
					Jun	126.40
					Jul	11.50
					Aug	11.50
					Sep	10.90
					Oct	11.50
					Nov	7.00
					Dec	7.00
Shell Creek (17A) above Reservoir	Flow	53	88	36	Jan	1.28
					Feb	0.68
					Mar	0.59
					Apr	1.29
					May	38.88
					Jun	47.39
					Jul	4.29
					Aug	3.89
					Sep	2.69
					Oct	2.67
					Nov	1.33
					Dec	0.70
Adelaide Creek (17B) above Reservoir	Flow	53	88	36	Jan	0.10
					Feb	0.07
					Mar	0.07
					Apr	0.10
					May	2.54
					Jun	4.69
					Jul	0.42
					Aug	0.31
					Sep	0.20
					Oct	0.21
					Nov	0.10
					Dec	0.10

Appendix B-Description of USFS Decree Water Rights

* water for channel maintenance to scare favorable conditions of water flow.
** water for recreation fish and wildlife, stock and watershed protection.

2. Quantified Waterflow Uses:

a. In this matter the United States has claimed the right to pass certain amounts of water, measured in acre-feet, past specified points on certain natural streams in the Bighorn and Shoshone National Forests in order to achieve the purposes of those Forests under the Organic Act of 1897.* The United States has also made a separate claim for the right to maintain certain levels of instream flows on those same streams to accomplish the additional purposes of the Bighorn National Forest under the Multiple Use-Sustained Yield Act of 1960.** It is the Decree of the Court that, with the limitations stated herein, the United States shall have a water right to pass those amounts of water shown on the following pages past the points identified on the streams specified on the Bighorn and Shoshone National Forests during the periods shown. The United States shall

have no other water right to the passage of any quantity of water or to the maintenance of any instream flows on the Bighorn and Shoshone National Forests except as specified by this Decree. Each of the following pages refers to a specific individual water right and defines the following elements of the right:

(1) The name of the national forest on which the stream is located;

(2) The name of the stream upon which the water right applies;

(3) The priority date of the water right;

(4) The point at which the water right is quantified, which is the point at which it may be enforced and maintained; and

(5) The amount of the water right, in total acre-feet annually and monthly at the point of quantification.

Each of the foregoing elements of each water right is to be construed as a limitation on the right. Other limitations on the water rights granted herein are as otherwise specified in this Decree.

b. The amounts shown for each of the water rights quantified on the following pages are displayed on a monthly basis. The monthly totals shall be considered to state a limitation upon the right decreed. The United States shall not be entitled in any month to the passage of a greater amount of water than as shown below for that month. Passage of a greater amount in any given month shall not, however, affect the amount to which the United States is entitled in subsequent months.

c. The priority date of each water right shall be as shown in this Decree on the page pertaining to an individual water right.

d. The water rights granted herein on behalf of the National Forests shall be in full and final satisfaction of all rights of the

United States to the passage of any quantity of water past any point on any natural stream on the Bighorn and Shoshone National Forests and the right to maintain any level of instream flow on the Forests. Any other section of this Decree notwithstanding, the United States shall have no right to make any change of any kind in the water rights decreed by this section of the Decree. The water decreed herein shall be used solely as decreed, to pass those amounts of water shown past the points shown and in the amounts shown, on the stream in which the water naturally flows. The United States shall have the same rights as any other water right holder in Wyoming to assert injury to the instream flow rights decreed herein as a bar or defense to a change of a state-awarded water right.

Appendix C-Diversion Analysis

Summary of Diversions and Return Flows-Based on Water Rights Obtained from the Wyoming State Engineers office and the US Forest Service
AMA 5/2/94

Diversion Location	Diversion Amounts per Month (CFS)											
	Oct	*Nov*	*Dec*	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sept*
Above Segment No. 1												
Diversions												
Irrigation								16.72	16.72	16.72	16.72	16.72
USFS and other												
Reservoirs	0.11	0.04	0.01	0.01	0.01	0.01	0.01	12.40	12.50	12.50	0.16	0.16
Other	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
TOTAL (cfs)	0.16	0.09	0.06	0.06	0.06	0.06	0.06	29.17	29.27	29.27	16.93	16.93
Return Flows												
Irrigation								9.20	9.20	9.20	9.20	9.20
USFS and other												
Reservoirs												
Other	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
TOTAL (cfs)	0.03	0.03	0.03	0.03	0.03	0.03	0.03	9.22	9.22	9.22	9.22	9.22
Appropriation Depletions												
Irrigation								7.52	7.52	7.52	7.52	7.52
USFS and other												
Reservoirs	0.11	0.04	0.01	0.01	0.01	0.01	0.01	12.40	12.50	12.50	0.16	0.16
Other	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
TOTAL (cfs)	0.13	0.06	0.03	0.03	0.03	0.03	0.03	19.95	20.05	20.05	7.71	7.71

Above Segment No. 2

Diversions

Irrigation								20.86	20.86	20.86	20.86	20.86
USFS and other Reservoirs	0.17	0.06	0.02	0.02	0.02	0.02	0.02	12.47	12.47	12.47	0.24	0.24
Other	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
TOTAL	0.22	0.11	0.07	0.07	0.07	0.07	0.07	33.38	33.38	33.38	21.15	21.15

Return Flows

Irrigation								11.47	11.47	11.47	11.47	11.47
USFS and other Reservoirs												
Other	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
TOTAL (cfs)	0.03	0.03	0.03	0.03	0.03	0.03	0.03	11.50	11.50	11.50	11.50	11.50

Appropriation Depletions+A27

Irrigation								9.39	9.39	9.39	9.39	9.39
USFS and other Reservoirs	0.17	0.06	0.02	0.02	0.02	0.02	0.02	12.47	12.47	12.47	0.24	0.24
Other	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
TOTAL (cfs)	0.19	0.08	0.04	0.04	0.04	0.04	0.04	21.88	21.88	21.88	9.65	9.65

Assumptions Made:
- Irrigation takes place in months May-Sept.
- Reservoirs fill during high flow months
- 65% of all USFS Reservoirs are above Segment 1
- Irrigation Return flows = 50 % of diversion
- Other return flows = 55% of Diversion
- The existing instream flows are non-consumptive
- The Reservoir Flows are not returned to the system

Appendix D-Gage Near Shell 06278500

Monthly Flows by Year **Shell Creek near Shell** USGS Gage Data

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Average Annual Flow, cfs	Annual Discharge, ac-ft
1940	60	40	30	30	30	31	35	353	231	82	77	102	92	66,654
1941	95	59	45	40	34	33	124	269	378	126	79	56	112	80,782
1942	50	46	43	39	37	38	69	215	694	211	85	70	133	96,220
1943	49	45	37	35	34	34	37	352	639	224	85	75	137	99,578
1944	55	48	39	38	37	35	35	197	600	308	107	105	134	96,759
1945	71	56	49	43	42	48	138	288	611	163	86	98	141	102,067
1946	80	64	53	45	45	41	47	355	541	255	100	84	143	103,293
1947	67	61	56	49	42	40	44	384	309	125	87	53	110	79,832
1948	49	45	42	37	33	33	53	393	489	122	73	65	120	86,756
1949	50	44	37	35	33	31	44	165	541	173	97	75	110	79,919
1950	68	51	41	33	32	33	39	320	363	204	115	70	115	83,071
1951	55	46	41	39	35	33	92	374	391	163	94	59	119	86,177
1952	46	40	37	38	37	36	35	93	690	141	89	60	111	80,667
1953	44	42	42	38	36	34	41	329	285	103	68	36	92	66,485
1954	35	32	33	29	31	33	38	288	578	156	78	49	115	83,347
1955	42	41	39	37	39	39	43	394	371	92	64	45	104	75,488
1956	37	37	34	30	30	31	34	162	535	155	94	67	104	75,026
1957	9	8	6	4	4	3	3	289	99	40	22	7	42	30,108
1958	45	41	38	35	32	32	38	114	572	127	98	71	103	74,788
1959	52	40	38	32	32	29	42	182	279	81	77	48	78	56,448
1960	47	34	32	29	27	26	29	295	261	69	68	50	81	58,485
1961	53	49	40	33	33	33	91	319	582	172	89	71	130	94,476
1962	55	52	43	35	35	33	40	273	670	123	85	59	125	90,567
1963	47	44	38	35	34	34	34	237	755	285	115	88	145	105,330
1964	67	50	47	42	37	35	44	131	916	258	113	93	152	110,223
1965	69	48	43	38	36	36	37	284	163	73	58	38	77	55,962
1966	39	36	35	28	28	32	35	218	810	281	94	92	144	104,100
1967	81	60	48	42	38	37	37	116	990	217	135	134	160	116,420
1968	94	76	60	47	42	42	91	438	271	209	101	72	129	93,580
1969	62	50	44	39	38	36	37	227	693	177	101	75	131	95,125
1970	50	43	41	39	37	36	41	280	638	142	112	70	127	92,110
1971	60					43	46	260	649	174	125	90		
1972						41	42	331	609	138	95	77		
1973							54	293	643	162	114	86		
1974							36	94	714	473	126	98		
1975							46	290	669	190	122	86		
1976							71	312	288	99	79	55		
1977							43	220	779	332	140	116		
1978							54	353	465	176	158	119		
1979							55	293	372	128	93	75		
1980							71	343	427	127	97	65		
1981							33	192	605	245	93	93		
1982							40	138	606	204	109	81		
1983							39	253	641	194	107	84		

Monthly Flows by Year **Shell Creek near Shell** USGS Gage Data

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Average Annual Flow, cfs	Annual Discharge, ac-ft
1984							56	330	192	85	73	60		
1985							41	273	727	135	109	93		
1986							120	290	210	104	94	82		
1987							62	553	298	100	75	56		
1988							38	253	319	123	86	73		
1989							62	200	666	186	106	66		
1990							35	308	489	124	114	88		
Mean	56	46	40	36	34	34	51	273	516	168	95	74	117	84,511
Max	95	76	60	49	45	48	138	553	990	473	158	134	160	116,420
Min	9	8	6	4	4	3	3	93	99	40	22	7	42	30,108

Monthly Flows by Year
Ranked by October Low Flows

Shell Creek near Shell

USGS Gage Data

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Average Annual Flow, cfs	Annual Discharge, ac-ft
1957	9	8	6	4	4	3	3	289	99	40	22	7	42	30,108
1954	35	32	33	29	31	33	38	288	578	156	78	49	115	83,347
1956	37	37	34	30	30	31	34	162	535	155	94	67	104	75,026
1966	39	36	35	28	28	32	35	218	810	281	94	92	144	104,100
1955	42	41	39	37	39	39	43	394	371	92	64	45	104	75,488
1953	44	42	42	38	36	34	41	329	285	103	68	36	92	66,485
1958	45	41	38	35	32	32	38	114	572	127	98	71	103	74,788
1952	46	40	37	38	37	36	35	93	690	141	89	60	111	80,667
1960	47	34	32	29	27	26	29	295	261	69	68	50	81	58,485
1963	47	44	38	35	34	34	34	237	755	285	115	88	145	105,330
1948	49	45	42	37	33	33	53	393	489	122	73	65	120	86,756
1943	49	45	37	35	34	34	37	352	639	224	85	75	137	99,578
1942	50	46	43	39	37	38	69	215	694	211	85	70	133	96,220
1970	50	43	41	39	37	36	41	280	638	142	112	70	127	92,110
1949	50	44	37	35	33	31	44	165	541	173	97	75	110	79,919
1959	52	40	38	32	32	29	42	182	279	81	77	48	78	56,448
1961	53	49	40	33	33	33	91	319	582	172	89	71	130	94,476
1944	55	48	39	38	37	35	35	197	600	308	107	105	134	96,759
1951	55	46	41	39	35	33	92	374	391	163	94	59	119	86,177
1962	55	52	43	35	35	33	40	273	670	123	85	59	125	90,567
1940	60	40	30	30	30	31	35	353	231	82	77	102	92	66,654
1971	60					43	46	260	649	174	125	90		
1969	62	50	44	39	38	36	37	227	693	177	101	75	131	95,125
1947	67	61	56	49	42	40	44	384	309	125	87	53	110	79,832
1964	67	50	47	42	37	35	44	131	916	258	113	93	152	110,223
1950	68	51	41	33	32	33	39	320	363	204	115	70	115	83,071
1965	69	48	43	38	36	36	37	284	163	73	58	38	77	55,962
1945	71	56	49	43	42	48	138	288	611	163	86	98	141	102,067
1946	80	64	53	45	45	41	47	355	541	255	100	84	143	103,293
1967	81	60	48	42	38	37	37	116	990	217	135	134	160	116,420
1968	94	76	60	47	42	42	91	438	271	209	101	72	129	93,580
1941	95	59	45	40	34	33	124	269	378	126	79	56	112	80,782
1972						41	42	331	609	138	95	77		
1973							54	293	643	162	114	86		
1974							36	94	714	473	126	98		
1975							46	290	669	190	122	86		
1976							71	312	288	99	79	55		
1977							43	220	779	332	140	116		
1978							54	353	465	176	158	119		
1979							55	293	372	128	93	75		
1980							71	343	427	127	97	65		
1981							33	192	605	245	93	93		
1982							40	138	606	204	109	81		
1983							39	253	641	194	107	84		

Monthly Flows by Year
Ranked by October Low Flows

Shell Creek near Shell

USGS Gage Data

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Average Annual Flow, cfs	Annual Discharge, ac-ft
1984							56	330	192	85	73	60		
1985							41	273	727	135	109	93		
1986							120	290	210	104	94	82		
1987							62	553	298	100	75	56		
1988							38	253	319	123	86	73		
1989							62	200	666	186	106	66		
1990							35	308	489	124	114	88		
Mean	56	46	40	36	34	34	51	273	516	168	95	74	117	84,511
Max	95	76	60	49	45	48	138	553	990	473	158	134	160	116,420
Min	9	8	6	4	4	3	3	93	99	40	22	7	42	30,108

Monthly Flows by Year
Ranked by November Low Flows

Shell Creek near Shell

USGS Gage Data

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Average Annual Flow, cfs	Annual Discharge, ac-ft
1957	9	8	6	4	4	3	3	289	99	40	22	7	42	30,108
1954	35	32	33	29	31	33	38	288	578	156	78	49	115	83,347
1960	47	34	32	29	27	26	29	295	261	69	68	50	81	58,485
1966	39	36	35	28	28	32	35	218	810	281	94	92	144	104,100
1956	37	37	34	30	30	31	34	162	535	155	94	67	104	75,026
1940	60	40	30	30	30	31	35	353	231	82	77	102	92	66,654
1952	46	40	37	38	37	36	35	93	690	141	89	60	111	80,667
1959	52	40	38	32	32	29	42	182	279	81	77	48	78	56,448
1955	42	41	39	37	39	39	43	394	371	92	64	45	104	75,488
1958	45	41	38	35	32	32	38	114	572	127	98	71	103	74,788
1953	44	42	42	38	36	34	41	329	285	103	68	36	92	66,485
1970	50	43	41	39	37	36	41	280	638	142	112	70	127	92,110
1949	50	44	37	35	33	31	44	165	541	173	97	75	110	79,919
1963	47	44	38	35	34	34	34	237	755	285	115	88	145	105,330
1943	49	45	37	35	34	34	37	352	639	224	85	75	137	99,578
1948	49	45	42	37	33	33	53	393	489	122	73	65	120	86,756
1942	50	46	43	39	37	38	69	215	694	211	85	70	133	96,220
1951	55	46	41	39	35	33	92	374	391	163	94	59	119	86,177
1965	69	48	43	38	36	36	37	284	163	73	58	38	77	55,962
1944	55	48	39	38	37	35	35	197	600	308	107	105	134	96,759
1961	53	49	40	33	33	33	91	319	582	172	89	71	130	94,476
1964	67	50	47	42	37	35	44	131	916	258	113	93	152	110,223
1969	62	50	44	39	38	36	37	227	693	177	101	75	131	95,125
1950	68	51	41	33	32	33	39	320	363	204	115	70	115	83,071
1962	55	52	43	35	35	33	40	273	670	123	85	59	125	90,567
1945	71	56	49	43	42	48	138	288	611	163	86	98	141	102,067
1941	95	59	45	40	34	33	124	269	378	126	79	56	112	80,782
1967	81	60	48	42	38	37	37	116	990	217	135	134	160	116,420
1947	67	61	56	49	42	40	44	384	309	125	87	53	110	79,832
1946	80	64	53	45	45	41	47	355	541	255	100	84	143	103,293
1968	94	76	60	47	42	42	91	438	271	209	101	72	129	93,580
1971	60					43	46	260	649	174	125	90		
1972						41	42	331	609	138	95	77		
1973							54	293	643	162	114	86		
1974							36	94	714	473	126	98		
1975							46	290	669	190	122	86		
1976							71	312	288	99	79	55		
1977							43	220	779	332	140	116		
1978							54	353	465	176	158	119		
1979							55	293	372	128	93	75		
1980							71	343	427	127	97	65		
1981							33	192	605	245	93	93		
1982							40	138	606	204	109	81		
1983							39	253	641	194	107	84		

Monthly Flows by Year
Ranked by November Low Flows

Shell Creek near Shell

USGS Gage Data

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Average Annual Flow, cfs	Annual Discharge, ac-ft
1984							56	330	192	85	73	60		
1985							41	273	727	135	109	93		
1986							120	290	210	104	94	82		
1987							62	553	298	100	75	56		
1988							38	253	319	123	86	73		
1989							62	200	666	186	106	66		
1990							35	308	489	124	114	88		
Mean	56	46	40	36	34	34	51	273	516	168	95	74	117	84,511
Max	95	76	60	49	45	48	138	553	990	473	158	134	160	116,420
Min	9	8	6	4	4	3	3	93	99	40	22	7	42	30,108

Monthly Flows by Year
Ranked by December Low Flows

Shell Creek near Shell

USGS Gage Data

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Average Annual Flow, cfs	Annual Discharge, ac-ft
1957	9	8	6	4	4	3	3	289	99	40	22	7	42	30,108
1940	60	40	30	30	30	31	35	353	231	82	77	102	92	66,654
1960	47	34	32	29	27	26	29	295	261	69	68	50	81	58,485
1954	35	32	33	29	31	33	38	288	578	156	78	49	115	83,347
1956	37	37	34	30	30	31	34	162	535	155	94	67	104	75,026
1966	39	36	35	28	28	32	35	218	810	281	94	92	144	104,100
1943	49	45	37	35	34	34	37	352	639	224	85	75	137	99,578
1949	50	44	37	35	33	31	44	165	541	173	97	75	110	79,919
1952	46	40	37	38	37	36	35	93	690	141	89	60	111	80,667
1963	47	44	38	35	34	34	34	237	755	285	115	88	145	105,330
1959	52	40	38	32	32	29	42	182	279	81	77	48	78	56,448
1958	45	41	38	35	32	32	38	114	572	127	98	71	103	74,788
1955	42	41	39	37	39	39	43	394	371	92	64	45	104	75,488
1944	55	48	39	38	37	35	35	197	600	308	107	105	134	96,759
1961	53	49	40	33	33	33	91	319	582	172	89	71	130	94,476
1951	55	46	41	39	35	33	92	374	391	163	94	59	119	86,177
1950	68	51	41	33	32	33	39	320	363	204	115	70	115	83,071
1970	50	43	41	39	37	36	41	280	638	142	112	70	127	92,110
1953	44	42	42	38	36	34	41	329	285	103	68	36	92	66,485
1948	49	45	42	37	33	33	53	393	489	122	73	65	120	86,756
1965	69	48	43	38	36	36	37	284	163	73	58	38	77	55,962
1942	50	46	43	39	37	38	69	215	694	211	85	70	133	96,220
1962	55	52	43	35	35	33	40	273	670	123	85	59	125	90,567
1969	62	50	44	39	38	36	37	227	693	177	101	75	131	95,125
1941	95	59	45	40	34	33	124	269	378	126	79	56	112	80,782
1964	67	50	47	42	37	35	44	131	916	258	113	93	152	110,223
1967	81	60	48	42	38	37	37	116	990	217	135	134	160	116,420
1945	71	56	49	43	42	48	138	288	611	163	86	98	141	102,067
1946	80	64	53	45	45	41	47	355	541	255	100	84	143	103,293
1947	67	61	56	49	42	40	44	384	309	125	87	53	110	79,832
1968	94	76	60	47	42	42	91	438	271	209	101	72	129	93,580
1971	60					43	46	260	649	174	125	90		
1972						41	42	331	609	138	95	77		
1973							54	293	643	162	114	86		
1974							36	94	714	473	126	98		
1975							46	290	669	190	122	86		
1976							71	312	288	99	79	55		
1977							43	220	779	332	140	116		
1978							54	353	465	176	158	119		
1979							55	293	372	128	93	75		
1980							71	343	427	127	97	65		
1981							33	192	605	245	93	93		
1982							40	138	606	204	109	81		
1983							39	253	641	194	107	84		

Monthly Flows by Year
Ranked by December Low Flows

Shell Creek near Shell

USGS Gage Data

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Average Annual Flow, cfs	Annual Discharge, ac-ft
1984							56	330	192	85	73	60		
1985							41	273	727	135	109	93		
1986							120	290	210	104	94	82		
1987							62	553	298	100	75	56		
1988							38	253	319	123	86	73		
1989							62	200	666	186	106	66		
1990							35	308	489	124	114	88		
Mean	56	46	40	36	34	34	51	273	516	168	95	74	117	84,511
Max	95	76	60	49	45	48	138	553	990	473	158	134	160	116,420
Min	9	8	6	4	4	3	3	93	99	40	22	7	42	30,108

Monthly Flows by Year
Ranked by January Low Flows

Shell Creek near Shell

USGS Gage Data

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Average Annual Flow, cfs	Annual Discharge, ac-ft
1957	9	8	6	4	4	3	3	289	99	40	22	7	42	30,108
1966	39	36	35	28	28	32	35	218	810	281	94	92	144	104,100
1960	47	34	32	29	27	26	29	295	261	69	68	50	81	58,485
1954	35	32	33	29	31	33	38	288	578	156	78	49	115	83,347
1940	60	40	30	30	30	31	35	353	231	82	77	102	92	66,654
1956	37	37	34	30	30	31	34	162	535	155	94	67	104	75,026
1959	52	40	38	32	32	29	42	182	279	81	77	48	78	56,448
1961	53	49	40	33	33	33	91	319	582	172	89	71	130	94,476
1950	68	51	41	33	32	33	39	320	363	204	115	70	115	83,071
1949	50	44	37	35	33	31	44	165	541	173	97	75	110	79,919
1962	55	52	43	35	35	33	40	273	670	123	85	59	125	90,567
1943	49	45	37	35	34	34	37	352	639	224	85	75	137	99,578
1958	45	41	38	35	32	32	38	114	572	127	98	71	103	74,788
1963	47	44	38	35	34	34	34	237	755	285	115	88	145	105,330
1955	42	41	39	37	39	39	43	394	371	92	64	45	104	75,488
1948	49	45	42	37	33	33	53	393	489	122	73	65	120	86,756
1944	55	48	39	38	37	35	35	197	600	308	107	105	134	96,759
1952	46	40	37	38	37	36	35	93	690	141	89	60	111	80,667
1953	44	42	42	38	36	34	41	329	285	103	68	36	92	66,485
1965	69	48	43	38	36	36	37	284	163	73	58	38	77	55,962
1942	50	46	43	39	37	38	69	215	694	211	85	70	133	96,220
1970	50	43	41	39	37	36	41	280	638	142	112	70	127	92,110
1951	55	46	41	39	35	33	92	374	391	163	94	59	119	86,177
1969	62	50	44	39	38	36	37	227	693	177	101	75	131	95,125
1941	95	59	45	40	34	33	124	269	378	126	79	56	112	80,782
1967	81	60	48	42	38	37	37	116	990	217	135	134	160	116,420
1964	67	50	47	42	37	35	44	131	916	258	113	93	152	110,223
1945	71	56	49	43	42	48	138	288	611	163	86	98	141	102,067
1946	80	64	53	45	45	41	47	355	541	255	100	84	143	103,293
1968	94	76	60	47	42	42	91	438	271	209	101	72	129	93,580
1947	67	61	56	49	42	40	44	384	309	125	87	53	110	79,832
1971	60					43	46	260	649	174	125	90		
1972						41	42	331	609	138	95	77		
1973							54	293	643	162	114	86		
1974							36	94	714	473	126	98		
1975							46	290	669	190	122	86		
1976							71	312	288	99	79	55		
1977							43	220	779	332	140	116		
1978							54	353	465	176	158	119		
1979							55	293	372	128	93	75		
1980							71	343	427	127	97	65		
1981							33	192	605	245	93	93		
1982							40	138	606	204	109	81		
1983							39	253	641	194	107	84		

Monthly Flows by Year
Ranked by January Low Flows

Shell Creek near Shell

USGS Gage Data

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Average Annual Flow, cfs	Annual Discharge, ac-ft
1984							56	330	192	85	73	60		
1985							41	273	727	135	109	93		
1986							120	290	210	104	94	82		
1987							62	553	298	100	75	56		
1988							38	253	319	123	86	73		
1989							62	200	666	186	106	66		
1990							35	308	489	124	114	88		
Mean	56	46	40	36	34	34	51	273	516	168	95	74	117	84,511
Max	95	76	60	49	45	48	138	553	990	473	158	134	160	116,420
Min	9	8	6	4	4	3	3	93	99	40	22	7	42	30,108

Monthly Flows by Year
Ranked by February Low Flows

Shell Creek near Shell

USGS Gage Data

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Average Annual Flow, cfs	Annual Discharge, ac-ft
1957	9	8	6	4	4	3	3	289	99	40	22	7	42	30,108
1960	47	34	32	29	27	26	29	295	261	69	68	50	81	58,485
1966	39	36	35	28	28	32	35	218	810	281	94	92	144	104,100
1940	60	40	30	30	30	31	35	353	231	82	77	102	92	66,654
1956	37	37	34	30	30	31	34	162	535	155	94	67	104	75,026
1954	35	32	33	29	31	33	38	288	578	156	78	49	115	83,347
1958	45	41	38	35	32	32	38	114	572	127	98	71	103	74,788
1959	52	40	38	32	32	29	42	182	279	81	77	48	78	56,448
1950	68	51	41	33	32	33	39	320	363	204	115	70	115	83,071
1948	49	45	42	37	33	33	53	393	489	122	73	65	120	86,756
1961	53	49	40	33	33	33	91	319	582	172	89	71	130	94,476
1949	50	44	37	35	33	31	44	165	541	173	97	75	110	79,919
1963	47	44	38	35	34	34	34	237	755	285	115	88	145	105,330
1943	49	45	37	35	34	34	37	352	639	224	85	75	137	99,578
1941	95	59	45	40	34	33	124	269	378	126	79	56	112	80,782
1962	55	52	43	35	35	33	40	273	670	123	85	59	125	90,567
1951	55	46	41	39	35	33	92	374	391	163	94	59	119	86,177
1953	44	42	42	38	36	34	41	329	285	103	68	36	92	66,485
1965	69	48	43	38	36	36	37	284	163	73	58	38	77	55,962
1952	46	40	37	38	37	36	35	93	690	141	89	60	111	80,667
1944	55	48	39	38	37	35	35	197	600	308	107	105	134	96,759
1970	50	43	41	39	37	36	41	280	638	142	112	70	127	92,110
1942	50	46	43	39	37	38	69	215	694	211	85	70	133	96,220
1964	67	50	47	42	37	35	44	131	916	258	113	93	152	110,223
1969	62	50	44	39	38	36	37	227	693	177	101	75	131	95,125
1967	81	60	48	42	38	37	37	116	990	217	135	134	160	116,420
1955	42	41	39	37	39	39	43	394	371	92	64	45	104	75,488
1968	94	76	60	47	42	42	91	438	271	209	101	72	129	93,580
1947	67	61	56	49	42	40	44	384	309	125	87	53	110	79,832
1945	71	56	49	43	42	48	138	288	611	163	86	98	141	102,067
1946	80	64	53	45	45	41	47	355	541	255	100	84	143	103,293
1971	60					43	46	260	649	174	125	90		
1972						41	42	331	609	138	95	77		
1973							54	293	643	162	114	86		
1974							36	94	714	473	126	98		
1975							46	290	669	190	122	86		
1976							71	312	288	99	79	55		
1977							43	220	779	332	140	116		
1978							54	353	465	176	158	119		
1979							55	293	372	128	93	75		
1980							71	343	427	127	97	65		
1981							33	192	605	245	93	93		
1982							40	138	606	204	109	81		
1983							39	253	641	194	107	84		

Monthly Flows by Year
Ranked by February Low Flows

Shell Creek near Shell

USGS Gage Data

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Average Annual Flow, cfs	Annual Discharge, ac-ft
1984							56	330	192	85	73	60		
1985							41	273	727	135	109	93		
1986							120	290	210	104	94	82		
1987							62	553	298	100	75	56		
1988							38	253	319	123	86	73		
1989							62	200	666	186	106	66		
1990							35	308	489	124	114	88		
Mean	56	46	40	36	34	34	51	273	516	168	95	74	117	84,511
Max	95	76	60	49	45	48	138	553	990	473	158	134	160	116,420
Min	9	8	6	4	4	3	3	93	99	40	22	7	42	30,108

Monthly Flows by Year
Ranked by March Low Flows

Shell Creek near Shell

USGS Gage Data

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Average Annual Flow, cfs	Annual Discharge, ac-ft
1957	9	8	6	4	4	3	3	289	99	40	22	7	42	30,108
1960	47	34	32	29	27	26	29	295	261	69	68	50	81	58,485
1959	52	40	38	32	32	29	42	182	279	81	77	48	78	56,448
1949	50	44	37	35	33	31	44	165	541	173	97	75	110	79,919
1940	60	40	30	30	30	31	35	353	231	82	77	102	92	66,654
1956	37	37	34	30	30	31	34	162	535	155	94	67	104	75,026
1958	45	41	38	35	32	32	38	114	572	127	98	71	103	74,788
1966	39	36	35	28	28	32	35	218	810	281	94	92	144	104,100
1941	95	59	45	40	34	33	124	269	378	126	79	56	112	80,782
1961	53	49	40	33	33	33	91	319	582	172	89	71	130	94,476
1950	68	51	41	33	32	33	39	320	363	204	115	70	115	83,071
1954	35	32	33	29	31	33	38	288	578	156	78	49	115	83,347
1962	55	52	43	35	35	33	40	273	670	123	85	59	125	90,567
1951	55	46	41	39	35	33	92	374	391	163	94	59	119	86,177
1948	49	45	42	37	33	33	53	393	489	122	73	65	120	86,756
1953	44	42	42	38	36	34	41	329	285	103	68	36	92	66,485
1963	47	44	38	35	34	34	34	237	755	285	115	88	145	105,330
1943	49	45	37	35	34	34	37	352	639	224	85	75	137	99,578
1944	55	48	39	38	37	35	35	197	600	308	107	105	134	96,759
1964	67	50	47	42	37	35	44	131	916	258	113	93	152	110,223
1969	62	50	44	39	38	36	37	227	693	177	101	75	131	95,125
1970	50	43	41	39	37	36	41	280	638	142	112	70	127	92,110
1952	46	40	37	38	37	36	35	93	690	141	89	60	111	80,667
1965	69	48	43	38	36	36	37	284	163	73	58	38	77	55,962
1967	81	60	48	42	38	37	37	116	990	217	135	134	160	116,420
1942	50	46	43	39	37	38	69	215	694	211	85	70	133	96,220
1955	42	41	39	37	39	39	43	394	371	92	64	45	104	75,488
1947	67	61	56	49	42	40	44	384	309	125	87	53	110	79,832
1946	80	64	53	45	45	41	47	355	541	255	100	84	143	103,293
1972						41	42	331	609	138	95	77		
1968	94	76	60	47	42	42	91	438	271	209	101	72	129	93,580
1971	60					43	46	260	649	174	125	90		
1945	71	56	49	43	42	48	138	288	611	163	86	98	141	102,067
1973							54	293	643	162	114	86		
1974							36	94	714	473	126	98		
1975							46	290	669	190	122	86		
1976							71	312	288	99	79	55		
1977							43	220	779	332	140	116		
1978							54	353	465	176	158	119		
1979							55	293	372	128	93	75		
1980							71	343	427	127	97	65		
1981							33	192	605	245	93	93		
1982							40	138	606	204	109	81		
1983							39	253	641	194	107	84		

Monthly Flows by Year
Ranked by March Low Flows

Shell Creek near Shell

USGS Gage Data

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Average Annual Flow, cfs	Annual Discharge, ac-ft
1984							56	330	192	85	73	60		
1985							41	273	727	135	109	93		
1986							120	290	210	104	94	82		
1987							62	553	298	100	75	56		
1988							38	253	319	123	86	73		
1989							62	200	666	186	106	66		
1990							35	308	489	124	114	88		
Mean	56	46	40	36	34	34	51	273	516	168	95	74	117	84,511
Max	95	76	60	49	45	48	138	553	990	473	158	134	160	116,420
Min	9	8	6	4	4	3	3	93	99	40	22	7	42	30,108

Monthly Flows by Year
Ranked by April Low Flows

Shell Creek near Shell

USGS Gage Data

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Average Annual Flow, cfs	Annual Discharge, ac-ft
1957	9	8	6	4	4	3	3	289	99	40	22	7	42	30,108
1960	47	34	32	29	27	26	29	295	261	69	68	50	81	58,485
1981							33	192	605	245	93	93		
1956	37	37	34	30	30	31	34	162	535	155	94	67	104	75,026
1963	47	44	38	35	34	34	34	237	755	285	115	88	145	105,330
1966	39	36	35	28	28	32	35	218	810	281	94	92	144	104,100
1940	60	40	30	30	30	31	35	353	231	82	77	102	92	66,654
1944	55	48	39	38	37	35	35	197	600	308	107	105	134	96,759
1952	46	40	37	38	37	36	35	93	690	141	89	60	111	80,667
1990							35	308	489	124	114	88		
1974							36	94	714	473	126	98		
1969	62	50	44	39	38	36	37	227	693	177	101	75	131	95,125
1965	69	48	43	38	36	36	37	284	163	73	58	38	77	55,962
1943	49	45	37	35	34	34	37	352	639	224	85	75	137	99,578
1967	81	60	48	42	38	37	37	116	990	217	135	134	160	116,420
1958	45	41	38	35	32	32	38	114	572	127	98	71	103	74,788
1954	35	32	33	29	31	33	38	288	578	156	78	49	115	83,347
1988							38	253	319	123	86	73		
1983							39	253	641	194	107	84		
1950	68	51	41	33	32	33	39	320	363	204	115	70	115	83,071
1962	55	52	43	35	35	33	40	273	670	123	85	59	125	90,567
1982							40	138	606	204	109	81		
1970	50	43	41	39	37	36	41	280	638	142	112	70	127	92,110
1953	44	42	42	38	36	34	41	329	285	103	68	36	92	66,485
1985							41	273	727	135	109	93		
1972						41	42	331	609	138	95	77		
1959	52	40	38	32	32	29	42	182	279	81	77	48	78	56,448
1955	42	41	39	37	39	39	43	394	371	92	64	45	104	75,488
1977							43	220	779	332	140	116		
1964	67	50	47	42	37	35	44	131	916	258	113	93	152	110,223
1947	67	61	56	49	42	40	44	384	309	125	87	53	110	79,832
1949	50	44	37	35	33	31	44	165	541	173	97	75	110	79,919
1975							46	290	669	190	122	86		
1971	60					43	46	260	649	174	125	90		
1946	80	64	53	45	45	41	47	355	541	255	100	84	143	103,293
1948	49	45	42	37	33	33	53	393	489	122	73	65	120	86,756
1973							54	293	643	162	114	86		
1978							54	353	465	176	158	119		
1979							55	293	372	128	93	75		
1984							56	330	192	85	73	60		
1987							62	553	298	100	75	56		
1989							62	200	666	186	106	66		
1942	50	46	43	39	37	38	69	215	694	211	85	70	133	96,220
1976							71	312	288	99	79	55		

Monthly Flows by Year
Ranked by April Low Flows

Shell Creek near Shell

USGS Gage Data

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Average Annual Flow, cfs	Annual Discharge, ac-ft
1980							71	343	427	127	97	65		
1961	53	49	40	33	33	33	91	319	582	172	89	71	130	94,476
1968	94	76	60	47	42	42	91	438	271	209	101	72	129	93,580
1951	55	46	41	39	35	33	92	374	391	163	94	59	119	86,177
1986							120	290	210	104	94	82		
1941	95	59	45	40	34	33	124	269	378	126	79	56	112	80,782
1945	71	56	49	43	42	48	138	288	611	163	86	98	141	102,067
Mean	56	46	40	36	34	34	51	273	516	168	95	74	117	84,511
Max	95	76	60	49	45	48	138	553	990	473	158	134	160	116,420
Min	9	8	6	4	4	3	3	93	99	40	22	7	42	30,108

Monthly Flows by Year
Ranked by May Low Flows

Shell Creek near Shell

USGS Gage Data

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Average Annual Flow, cfs	Annual Discharge, ac-ft
1952	46	40	37	38	37	36	35	93	690	141	89	60	111	80,667
1974							36	94	714	473	126	98		
1958	45	41	38	35	32	32	38	114	572	127	98	71	103	74,788
1967	81	60	48	42	38	37	37	116	990	217	135	134	160	116,420
1964	67	50	47	42	37	35	44	131	916	258	113	93	152	110,223
1982							40	138	606	204	109	81		
1956	37	37	34	30	30	31	34	162	535	155	94	67	104	75,026
1949	50	44	37	35	33	31	44	165	541	173	97	75	110	79,919
1959	52	40	38	32	32	29	42	182	279	81	77	48	78	56,448
1981							33	192	605	245	93	93		
1944	55	48	39	38	37	35	35	197	600	308	107	105	134	96,759
1989							62	200	666	186	106	66		
1942	50	46	43	39	37	38	69	215	694	211	85	70	133	96,220
1966	39	36	35	28	28	32	35	218	810	281	94	92	144	104,100
1977							43	220	779	332	140	116		
1969	62	50	44	39	38	36	37	227	693	177	101	75	131	95,125
1963	47	44	38	35	34	34	34	237	755	285	115	88	145	105,330
1988							38	253	319	123	86	73		
1983							39	253	641	194	107	84		
1971	60					43	46	260	649	174	125	90		
1941	95	59	45	40	34	33	124	269	378	126	79	56	112	80,782
1985							41	273	727	135	109	93		
1962	55	52	43	35	35	33	40	273	670	123	85	59	125	90,567
1970	50	43	41	39	37	36	41	280	638	142	112	70	127	92,110
1965	69	48	43	38	36	36	37	284	163	73	58	38	77	55,962
1945	71	56	49	43	42	48	138	288	611	163	86	98	141	102,067
1954	35	32	33	29	31	33	38	288	578	156	78	49	115	83,347
1957	9	8	6	4	4	3	3	289	99	40	22	7	42	30,108
1975							46	290	669	190	122	86		
1986							120	290	210	104	94	82		
1979							55	293	372	128	93	75		
1973							54	293	643	162	114	86		
1960	47	34	32	29	27	26	29	295	261	69	68	50	81	58,485
1990							35	308	489	124	114	88		
1976							71	312	288	99	79	55		
1961	53	49	40	33	33	33	91	319	582	172	89	71	130	94,476
1950	68	51	41	33	32	33	39	320	363	204	115	70	115	83,071
1953	44	42	42	38	36	34	41	329	285	103	68	36	92	66,485
1984							56	330	192	85	73	60		
1972						41	42	331	609	138	95	77		
1980							71	343	427	127	97	65		
1943	49	45	37	35	34	34	37	352	639	224	85	75	137	99,578
1940	60	40	30	30	30	31	35	353	231	82	77	102	92	66,654
1978							54	353	465	176	158	119		

Monthly Flows by Year
Ranked by May Low Flows

Shell Creek near Shell

USGS Gage Data

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Average Annual Flow, cfs	Annual Discharge, ac-ft
1946	80	64	53	45	45	41	47	355	541	255	100	84	143	103,293
1951	55	46	41	39	35	33	92	374	391	163	94	59	119	86,177
1947	67	61	56	49	42	40	44	384	309	125	87	53	110	79,832
1948	49	45	42	37	33	33	53	393	489	122	73	65	120	86,756
1955	42	41	39	37	39	39	43	394	371	92	64	45	104	75,488
1968	94	76	60	47	42	42	91	438	271	209	101	72	129	93,580
1987							62	553	298	100	75	56		
Mean	56	46	40	36	34	34	51	273	516	168	95	74	117	84,511
Max	95	76	60	49	45	48	138	553	990	473	158	134	160	116,420
Min	9	8	6	4	4	3	3	93	99	40	22	7	42	30,108

Monthly Flows by Year
Ranked by June Low Flows

Shell Creek near Shell

USGS Gage Data

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Average Annual Flow, cfs	Annual Discharge, ac-ft
1957	9	8	6	4	4	3	3	289	99	40	22	7	42	30,108
1965	69	48	43	38	36	36	37	284	163	73	58	38	77	55,962
1984							56	330	192	85	73	60		
1986							120	290	210	104	94	82		
1940	60	40	30	30	30	31	35	353	231	82	77	102	92	66,654
1960	47	34	32	29	27	26	29	295	261	69	68	50	81	58,485
1968	94	76	60	47	42	42	91	438	271	209	101	72	129	93,580
1959	52	40	38	32	32	29	42	182	279	81	77	48	78	56,448
1953	44	42	42	38	36	34	41	329	285	103	68	36	92	66,485
1976							71	312	288	99	79	55		
1987							62	553	298	100	75	56		
1947	67	61	56	49	42	40	44	384	309	125	87	53	110	79,832
1988							38	253	319	123	86	73		
1950	68	51	41	33	32	33	39	320	363	204	115	70	115	83,071
1955	42	41	39	37	39	39	43	394	371	92	64	45	104	75,488
1979							55	293	372	128	93	75		
1941	95	59	45	40	34	33	124	269	378	126	79	56	112	80,782
1951	55	46	41	39	35	33	92	374	391	163	94	59	119	86,177
1980							71	343	427	127	97	65		
1978							54	353	465	176	158	119		
1948	49	45	42	37	33	33	53	393	489	122	73	65	120	86,756
1990							35	308	489	124	114	88		
1956	37	37	34	30	30	31	34	162	535	155	94	67	104	75,026
1946	80	64	53	45	45	41	47	355	541	255	100	84	143	103,293
1949	50	44	37	35	33	31	44	165	541	173	97	75	110	79,919
1958	45	41	38	35	32	32	38	114	572	127	98	71	103	74,788
1954	35	32	33	29	31	33	38	288	578	156	78	49	115	83,347
1961	53	49	40	33	33	33	91	319	582	172	89	71	130	94,476
1944	55	48	39	38	37	35	35	197	600	308	107	105	134	96,759
1981							33	192	605	245	93	93		
1982							40	138	606	204	109	81		
1972						41	42	331	609	138	95	77		
1945	71	56	49	43	42	48	138	288	611	163	86	98	141	102,067
1970	50	43	41	39	37	36	41	280	638	142	112	70	127	92,110
1943	49	45	37	35	34	34	37	352	639	224	85	75	137	99,578
1983							39	253	641	194	107	84		
1973							54	293	643	162	114	86		
1971	60					43	46	260	649	174	125	90		
1989							62	200	666	186	106	66		
1975							46	290	669	190	122	86		
1962	55	52	43	35	35	33	40	273	670	123	85	59	125	90,567
1952	46	40	37	38	37	36	35	93	690	141	89	60	111	80,667
1969	62	50	44	39	38	36	37	227	693	177	101	75	131	95,125
1942	50	46	43	39	37	38	69	215	694	211	85	70	133	96,220

Monthly Flows by Year
Ranked by June Low Flows

Shell Creek near Shell

USGS Gage Data

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Average Annual Flow, cfs	Annual Discharge, ac-ft
1974							36	94	714	473	126	98		
1985							41	273	727	135	109	93		
1963	47	44	38	35	34	34	34	237	755	285	115	88	145	105,330
1977							43	220	779	332	140	116		
1966	39	36	35	28	28	32	35	218	810	281	94	92	144	104,100
1964	67	50	47	42	37	35	44	131	916	258	113	93	152	110,223
1967	81	60	48	42	38	37	37	116	990	217	135	134	160	116,420
Mean	56	46	40	36	34	34	51	273	516	168	95	74	117	84,511
Max	95	76	60	49	45	48	138	553	990	473	158	134	160	116,420
Min	9	8	6	4	4	3	3	93	99	40	22	7	42	30,108

Monthly Flows by Year
Ranked by July Low Flows

Shell Creek near Shell

USGS Gage Data

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Average Annual Flow, cfs	Annual Discharge, ac-ft
1957	9	8	6	4	4	3	3	289	99	40	22	7	42	30,108
1960	47	34	32	29	27	26	29	295	261	69	68	50	81	58,485
1965	69	48	43	38	36	36	37	284	163	73	58	38	77	55,962
1959	52	40	38	32	32	29	42	182	279	81	77	48	78	56,448
1940	60	40	30	30	30	31	35	353	231	82	77	102	92	66,654
1984							56	330	192	85	73	60		
1955	42	41	39	37	39	39	43	394	371	92	64	45	104	75,488
1976							71	312	288	99	79	55		
1987							62	553	298	100	75	56		
1953	44	42	42	38	36	34	41	329	285	103	68	36	92	66,485
1986							120	290	210	104	94	82		
1948	49	45	42	37	33	33	53	393	489	122	73	65	120	86,756
1988							38	253	319	123	86	73		
1962	55	52	43	35	35	33	40	273	670	123	85	59	125	90,567
1990							35	308	489	124	114	88		
1947	67	61	56	49	42	40	44	384	309	125	87	53	110	79,832
1941	95	59	45	40	34	33	124	269	378	126	79	56	112	80,782
1958	45	41	38	35	32	32	38	114	572	127	98	71	103	74,788
1980							71	343	427	127	97	65		
1979							55	293	372	128	93	75		
1985							41	273	727	135	109	93		
1972						41	42	331	609	138	95	77		
1952	46	40	37	38	37	36	35	93	690	141	89	60	111	80,667
1970	50	43	41	39	37	36	41	280	638	142	112	70	127	92,110
1956	37	37	34	30	30	31	34	162	535	155	94	67	104	75,026
1954	35	32	33	29	31	33	38	288	578	156	78	49	115	83,347
1973							54	293	643	162	114	86		
1945	71	56	49	43	42	48	138	288	611	163	86	98	141	102,067
1951	55	46	41	39	35	33	92	374	391	163	94	59	119	86,177
1961	53	49	40	33	33	33	91	319	582	172	89	71	130	94,476
1949	50	44	37	35	33	31	44	165	541	173	97	75	110	79,919
1971	60					43	46	260	649	174	125	90		
1978							54	353	465	176	158	119		
1969	62	50	44	39	38	36	37	227	693	177	101	75	131	95,125
1989							62	200	666	186	106	66		
1975							46	290	669	190	122	86		
1983							39	253	641	194	107	84		
1982							40	138	606	204	109	81		
1950	68	51	41	33	32	33	39	320	363	204	115	70	115	83,071
1968	94	76	60	47	42	42	91	438	271	209	101	72	129	93,580
1942	50	46	43	39	37	38	69	215	694	211	85	70	133	96,220
1967	81	60	48	42	38	37	37	116	990	217	135	134	160	116,420
1943	49	45	37	35	34	34	37	352	639	224	85	75	137	99,578
1981							33	192	605	245	93	93		

Monthly Flows by Year
Ranked by July Low Flows

Shell Creek near Shell

USGS Gage Data

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Average Annual Flow, cfs	Annual Discharge, ac-ft
1946	80	64	53	45	45	41	47	355	541	255	100	84	143	103,293
1964	67	50	47	42	37	35	44	131	916	258	113	93	152	110,223
1966	39	36	35	28	28	32	35	218	810	281	94	92	144	104,100
1963	47	44	38	35	34	34	34	237	755	285	115	88	145	105,330
1944	55	48	39	38	37	35	35	197	600	308	107	105	134	96,759
1977							43	220	779	332	140	116		
1974							36	94	714	473	126	98		
Mean	56	46	40	36	34	34	51	273	516	168	95	74	117	84,511
Max	95	76	60	49	45	48	138	553	990	473	158	134	160	116,420
Min	9	8	6	4	4	3	3	93	99	40	22	7	42	30,108

Monthly Flows by Year
Ranked by August Low Flows

Shell Creek near Shell

USGS Gage Data

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Average Annual Flow, cfs	Annual Discharge, ac-ft
1957	9	8	6	4	4	3	3	289	99	40	22	7	42	30,108
1965	69	48	43	38	36	36	37	284	163	73	58	38	77	55,962
1955	42	41	39	37	39	39	43	394	371	92	64	45	104	75,488
1960	47	34	32	29	27	26	29	295	261	69	68	50	81	58,485
1953	44	42	42	38	36	34	41	329	285	103	68	36	92	66,485
1984							56	330	192	85	73	60		
1948	49	45	42	37	33	33	53	393	489	122	73	65	120	86,756
1987							62	553	298	100	75	56		
1940	60	40	30	30	30	31	35	353	231	82	77	102	92	66,654
1959	52	40	38	32	32	29	42	182	279	81	77	48	78	56,448
1954	35	32	33	29	31	33	38	288	578	156	78	49	115	83,347
1976							71	312	288	99	79	55		
1941	95	59	45	40	34	33	124	269	378	126	79	56	112	80,782
1962	55	52	43	35	35	33	40	273	670	123	85	59	125	90,567
1943	49	45	37	35	34	34	37	352	639	224	85	75	137	99,578
1942	50	46	43	39	37	38	69	215	694	211	85	70	133	96,220
1988							38	253	319	123	86	73		
1945	71	56	49	43	42	48	138	288	611	163	86	98	141	102,067
1947	67	61	56	49	42	40	44	384	309	125	87	53	110	79,832
1961	53	49	40	33	33	33	91	319	582	172	89	71	130	94,476
1952	46	40	37	38	37	36	35	93	690	141	89	60	111	80,667
1979							55	293	372	128	93	75		
1981							33	192	605	245	93	93		
1956	37	37	34	30	30	31	34	162	535	155	94	67	104	75,026
1966	39	36	35	28	28	32	35	218	810	281	94	92	144	104,100
1986							120	290	210	104	94	82		
1951	55	46	41	39	35	33	92	374	391	163	94	59	119	86,177
1972						41	42	331	609	138	95	77		
1949	50	44	37	35	33	31	44	165	541	173	97	75	110	79,919
1980							71	343	427	127	97	65		
1958	45	41	38	35	32	32	38	114	572	127	98	71	103	74,788
1946	80	64	53	45	45	41	47	355	541	255	100	84	143	103,293
1969	62	50	44	39	38	36	37	227	693	177	101	75	131	95,125
1968	94	76	60	47	42	42	91	438	271	209	101	72	129	93,580
1989							62	200	666	186	106	66		
1944	55	48	39	38	37	35	35	197	600	308	107	105	134	96,759
1983							39	253	641	194	107	84		
1982							40	138	606	204	109	81		
1985							41	273	727	135	109	93		
1970	50	43	41	39	37	36	41	280	638	142	112	70	127	92,110
1964	67	50	47	42	37	35	44	131	916	258	113	93	152	110,223
1973							54	293	643	162	114	86		
1990							35	308	489	124	114	88		
1963	47	44	38	35	34	34	34	237	755	285	115	88	145	105,330

Monthly Flows by Year
Ranked by August Low Flows

Shell Creek near Shell

USGS Gage Data

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Average Annual Flow, cfs	Annual Discharge, ac-ft
1950	68	51	41	33	32	33	39	320	363	204	115	70	115	83,071
1975							46	290	669	190	122	86		
1971	60					43	46	260	649	174	125	90		
1974							36	94	714	473	126	98		
1967	81	60	48	42	38	37	37	116	990	217	135	134	160	116,420
1977							43	220	779	332	140	116		
1978							54	353	465	176	158	119		
Mean	56	46	40	36	34	34	51	273	516	168	95	74	117	84,511
Max	95	76	60	49	45	48	138	553	990	473	158	134	160	116,420
Min	9	8	6	4	4	3	3	93	99	40	22	7	42	30,108

Monthly Flows by Year
Ranked by September Low Flows

Shell Creek near Shell

USGS Gage Data

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Average Annual Flow, cfs	Annual Discharge, ac-ft
1957	9	8	6	4	4	3	3	289	99	40	22	7	42	30,108
1953	44	42	42	38	36	34	41	329	285	103	68	36	92	66,485
1965	69	48	43	38	36	36	37	284	163	73	58	38	77	55,962
1955	42	41	39	37	39	39	43	394	371	92	64	45	104	75,488
1959	52	40	38	32	32	29	42	182	279	81	77	48	78	56,448
1954	35	32	33	29	31	33	38	288	578	156	78	49	115	83,347
1960	47	34	32	29	27	26	29	295	261	69	68	50	81	58,485
1947	67	61	56	49	42	40	44	384	309	125	87	53	110	79,832
1976							71	312	288	99	79	55		
1941	95	59	45	40	34	33	124	269	378	126	79	56	112	80,782
1987							62	553	298	100	75	56		
1951	55	46	41	39	35	33	92	374	391	163	94	59	119	86,177
1962	55	52	43	35	35	33	40	273	670	123	85	59	125	90,567
1984							56	330	192	85	73	60		
1952	46	40	37	38	37	36	35	93	690	141	89	60	111	80,667
1948	49	45	42	37	33	33	53	393	489	122	73	65	120	86,756
1980							71	343	427	127	97	65		
1989							62	200	666	186	106	66		
1956	37	37	34	30	30	31	34	162	535	155	94	67	104	75,026
1970	50	43	41	39	37	36	41	280	638	142	112	70	127	92,110
1950	68	51	41	33	32	33	39	320	363	204	115	70	115	83,071
1942	50	46	43	39	37	38	69	215	694	211	85	70	133	96,220
1961	53	49	40	33	33	33	91	319	582	172	89	71	130	94,476
1958	45	41	38	35	32	32	38	114	572	127	98	71	103	74,788
1968	94	76	60	47	42	42	91	438	271	209	101	72	129	93,580
1988							38	253	319	123	86	73		
1969	62	50	44	39	38	36	37	227	693	177	101	75	131	95,125
1979							55	293	372	128	93	75		
1943	49	45	37	35	34	34	37	352	639	224	85	75	137	99,578
1949	50	44	37	35	33	31	44	165	541	173	97	75	110	79,919
1972						41	42	331	609	138	95	77		
1982							40	138	606	204	109	81		
1986							120	290	210	104	94	82		
1946	80	64	53	45	45	41	47	355	541	255	100	84	143	103,293
1983							39	253	641	194	107	84		
1973							54	293	643	162	114	86		
1975							46	290	669	190	122	86		
1990							35	308	489	124	114	88		
1963	47	44	38	35	34	34	34	237	755	285	115	88	145	105,330
1971	60					43	46	260	649	174	125	90		
1966	39	36	35	28	28	32	35	218	810	281	94	92	144	104,100
1981							33	192	605	245	93	93		
1985							41	273	727	135	109	93		
1964	67	50	47	42	37	35	44	131	916	258	113	93	152	110,223

Monthly Flows by Year
Ranked by September Low Flows

Shell Creek near Shell

USGS Gage Data

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Average Annual Flow, cfs	Annual Discharge, ac-ft
1974							36	94	714	473	126	98		
1945	71	56	49	43	42	48	138	288	611	163	86	98	141	102,067
1940	60	40	30	30	30	31	35	353	231	82	77	102	92	66,654
1944	55	48	39	38	37	35	35	197	600	308	107	105	134	96,759
1977							43	220	779	332	140	116		
1978							54	353	465	176	158	119		
1967	81	60	48	42	38	37	37	116	990	217	135	134	160	116,420
Mean	56	46	40	36	34	34	51	273	516	168	95	74	117	84,511
Max	95	76	60	49	45	48	138	553	990	473	158	134	160	116,420
Min	9	8	6	4	4	3	3	93	99	40	22	7	42	30,108

Year	Date	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1940	1	60	40	30									
1940	2	60	40	30									
1940	3	60	40	30									
1940	4	60	40	30									
1940	5	60	40	30									
1940	6	60	40	30									
1940	7	60	40	30									
1940	8	60	40	30									
1940	9	60	40	30									
1940	10	60	40	30									
1940	11	60	40	30									
1940	12	60	40	30									
1940	13	60	40	30									
1940	14	60	40	30									
1940	15	60	40	30									
1940	16	60	40	30									
1940	17	60	40	30									
1940	18	60	40	30									
1940	19	60	40	30									
1940	20	60	40	30									
1940	21	60	40	30									
1940	22	60	40	30									
1940	23	60	40	30									
1940	24	60	40	30									
1940	25	60	40	30									
1940	26	60	40	30									
1940	27	60	40	30									
1940	28	60	40	30									
1940	29	60	40	30									
1940	30	60	40	30									
1940	31	60		30									
1941	1	115	76	50	30	28	31	35	63	312	109	73	70
1941	2	114	70	49	29	28	31	33	82	278	103	72	66
1941	3	109	67	53	29	29	30	33	96	283	112	72	68
1941	4	115	71	51	28	30	30	33	118	358	103	72	71
1941	5	120	66	46	28	30	31	32	97	355	96	72	60
1941	6	114	68	48	28	30	30	32	86	317	93	72	68
1941	7	106	59	49	29	30	30	31	76	259	89	72	128
1941	8	106	60	47	29	29	30	31	73	281	84	73	96
1941	9	100	67	47	30	30	30	29	86	337	80	75	93
1941	10	100	62	46	30	31	29	31	128	314	75	79	96
1941	11	100	58	45	32	33	28	32	190	266	75	84	128
1941	12	98	60	44	31	32	27	33	332	228	77	93	139
1941	13	104	62	43	30	31	28	34	670	226	79	80	118
1941	14	97	60	45	31	31	31	31	765	245	73	80	110
1941	15	96	60	44	31	31	31	32	402	262	71	76	107
1941	16	97	59	44	32	30	30	34	295	252	70	76	106
1941	17	96	60	44	31	30	31	33	402	245	67	75	104

Year	Date	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1941	18	91	60	44	31	30	33	31	865	243	64	80	100
1941	19	89	48	44	32	30	33	31	524	218	66	84	103
1941	20	89	40	43	33	30	33	30	293	196	83	93	100
1941	21	89	48	44	33	30	33	31	342	206	80	93	103
1941	22	90	41	42	31	30	31	31	520	174	68	86	106
1941	23	87	43	41	30	30	31	32	520	161	66	77	109
1941	24	87	59	45	30	30	31	34	700	150	71	70	109
1941	25	104	72	41	29	30	30	37	695	144	100	66	110
1941	26	94	60	35	29	30	31	39	500	134	91	66	109
1941	27	79	55	36	29	30	32	47	585	125	87	75	125
1941	28	79	54	41	30	31	32	54	402	117	82	76	117
1941	29	73	53	45	30		34	50	363	115	79	72	118
1941	30	48	51	44	29		36	54	347	115	79	68	115
1941	31	66		40	29		34		317		77	72	
1942	1	51	51	45	37	38	33	41	75	396	198	84	60
1942	2	51	49	47	44	37	33	42	78	566	208	82	60
1942	3	51	51	45	42	37	33	43	79	730	194	85	59
1942	4	51	51	37	40	36	33	43	68	843	208	81	56
1942	5	51	48	43	38	36	33	41	66	897	194	78	57
1942	6	51	41	43	39	35	33	41	61	602	188	79	56
1942	7	51	52	46	40	35	33	43	67	662	174	82	55
1942	8	51	50	45	41	34	33	53	76	670	166	84	55
1942	9	51	47	46	42	34	34	55	130	708	152	84	54
1942	10	51	39	46	42	33	34	62	228	650	139	85	55
1942	11	51	46	45	42	33	33	101	268	304	132	81	55
1942	12	51	47	44	42	33	34	112	218	214	127	79	57
1942	13	51	46	43	42	33	33	123	150	172	118	84	72
1942	14	51	46	43	41	33	33	161	123	192	111	85	66
1942	15	51	47	43	41	33	32	146	119	216	109	85	60
1942	16	51	45	44	41	33	31	101	103	260	108	85	55
1942	17	50	43	44	41	32	31	141	92	208	104	82	54
1942	18	50	46	43	41	34	31	163	85	206	101	81	52
1942	19	49	47	43	41	36	32	115	84	248	96	79	53
1942	20	49	45	43	41	36	31	182	87	250	95	76	53
1942	21	49	39	43	40	36	32	327	106	228	93	78	53
1942	22	51	47	41	40	36	33	396	232	218	88	78	53
1942	23	46	47	43	40	36	34	368	570	210	88	78	53
1942	24	43	46	43	39	35	34	198	843	238	92	76	52
1942	25	43	43	43	39	34	32	145	852	272	87	78	52
1942	26	50	33	40	39	33	31	114	969	272	85	78	52
1942	27	52	51	37	39	32	31	96	843	272	88	76	52
1942	28	50	45	47	38	32	30	90	414	226	96	71	52
1942	29	46	45	43	38		32	88	403	214	93	62	52
1942	30	48	46	42	38		32	79	474	198	90	64	52
1942	31	48		42	38		34		375		87	61	
1943	1	50	37	41	43	35	34	35	151	710	494	94	97
1943	2	50	40	39	41	33	30	35	198	728	434	100	92
1943	3	50	50	39	37	34	38	38	231	566	406	98	96
1943	4	49	53	39	38	33	38	39	283	458	382	92	90
1943	5	49	51	39	46	33	38	39	277	406	337	88	86

Year	Date	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1943	6	49	49	37	45	37	38	41	229	368	310	86	86
1943	7	49	48	40	43	39	38	43	202	382	295	92	85
1943	8	49	41	37	43	39	38	48	163	406	277	92	82
1943	9	49	52	31	42	36	38	47	159	478	266	91	81
1943	10	49	49	38	41	42	38	50	148	562	249	90	78
1943	11	49	48	42	41	38	38	56	144	737	234	88	76
1943	12	50	48	38	41	38	38	51	122	1,040	229	85	75
1943	13	50	47	38	42	38	38	52	118	836	229	84	72
1943	14	49	47	39	43	38	38	49	116	863	195	81	71
1943	15	47	47	38	43	38	38	54	111	782	180	80	70
1943	16	49	46	36	32	38	38	58	111	606	176	80	68
1943	17	49	45	36	29	38	38	65	102	606	163	78	67
1943	18	48	45	36	35	38	39	67	97	886	151	76	62
1943	19	50	46	36	35	38	39	81	102	1,040	142	76	62
1943	20	51	46	36	35	38	39	97	97	1,000	134	86	62
1943	21	48	46	36	35	38	39	91	114	976	130	85	61
1943	22	48	45	35	41	38	38	82	134	944	128	84	59
1943	23	48	45	36	44	37	39	86	155	863	126	81	59
1943	24	46	44	36	42	36	39	113	142	822	124	81	56
1943	25	50	40	36	38	36	40	113	151	786	118	82	54
1943	26	50	31	35	39	38	37	122	163	719	116	84	53
1943	27	50	43	34	35	38	37	104	226	719	113	81	52
1943	28	50	45	34	32	38	37	104	430	552	113	80	52
1943	29	50	42	34	32		40	102	642	482	107	78	51
1943	30	52	43	34	34		39	104	665	494	100	80	51
1943	31	49		35	32		35		670		96	90	
1944	1	59	51	43	34	35	35	35	39	970	477	100	82
1944	2	59	53	44	36	35	34	35	37	833	473	95	87
1944	3	59	51	43	36	35	34	36	37	833	457	93	98
1944	4	58	52	41	34	35	34	37	36	662	418	92	93
1944	5	56	53	42	34	35	34	38	39	489	372	89	87
1944	6	54	53	42	34	35	34	39	51	441	340	87	83
1944	7	54	54	42	34	35	34	37	57	563	315	86	80
1944	8	54	54	41	34	35	34	36	49	493	290	83	77
1944	9	54	52	39	35	35	35	36	52	469	285	82	75
1944	10	54	52	36	34	30	35	36	68	581	275	80	74
1944	11	54	52	40	35	33	34	38	90	622	258	77	74
1944	12	54	52	39	34	36	34	42	116	626	236	76	76
1944	13	54	51	40	36	36	33	43	154	541	215	77	76
1944	14	53	48	39	35	35	32	36	220	521	202	84	76
1944	15	53	44	38	34	34	36	36	376	644	189	87	77
1944	16	55	42	38	35	34	36	36	469	694	178	87	77
1944	17	56	42	38	35	34	36	36	469	730	168	89	77
1944	18	59	44	36	36	34	35	36	497	572	158	87	79
1944	19	60	45	37	36	34	35	36	376	533	150	84	79
1944	20	59	43	36	36	34	34	36	293	604	150	84	77
1944	21	56	44	36	36	34	34	36	258	684	148	84	75
1944	22	56	50	38	36	34	34	36	320	896	140	83	72
1944	23	55	50	31	36	34	34	35	662	644	135	83	70
1944	24	54	49	38	36	34	34	35	815	635	129	83	69

Year	Date	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1944	25	53	45	39	36	34	34	36	481	716	124	83	65
1944	26	53	36	40	36	34	34	36	376	698	120	82	64
1944	27	52	45	40	35	34	32	36	489	828	119	82	62
1944	28	52	46	42	35	34	34	42	824	622	112	80	59
1944	29	51	43	44	35	34	34	46	1,010	529	109	80	58
1944	30	51	45	40	35		34	40	1,040	493	106	83	57
1944	31	51		40	35		34		1,120		103	83	
1945	1	92	63	53	41	39	37	30	49	477	376	121	98
1945	2	90	62	51	42	39	37	25	55	425	427	117	97
1945	3	89	63	47	40	39	37	28	63	422	527	119	95
1945	4	87	63	54	39	39	36	34	82	617	583	117	94
1945	5	84	63	52	40	38	34	33	104	662	539	117	91
1945	6	79	61	51	41	36	40	33	119	779	458	111	106
1945	7	76	60	51	40	36	39	33	122	568	427	108	135
1945	8	75	50	49	40	36	38	35	96	505	418	106	117
1945	9	73	41	45	39	36	38	36	112	465	411	103	106
1945	10	72	58	45	39	36	38	34	158	411	376	100	103
1945	11	71	62	52	38	36	38	33	162	397	427	97	100
1945	12	70	55	49	37	36	37	33	162	509	454	98	100
1945	13	70	53	50	36	36	36	33	198	630	398	100	97
1945	14	68	53	48	36	36	34	32	193	457	323	103	97
1945	15	68	56	48	36	34	33	33	156	372	311	97	95
1945	16	67	55	50	36	30	33	34	127	335	296	92	109
1945	17	67	54	49	36	35	33	33	144	318	263	88	116
1945	18	68	54	47	36	38	33	33	135	293	254	87	111
1945	19	64	54	49	36	38	32	34	129	323	248	87	108
1945	20	71	54	50	32	37	33	36	119	437	260	129	108
1945	21	63	52	50	31	37	33	40	101	833	229	140	114
1945	22	71	50	49	41	37	33	44	103	1,140	206	119	126
1945	23	63	59	49	40	37	34	39	124	1,100	185	111	116
1945	24	63	55	49	39	37	33	37	209	1,460	170	106	109
1945	25	67	55	48	38	36	33	36	282	964	159	104	106
1945	26	64	55	48	38	37	33	36	376	874	150	119	103
1945	27	63	54	47	38	37	32	39	404	734	146	109	101
1945	28	63	54	48	37	37	31	41	349	579	139	103	97
1945	29	61	54	50	36		30	43	390	475	135	100	97
1945	30	62	54	48	37		31	46	533	424	129	100	95
1945	31	64		48	39		31		743		128	101	
1946	1	84	66	59	48	42	44	55	257	360	343	92	82
1946	2	84	68	60	47	42	45	50	218	329	346	90	80
1946	3	83	52	59	47	42	45	49	248	373	355	87	80
1946	4	83	73	60	46	42	44	47	281	712	280	87	77
1946	5	84	73	60	46	42	43	49	317	1,020	250	86	92
1946	6	80	71	60	45	42	44	50	260	1,140	224	87	86
1946	7	89	71	59	45	42	42	50	229	869	209	92	101
1946	8	86	71	59	44	42	44	51	232	698	191	89	117
1946	9	86	70	58	42	42	43	54	240	828	180	89	119
1946	10	80	63	58	45	42	45	50	198	896	172	87	106
1946	11	83	68	56	43	42	47	50	182	882	158	84	100
1946	12	86	63	58	43	42	47	55	182	869	150	87	95

Year	Date	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1946	13	83	64	58	43	42	47	59	188	599	148	95	92
1946	14	83	67	58	42	42	47	66	182	648	150	93	89
1946	15	83	66	58	41	42	45	62	172	748	140	89	86
1946	16	83	63	51	42	42	44	73	172	752	138	84	92
1946	17	80	61	30	41	42	43	90	175	694	131	82	131
1946	18	80	63	52	41	42	47	111	215	579	124	82	119
1946	19	76	62	58	40	42	52	131	201	444	120	82	112
1946	20	77	63	55	40	42	63	154	188	395	112	79	111
1946	21	79	56	54	39	42	57	150	218	398	109	79	109
1946	22	76	66	53	44	42	47	137	314	483	106	77	109
1946	23	77	62	51	41	42	46	139	363	551	108	79	100
1946	24	72	62	50	41	42	46	168	272	515	119	83	100
1946	25	77	60	49	41	43	45	226	246	430	108	84	100
1946	26	76	61	49	40	43	45	305	320	414	101	86	96
1946	27	77	61	49	41	42	51	414	527	418	104	87	95
1946	28	77	61	38	41	43	57	427	874	430	96	87	90
1946	29	77	61	40	41		62	402	644	408	93	98	87
1946	30	68	61	44	41		57	421	447	447	92	89	86
1946	31	63		47	42		55		366		89	83	
1947	1	72	63	59	47	42	42	42	66	346	383	116	89
1947	2	72	66	58	44	41	41	42	80	464	403	112	87
1947	3	72	68	52	44	41	41	43	157	584	488	108	86
1947	4	72	61	62	48	41	41	43	197	548	500	103	86
1947	5	71	61	59	50	42	40	40	219	464	448	106	84
1947	6	70	48	60	49	42	40	40	314	500	396	100	83
1947	7	68	59	58	47	41	41	40	492	548	386	98	82
1947	8	67	67	54	47	40	41	40	560	827	372	104	82
1947	9	67	67	58	47	44	41	40	692	950	369	92	82
1947	10	67	63	56	47	50	41	40	692	600	346	93	87
1947	11	68	64	58	46	48	40	39	568	484	297	112	95
1947	12	67	62	58	46	48	41	39	500	396	271	100	93
1947	13	67	62	59	45	48	40	41	440	362	247	104	89
1947	14	67	63	58	44	47	40	45	390	400	224	104	89
1947	15	67	60	56	41	46	40	45	350	476	204	101	87
1947	16	66	60	56	47	48	40	45	380	536	211	100	86
1947	17	64	62	58	46	46	40	45	430	596	216	100	84
1947	18	63	63	56	46	46	43	45	400	564	202	100	84
1947	19	63	61	56	46	46	40	47	360	642	180	96	87
1947	20	62	60	56	46	46	40	52	334	876	175	95	86
1947	21	62	58	56	46	46	40	50	325	612	168	93	83
1947	22	64	53	56	46	46	41	47	300	460	161	98	82
1947	23	66	62	55	45	46	43	45	286	417	166	98	80
1947	24	67	62	55	44	45	39	44	265	428	164	100	80
1947	25	61	60	55	43	44	40	44	278	432	150	98	80
1947	26	66	60	55	43	42	40	46	319	568	142	96	77
1947	27	68	58	54	41	43	39	55	432	737	133	95	77
1947	28	67	56	54	42	43	39	70	325	552	129	93	77
1947	29	67	58	53	42		41	75	281	436	127	93	76
1947	30	68	58	48	42		47	80	263	410	117	92	75
1947	31	66		36	42		44		297		116	90	

Year	Date	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1948	1	49	47	46	53	45	42	40	73	670	187	103	64
1948	2	49	47	45	56	43	42	39	63	684	182	109	62
1948	3	49	47	45	52	43	42	40	55	648	174	105	60
1948	4	49	46	44	50	43	40	39	56	512	170	101	59
1948	5	50	39	38	50	43	41	39	59	410	158	101	57
1948	6	50	47	45	50	43	42	39	56	386	148	105	57
1948	7	49	47	44	51	42	42	38	70	356	143	99	57
1948	8	51	41	45	51	42	41	34	90	341	141	101	56
1948	9	51	47	44	49	42	41	38	84	310	138	107	55
1948	10	50	49	45	44	41	39	39	73	314	131	101	52
1948	11	50	47	44	53	40	40	38	71	284	124	99	51
1948	12	49	50	44	47	40	42	38	67	274	120	95	50
1948	13	49	49	44	40	41	41	37	67	271	113	91	50
1948	14	49	47	41	53	41	41	38	82	244	129	89	48
1948	15	52	47	41	49	41	39	38	93	216	146	88	47
1948	16	51	45	39	45	41	37	41	110	200	124	86	47
1948	17	44	46	39	49	42	39	43	157	216	118	82	47
1948	18	52	40	42	48	43	40	45	224	216	111	82	48
1948	19	51	34	45	47	42	40	43	500	187	107	80	54
1948	20	50	49	44	49	42	40	42	1,140	182	111	79	68
1948	21	49	49	41	51	42	38	43	1,160	207	103	79	60
1948	22	49	44	36	50	42	40	47	1,140	278	95	77	54
1948	23	49	46	39	50	41	40	50	870	256	91	77	52
1948	24	47	46	42	50	41	40	48	760	244	88	75	51
1948	25	49	46	41	46	44	40	47	728	278	88	74	51
1948	26	47	44	41	42	45	37	45	634	244	103	72	50
1948	27	46	38	42	44	36	36	45	742	232	103	70	48
1948	28	45	42	41	50	43	38	49	661	218	99	69	48
1948	29	49	49	41	48	42	40	68	702	205	107	68	48
1948	30	47	49	41	48		40	83	661	194	111	66	50
1948	31	44		41	46		38		661		103	64	
1949	1	53	49	40	41	34	34	33	110	465	177	79	69
1949	2	55	46	43	40	34	35	33	120	417	162	79	69
1949	3	55	46	37	40	34	34	34	150	379	152	79	81
1949	4	57	46	25	37	34	34	34	180	365	157	79	87
1949	5	53	45	42	38	34	34	34	180	413	162	74	78
1949	6	52	45	41	40	34	34	35	154	830	162	72	78
1949	7	50	45	33	41	34	35	36	150	760	136	71	74
1949	8	49	45	40	41	33	33	38	159	660	123	71	71
1949	9	48	46	42	38	33	33	38	205	720	116	71	71
1949	10	49	45	40	35	33	33	35	297	725	119	76	69
1949	11	46	45	28	37	34	33	38	354	840	141	72	71
1949	12	46	43	29	38	32	33	41	432	750	177	69	72
1949	13	49	46	39	41	32	33	42	513	705	162	68	71
1949	14	44	46	37	41	32	33	39	551	630	141	68	69
1949	15	48	45	42	41	32	33	36	600	541	130	66	68
1949	16	48	42	41	39	34	33	38	760	536	125	64	64
1949	17	50	46	39	38	32	33	40	600	550	119	72	63
1949	18	55	44	39	36	33	33	41	469	503	114	81	63
1949	19	52	43	38	36	33	33	51	398	595	110	81	61

Year	Date	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1949	20	46	40	34	36	33	33	58	405	517	106	78	61
1949	21	45	34	37	36	33	33	49	398	379	104	76	60
1949	22	54	43	38	35	34	34	46	368	344	102	74	57
1949	23	53	44	37	36	33	35	46	347	333	96	74	55
1949	24	50	45	38	35	33	34	64	307	296	90	76	53
1949	25	53	44	37	33	33	34	77	320	252	92	74	52
1949	26	50	43	37	33	33	33	77	344	269	90	72	50
1949	27	50	42	37	33	34	33	89	487	282	88	71	50
1949	28	49	44	37	34	34	32	106	620	218	87	71	50
1949	29	49	37	37	34		32	126	820	206	85	71	49
1949	30	46	39	37	34		32	143	715	190	81	71	50
1949	31	46		37	34		33		660		81	71	
1950	1	68	62	49	37	33	29	34	37	340	252	126	81
1950	2	71	50	49	33	33	34	37	40	352	282	118	80
1950	3	72	40	49	31	33	29	33	39	269	262	111	77
1950	4	71	50	48	36	33	20	33	37	272	242	109	76
1950	5	69	65	20	37	33	18	31	36	480	318	108	74
1950	6	80	64	30	38	33	20	37	36	750	259	103	74
1950	7	70	54	45	37	33	18	48	37	1,030	221	100	73
1950	8	65	40	48	37	33	20	54	38	755	206	97	72
1950	9	75	19	48	37	33	22	40	35	344	190	95	72
1950	10	74	21	47	36	33	38	36	36	286	177	94	75
1950	11	74	43	45	37	33	38	37	37	387	187	94	80
1950	12	71	50	43	36	33	38	42	45	955	185	118	77
1950	13	71	62	47	36	33	38	52	57	955	157	116	77
1950	14	69	63	44	36	33	38	52	79	895	139	101	80
1950	15	69	60	43	35	33	38	52	98	875	132	94	81
1950	16	68	55	43	35	34	37	57	110	850	136	90	77
1950	17	69	55	40	35	34	37	60	130	805	143	88	77
1950	18	68	56	40	35	34	31	55	193	705	143	86	82
1950	19	68	54	40	35	34	29	46	146	522	139	89	78
1950	20	68	56	40	35	34	30	46	121	536	125	94	77
1950	21	68	54	38	36	34	30	50	127	485	116	94	78
1950	22	67	50	36	36	34	31	56	279	546	112	93	75
1950	23	65	53	37	36	33	32	50	498	458	143	90	75
1950	24	65	53	39	34	33	31	44	555	458	162	89	73
1950	25	64	51	39	25	34	33	39	367	585	146	93	71
1950	26	65	51	37	33	34	33	44	290	314	141	95	70
1950	27	64	50	34	33	36	32	40	279	282	124	90	69
1950	28	60	49	38	33	34	32	41	352	265	116	88	70
1950	29	65	50	38	33		33	37	311	239	122	85	70
1950	30	63	49	38	33		33	38	337	233	160	84	68
1950	31	64		38	33		34		318		139	83	
1951	1	56	22	43	35	19	33	32	64	343	226	128	96
1951	2	59	26	43	36	20	34	33	55	281	236	123	92
1951	3	58	62	41	37	23	32	34	53	243	241	122	92
1951	4	59	67	43	36	26	34	34	63	231	249	128	90
1951	5	58	56	42	36	29	33	35	94	241	262	150	86
1951	6	58	53	42	35	31	32	34	111	276	233	150	84
1951	7	56	51	41	31	33	31	33	111	305	214	143	82

Year	Date	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1951	8	55	51	34	35	34	32	35	125	259	209	139	78
1951	9	54	50	30	37	38	34	35	113	238	189	132	76
1951	10	53	48	48	36	40	33	32	113	273	238	135	75
1951	11	53	47	48	35	40	32	32	134	279	226	132	72
1951	12	53	47	43	35	35	31	31	181	323	246	127	71
1951	13	55	48	40	35	26	35	34	194	548	231	122	65
1951	14	55	47	35	35	30	34	38	173	508	211	122	67
1951	15	56	42	38	36	33	34	33	214	562	200	122	62
1951	16	50	41	44	36	35	34	32	223	727	187	115	59
1951	17	55	38	43	35	35	32	39	251	688	185	111	56
1951	18	53	50	42	35	35	30	42	376	553	196	108	58
1951	19	56	48	41	35	35	33	43	526	508	177	102	58
1951	20	60	45	35	35	34	33	42	508	428	177	100	58
1951	21	58	45	45	35	35	34	39	390	376	236	99	59
1951	22	55	45	45	35	34	33	34	349	336	290	97	58
1951	23	53	45	42	35	34	32	39	624	296	219	96	68
1951	24	60	44	41	35	35	33	39	835	290	183	94	68
1951	25	58	44	40	40	34	34	38	576	380	169	94	67
1951	26	55	44	39	38	33	34	43	383	333	167	91	64
1951	27	48	44	42	28	34	32	47	482	311	158	102	62
1951	28	56	44	42	21	33	31	50	930	267	152	100	60
1951	29	54	43	40	19		30	68	762	254	146	100	59
1951	30	49	43	40	18		33	84	521	238	143	97	58
1951	31	47		38	18		34		394		134	97	
1952	1	49	45	41	34	38	35	36	405	499	160	112	72
1952	2	49	39	41	39	38	35	36	526	683	153	113	68
1952	3	49	34	41	41	36	34	35	732	693	142	114	65
1952	4	49	41	39	41	36	35	35	850	581	135	114	63
1952	5	49	44	39	41	36	34	39	634	698	129	108	64
1952	6	46	43	39	41	36	33	43	469	930	129	106	64
1952	7	49	42	39	41	36	33	48	405	910	142	101	63
1952	8	48	40	38	41	36	34	44	402	718	132	100	63
1952	9	48	31	38	40	35	34	39	320	548	121	98	60
1952	10	48	41	37	40	35	33	39	254	562	114	104	59
1952	11	47	46	37	40	35	34	41	249	448	113	114	59
1952	12	47	43	38	39	35	33	41	293	394	167	104	59
1952	13	47	43	38	39	34	32	39	380	349	492	98	60
1952	14	46	42	37	38	34	32	41	413	311	373	94	60
1952	15	43	43	37	36	33	32	48	413	290	249	93	60
1952	16	49	43	37	39	35	32	51	287	265	205	91	58
1952	17	48	44	37	39	35	32	47	249	226	183	88	58
1952	18	46	44	37	39	34	32	62	223	211	171	87	57
1952	19	46	43	36	39	28	32	76	219	209	167	93	56
1952	20	46	43	36	39	30	30	88	221	209	173	94	56
1952	21	46	42	35	39	40	29	86	228	194	154	92	56
1952	22	46	29	35	35	38	29	68	219	183	146	89	56
1952	23	45	33	35	40	36	28	69	223	167	139	88	55
1952	24	45	41	29	39	35	32	92	259	179	134	86	54
1952	25	45	35	32	38	35	30	125	320	223	129	83	53
1952	26	44	34	36	38	36	30	154	436	202	124	81	52

Year	Date	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1952	27	43	34	40	38	36	32	179	314	267	122	81	52
1952	28	42	37	40	38	36	45	281	302	233	118	78	52
1952	29	43	41	39	38	33	40	380	444	189	114	76	52
1952	30	44	41	39	38		38	390	539	173	112	74	51
1952	31	42		39	38		36		376		112	72	
1953	1	43	42	44	39	38	36	34	43	440	260	117	68
1953	2	42	43	42	39	37	34	32	42	553	246	116	74
1953	3	43	42	38	39	38	36	30	43	624	226	163	76
1953	4	44	40	42	39	37	37	32	42	530	209	123	75
1953	5	44	43	42	39	37	37	31	41	444	197	96	74
1953	6	44	45	44	38	37	36	32	50	398	185	87	71
1953	7	45	39	42	39	37	37	32	69	406	176	82	68
1953	8	44	35	37	38	37	37	32	80	464	164	79	67
1953	9	43	42	45	38	34	37	30	76	581	159	78	65
1953	10	43	42	42	38	32	37	30	67	956	155	78	64
1953	11	43	42	39	38	38	38	29	60	1,300	150	82	62
1953	12	42	40	44	38	38	37	32	53	1,410	148	83	62
1953	13	42	42	42	39	37	37	32	54	1,490	140	94	61
1953	14	40	43	42	37	37	36	32	50	1,190	131	94	59
1953	15	40	44	43	32	37	35	32	49	1,410	123	95	58
1953	16	43	46	43	40	37	37	32	51	1,250	125	98	58
1953	17	47	46	43	40	37	37	32	56	1,430	123	92	62
1953	18	46	42	42	39	36	35	33	61	885	116	89	64
1953	19	43	32	42	39	34	36	32	70	820	111	89	59
1953	20	42	26	43	38	33	37	32	80	665	106	87	56
1953	21	47	35	42	39	37	35	34	74	488	102	84	55
1953	22	44	49	40	37	37	36	37	67	448	99	84	54
1953	23	41	51	41	39	37	35	41	64	444	95	83	53
1953	24	48	47	43	38	37	35	41	87	404	92	79	53
1953	25	44	46	42	38	37	35	37	79	316	106	76	52
1953	26	42	48	42	37	36	35	38	96	290	106	75	50
1953	27	45	45	41	37	37	36	44	160	269	105	74	48
1953	28	44	45	42	38	37	36	52	209	262	104	71	48
1953	29	44	44	42	38		36	53	281	262	101	71	47
1953	30	45	44	42	38		36	47	267	260	101	70	47
1953	31	43		42	38		34		352		101	69	
1954	1	38	33	27	42	36	35	35	53	259	168	81	45
1954	2	37	33	37	41	36	25	33	52	226	166	80	43
1954	3	37	33	43	41	36	29	34	49	241	152	77	43
1954	4	36	32	41	40	36	36	35	51	265	143	77	42
1954	5	36	34	36	40	36	38	35	55	320	134	83	42
1954	6	36	33	34	40	36	38	36	73	384	143	88	41
1954	7	35	32	34	40	36	37	33	71	289	145	87	39
1954	8	34	30	33	40	36	35	33	70	250	127	83	37
1954	9	34	30	33	39	36	37	35	96	244	118	78	36
1954	10	36	31	35	37	36	37	35	138	280	112	77	35
1954	11	36	32	33	35	36	37	35	161	301	104	76	34
1954	12	35	32	32	37	36	31	36	211	262	99	74	34
1954	13	33	32	33	38	36	30	38	376	310	94	74	35
1954	14	33	31	33	41	36	35	40	456	384	94	73	34

Year	Date	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1954	15	33	32	33	37	35	33	38	504	320	98	70	34
1954	16	33	34	33	35	35	34	38	536	338	96	68	33
1954	17	33	33	33	42	35	34	40	436	307	90	66	33
1954	18	34	33	33	40	35	34	42	504	262	84	66	33
1954	19	36	32	32	38	31	33	40	620	235	86	65	33
1954	20	36	30	32	30	38	33	38	725	262	84	63	33
1954	21	36	29	32	38	36	35	36	770	317	80	65	33
1954	22	36	34	32	40	36	34	37	850	304	80	63	33
1954	23	35	34	32	38	35	33	38	560	301	74	60	33
1954	24	36	32	32	38	36	35	43	400	307	70	58	33
1954	25	36	33	32	38	36	32	45	416	274	66	57	33
1954	26	36	32	27	37	36	33	53	492	271	65	55	33
1954	27	36	34	22	37	33	34	57	348	314	84	54	34
1954	28	36	27	29	37	35	32	69	298	307	94	53	34
1954	29	36	24	31	38		33	68	271	223	88	52	36
1954	30	35	25	29	37		32	58	292	188	87	50	39
1954	31	34		32	36		32		250		83	47	
1955	1	44	32	41	31	31	34	33	74	545	301	77	63
1955	2	44	29	40	30	31	34	34	90	520	274	73	62
1955	3	43	44	38	30	30	34	32	71	428	262	69	59
1955	4	42	51	37	30	30	32	29	60	334	265	68	58
1955	5	42	45	38	29	30	29	33	66	301	250	78	57
1955	6	43	40	43	29	30	34	33	80	274	232	81	56
1955	7	42	41	41	28	30	34	34	98	289	210	83	55
1955	8	43	42	40	29	30	34	35	120	424	190	83	55
1955	9	41	42	40	28	30	34	37	130	373	172	81	54
1955	10	40	44	39	29	26	34	39	124	317	162	80	54
1955	11	41	42	39	29	29	34	38	148	338	156	77	51
1955	12	41	30	39	29	35	33	34	178	508	156	76	48
1955	13	40	25	35	29	31	33	35	232	770	146	77	44
1955	14	41	40	30	29	31	33	36	345	830	136	93	43
1955	15	42	29	38	28	31	32	37	524	1,260	130	92	42
1955	16	41	33	43	28	31	31	35	580	968	130	88	43
1955	17	42	44	41	28	31	33	36	400	950	118	86	44
1955	18	43	51	38	28	25	32	37	274	730	112	84	44
1955	19	42	53	41	28	31	32	41	338	650	105	88	44
1955	20	44	51	40	28	34	29	36	560	725	104	87	47
1955	21	45	49	40	28	34	30	36	695	710	102	81	44
1955	22	44	44	41	28	33	34	39	725	675	118	78	45
1955	23	44	40	44	29	33	33	42	460	635	120	77	44
1955	24	41	42	44	29	34	32	43	373	730	132	76	47
1955	25	44	41	40	31	34	30	44	331	640	141	76	48
1955	26	41	42	39	31	34	34	45	298	645	152	74	48
1955	27	44	35	40	31	34	34	53	307	540	113	76	47
1955	28	40	42	37	31	34	34	43	253	468	101	70	46
1955	29	44	42	22	31		36	44	259	400	93	69	46
1955	30	43	42	40	31		34	53	307	352	86	65	46
1955	31	42		48	31		33		432		80	64	
1956	1	40	37	36	42	35	36	36	51	914	134	78	48
1956	2	40	25	36	39	39	36	34	50	860	132	77	48

Year	Date	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1956	3	40	33	36	39	40	38	34	53	764	132	76	47
1956	4	40	41	36	39	40	37	34	51	740	120	74	47
1956	5	40	41	29	38	40	36	34	65	725	113	71	47
1956	6	39	41	29	38	40	35	28	68	585	110	70	47
1956	7	38	40	33	37	39	34	33	74	440	107	68	47
1956	8	37	38	33	37	38	36	34	94	448	104	65	47
1956	9	37	38	36	37	40	37	34	118	460	99	63	45
1956	10	37	39	41	37	40	35	36	132	452	98	60	44
1956	11	37	39	38	37	40	30	36	107	396	94	59	44
1956	12	37	38	37	37	40	35	36	112	370	99	83	44
1956	13	37	38	37	37	40	39	36	96	342	92	87	44
1956	14	38	34	35	37	39	37	40	86	324	87	93	45
1956	15	36	21	34	34	38	37	42	92	298	81	86	45
1956	16	37	42	34	34	40	38	45	98	277	80	76	45
1956	17	36	43	34	38	41	40	45	146	241	68	66	45
1956	18	35	37	34	38	40	40	45	208	262	78	59	44
1956	19	36	31	33	38	39	42	47	310	232	84	55	44
1956	20	35	30	33	37	40	43	53	512	212	84	53	44
1956	21	35	41	33	37	40	43	58	890	229	84	51	44
1956	22	35	41	33	37	40	43	60	932	235	84	50	44
1956	23	37	38	32	37	40	45	53	956	215	81	51	43
1956	24	40	37	33	37	40	47	51	932	182	78	51	43
1956	25	35	37	32	35	39	49	49	980	172	77	51	43
1956	26	38	36	33	37	39	46	52	962	164	77	56	42
1956	27	38	36	33	38	40	39	53	974	156	78	54	42
1956	28	38	36	33	35	39	35	51	890	150	77	52	42
1956	29	38	36	33	32	38	34	53	725	146	76	49	41
1956	30	29	36	33	36		37	51	685	139	76	49	41
1956	31	41		32	34		36		776		69	49	
1957	1	10	8	7	32	30	33	33	48	339	396	83	82
1957	2	10	8	7	32	30	33	32	55	420	350	101	79
1957	3	10	8	6	32	30	33	31	64	545	308	111	72
1957	4	10	8	6	31	30	33	31	72	936	275	109	70
1957	5	9	8	6	28	30	33	32	76	1,020	240	106	68
1957	6	10	8	6	29	30	31	32	84	1,030	228	103	67
1957	7	10	8	6	31	30	34	29	111	1,020	215	100	66
1957	8	9	8	7	29	30	33	33	142	766	198	95	64
1957	9	9	8	6	27	31	33	33	142	826	185	95	64
1957	10	9	8	6	30	31	32	33	147	922	173	94	64
1957	11	9	8	6	32	31	31	33	179	724	147	91	65
1957	12	9	8	6	31	31	32	30	222	510	130	91	69
1957	13	9	8	7	31	31	31	34	225	468	154	90	72
1957	14	9	8	7	30	31	24	33	215	360	138	87	69
1957	15	10	8	7	29	31	31	34	200	314	130	85	67
1957	16	10	8	7	28	31	31	34	170	322	128	84	66
1957	17	10	8	7	32	31	31	34	160	311	112	88	65
1957	18	9	8	7	31	31	30	35	150	325	108	98	65
1957	19	9	8	7	31	30	30	36	170	322	97	103	68
1957	20	9	8	7	31	29	31	36	190	350	92	103	68
1957	21	9	8	7	31	28	30	37	170	480	98	100	69

Year	Date	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1957	22	9	7	7	30	28	29	37	150	444	98	103	69
1957	23	9	7	7	30	28	29	40	140	376	92	103	68
1957	24	9	7	6	31	29	26	35	140	364	92	95	66
1957	25	9	7	6	32	32	31	33	140	408	92	85	66
1957	26	10	7	6	31	32	31	32	144	392	91	82	65
1957	27	8	7	6	30	32	30	30	175	428	87	85	60
1957	28	8	7	6	30	33	31	31	230	420	82	83	56
1957	29	8	7	6	30		31	34	255	448	84	84	55
1957	30	8	7	6	30		32	41	294	456	88	83	53
1957	31	8		5	30		33		356		84	80	
1958	1	55	40	42	5	4	3	3	30	174	36	57	10
1958	2	54	41	41	5	4	3	3	48	182	34	49	10
1958	3	54	43	41	5	4	3	3	72	215	33	43	9
1958	4	53	43	41	5	4	3	3	64	194	39	38	9
1958	5	51	41	37	5	4	3	3	73	150	39	34	9
1958	6	50	39	39	5	4	3	3	92	155	34	32	8
1958	7	50	44	42	4	4	3	3	127	140	36	29	8
1958	8	52	41	38	4	4	3	3	127	118	42	26	8
1958	9	50	43	41	4	4	3	3	148	102	41	25	8
1958	10	50	43	42	4	4	3	3	185	84	34	24	7
1958	11	51	41	43	4	4	3	3	270	72	30	23	7
1958	12	49	37	42	4	4	3	3	332	68	30	21	7
1958	13	49	46	40	4	4	3	3	342	93	29	19	8
1958	14	45	44	38	4	4	3	3	320	135	30	18	7
1958	15	41	41	41	4	4	3	3	294	117	28	17	7
1958	16	39	37	39	4	4	3	3	286	95	26	16	7
1958	17	39	34	37	4	4	3	3	326	80	24	15	7
1958	18	40	39	37	4	4	3	3	428	74	28	16	7
1958	19	40	48	35	4	4	3	3	468	74	26	16	6
1958	20	43	45	36	4	4	3	3	472	88	25	15	6
1958	21	40	43	34	4	4	3	3	548	73	34	14	6
1958	22	41	42	33	4	4	3	3	470	63	36	14	6
1958	23	42	41	33	4	4	3	3	498	59	31	15	6
1958	24	43	41	35	4	4	3	3	468	74	40	14	7
1958	25	41	37	37	4	4	3	3	478	66	41	13	7
1958	26	40	30	36	4	4	3	3	445	58	84	12	7
1958	27	38	36	36	4	4	3	3	421	51	81	12	6
1958	28	39	38	35	4	4	3	3	350	46	60	11	6
1958	29	36	48	37	4		3	3	310	42	48	11	6
1958	30	36	46	39	4		3	3	254	39	65	12	6
1958	31	40		40	4		3		217		72	11	
1959	1	59	43	39	37	31	33	31	61	165	223	77	84
1959	2	56	41	40	30	33	32	34	77	223	193	72	83
1959	3	59	40	41	30	33	32	31	80	416	178	72	83
1959	4	57	33	40	35	33	31	33	68	652	196	70	82
1959	5	56	20	39	41	32	29	34	64	844	178	69	80
1959	6	56	38	40	36	33	34	38	63	1,040	160	69	79
1959	7	57	50	40	42	31	34	35	59	1,320	152	68	77
1959	8	55	44	38	41	33	33	33	62	1,050	148	64	76
1959	9	57	42	40	40	33	33	29	70	928	138	63	77

Year	Date	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1959	10	55	41	40	38	32	33	33	72	934	130	80	76
1959	11	55	40	40	37	32	34	37	66	802	128	90	74
1959	12	61	38	40	37	32	34	35	68	784	125	95	73
1959	13	56	28	40	37	32	34	37	84	808	125	175	72
1959	14	56	39	40	37	31	33	40	108	844	122	178	72
1959	15	56	46	41	35	32	33	38	136	790	120	150	71
1959	16	57	32	40	36	32	33	42	178	820	116	145	79
1959	17	54	44	39	35	31	33	38	175	525	115	142	77
1959	18	57	46	39	35	32	33	39	160	455	116	138	73
1959	19	56	45	39	35	32	33	37	138	432	122	116	69
1959	20	55	44	37	32	31	31	36	124	400	118	108	67
1959	21	53	44	37	31	31	32	37	108	368	120	100	66
1959	22	53	41	37	37	31	33	40	102	368	108	98	65
1959	23	54	43	37	35	31	33	41	104	324	100	97	63
1959	24	48	43	37	33	31	31	42	128	280	95	90	62
1959	25	45	43	37	33	31	31	42	145	268	92	89	61
1959	26	43	41	37	33	31	30	42	188	288	90	89	61
1959	27	40	40	32	33	30	33	44	199	265	86	89	62
1959	28	44	40	35	33	30	30	42	175	247	82	86	59
1959	29	42	41	33	33		30	44	165	259	78	84	58
1959	30	37	40	36	32		29	52	158	250	90	84	56
1959	31	37		36	34		30		148		89	83	
1960	1	47	39	37	32	30	27	27	41	334	118	77	53
1960	2	47	33	34	31	30	27	28	44	307	111	74	53
1960	3	47	43	34	33	32	27	28	46	388	107	73	54
1960	4	47	40	33	33	32	28	29	46	364	109	73	53
1960	5	46	31	24	33	32	28	33	43	316	106	71	50
1960	6	45	39	23	34	33	28	38	40	283	101	74	50
1960	7	45	42	31	33	32	28	40	42	278	96	79	49
1960	8	51	37	34	33	33	28	38	65	286	92	101	48
1960	9	68	25	34	32	34	28	41	62	316	90	97	48
1960	10	57	40	34	32	32	26	47	90	530	84	90	48
1960	11	56	40	34	31	33	26	42	156	435	83	87	45
1960	12	53	37	33	31	32	27	43	242	425	83	83	44
1960	13	51	36	33	32	33	27	45	360	360	80	81	43
1960	14	49	34	33	31	32	27	41	384	348	81	81	45
1960	15	48	32	30	31	33	27	38	258	376	79	84	53
1960	16	48	33	30	31	32	27	37	195	376	73	87	49
1960	17	48	33	33	30	32	27	33	222	304	68	96	46
1960	18	48	33	32	28	31	28	37	198	283	66	94	45
1960	19	47	30	33	28	31	29	38	152	252	63	84	42
1960	20	46	30	33	28	33	30	38	130	242	61	76	41
1960	21	45	33	33	30	32	30	41	142	222	61	69	45
1960	22	45	30	33	32	32	31	54	235	192	59	68	53
1960	23	44	31	33	33	32	32	71	337	174	56	68	51
1960	24	43	33	33	34	33	31	86	408	164	57	67	49
1960	25	41	33	33	34	33	31	59	260	154	56	66	48
1960	26	41	33	32	33	31	33	48	222	144	69	65	48
1960	27	41	30	32	33	33	35	48	260	140	79	65	48
1960	28	39	20	29	33	33	37	46	250	132	81	65	48

Year	Date	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1960	29	39	28	33	33	33	34	41	210	127	80	65	47
1960	30	35	39	34	33		31	38	212	121	79	62	47
1960	31	42		32	33		30		289		77	53	
1961	1	47	56	44	32	28	25	26	33	632	74	74	51
1961	2	43	43	43	30	28	25	28	41	580	72	73	56
1961	3	45	46	45	32	28	24	28	41	540	69	72	55
1961	4	46	51	43	32	28	24	33	44	510	67	71	54
1961	5	46	38	45	33	28	23	26	42	510	67	63	53
1961	6	46	54	40	32	28	25	25	81	495	69	67	50
1961	7	51	56	41	31	27	25	23	89	400	72	77	53
1961	8	48	53	41	30	28	25	26	84	372	69	80	49
1961	9	48	56	35	30	28	25	27	94	356	67	81	49
1961	10	61	56	30	28	28	25	26	112	340	66	83	62
1961	11	55	55	37	28	29	25	26	150	310	69	79	60
1961	12	55	51	38	29	30	25	28	164	268	73	77	63
1961	13	54	43	45	28	27	25	28	119	245	73	77	53
1961	14	56	56	46	28	27	26	28	129	228	67	79	48
1961	15	56	49	46	28	27	28	27	144	222	66	72	47
1961	16	59	47	44	28	27	28	27	125	185	61	68	45
1961	17	61	40	45	28	27	29	27	111	168	60	68	43
1961	18	57	49	44	28	25	27	30	111	158	57	66	44
1961	19	55	51	43	26	26	25	36	101	156	56	65	49
1961	20	59	51	42	28	26	27	40	136	146	55	63	48
1961	21	57	49	41	28	26	27	33	255	134	57	63	53
1961	22	60	48	39	29	26	25	33	356	119	55	62	49
1961	23	53	48	38	28	25	25	34	465	112	56	59	48
1961	24	57	47	37	28	24	29	30	505	106	80	57	46
1961	25	47	47	37	27	25	31	27	485	99	89	57	46
1961	26	60	45	37	23	25	28	29	595	94	87	61	47
1961	27	57	45	36	24	25	27	28	1,020	92	83	59	46
1961	28	51	44	37	29	26	25	28	1,010	87	79	57	46
1961	29	43	45	37	30		23	30	919	83	77	56	50
1961	30	50	44	37	29		27	32	940	77	76	56	46
1961	31	56		36	28		25		632		76	53	
1962	1	58	52	48	36	34	38	32	107	360	322	111	81
1962	2	57	52	49	36	36	33	32	111	515	289	99	79
1962	3	57	52	50	35	36	33	34	127	656	278	92	79
1962	4	56	52	42	35	36	32	32	178	776	262	86	77
1962	5	56	52	45	34	34	31	34	248	550	242	87	77
1962	6	59	53	53	34	34	32	32	298	440	222	96	79
1962	7	59	45	48	33	34	34	32	360	380	215	102	76
1962	8	58	50	48	30	34	33	32	380	337	202	102	77
1962	9	57	55	47	22	34	33	32	430	352	195	97	80
1962	10	55	54	46	35	36	32	32	540	545	185	126	80
1962	11	55	48	45	37	39	30	32	585	758	176	127	76
1962	12	56	55	45	36	43	29	33	540	877	174	109	74
1962	13	55	54	44	33	37	30	41	460	877	190	96	72
1962	14	55	53	45	32	33	31	62	344	856	208	90	71
1962	15	58	53	44	32	31	31	71	307	776	190	84	69
1962	16	55	52	44	30	33	32	86	270	756	168	84	68

Year	Date	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1962	17	55	36	44	31	33	32	97	265	698	154	83	67
1962	18	56	49	43	31	30	32	102	252	605	144	83	66
1962	19	57	50	43	30	33	33	128	258	686	140	79	66
1962	20	55	61	43	31	30	33	184	360	662	130	76	65
1962	21	54	57	43	32	30	34	156	420	580	123	74	65
1962	22	53	54	36	34	34	34	111	396	570	116	76	76
1962	23	53	44	32	34	28	32	140	313	590	114	76	71
1962	24	53	48	32	32	23	32	178	310	570	123	72	65
1962	25	52	56	29	32	33	32	212	331	545	114	72	65
1962	26	53	54	40	32	32	32	210	316	505	107	72	62
1962	27	54	53	43	36	33	34	162	286	495	114	72	60
1962	28	52	52	44	34	34	36	158	262	440	119	74	59
1962	29	51	52	44	34		34	130	258	368	116	84	59
1962	30	51	49	43	34		32	111	260	348	106	87	57
1962	31	51		41	34		34		325		106	84	
1963	1	51	42	41	40	36	33	38	59	882	185	92	73
1963	2	50	47	36	40	36	32	38	58	936	175	91	71
1963	3	50	47	40	38	38	32	35	55	1,230	168	89	71
1963	4	49	46	39	38	38	31	35	60	1,170	168	89	66
1963	5	49	46	40	37	38	32	36	73	1,230	162	88	64
1963	6	48	44	40	37	37	32	36	96	974	156	86	58
1963	7	48	46	37	36	37	32	37	107	810	150	91	57
1963	8	48	46	29	36	36	32	38	102	768	144	86	65
1963	9	48	46	40	36	36	32	40	118	690	142	83	65
1963	10	49	45	36	28	34	32	40	132	635	152	89	59
1963	11	48	46	31	24	29	32	36	156	655	136	89	58
1963	12	47	45	36	32	35	32	36	172	798	120	92	56
1963	13	47	45	31	36	38	31	36	128	804	116	91	56
1963	14	47	45	38	38	36	32	40	132	749	110	88	56
1963	15	46	47	40	38	36	32	47	162	1,440	114	86	55
1963	16	46	48	40	37	36	32	40	200	1,080	107	84	58
1963	17	46	41	39	36	35	32	39	210	615	102	84	56
1963	18	45	44	41	34	34	32	42	223	530	99	83	55
1963	19	45	44	40	37	34	32	40	198	490	92	83	55
1963	20	45	48	40	34	35	32	37	192	480	102	81	54
1963	21	45	44	39	36	34	33	36	190	475	107	91	59
1963	22	45	38	37	38	34	35	37	215	470	104	92	65
1963	23	45	44	38	36	34	36	36	301	358	102	92	58
1963	24	47	46	37	30	34	36	36	394	330	105	86	56
1963	25	46	39	38	32	33	33	37	438	318	102	84	54
1963	26	45	44	37	32	34	33	39	580	286	97	80	53
1963	27	44	43	38	32	34	35	53	600	250	112	78	53
1963	28	43	36	38	32	33	37	52	620	229	102	74	51
1963	29	46	37	37	34		36	48	738	215	99	70	51
1963	30	50	40	37	34		36	52	786	202	96	67	51
1963	31	42		36	36		36		981		94	66	
1964	1	75	61	48	36	36	33	38	51	302	778	109	114
1964	2	75	61	47	37	36	33	38	56	290	680	111	107
1964	3	76	58	46	36	34	33	36	51	348	590	112	105
1964	4	72	52	44	36	35	33	36	41	364	560	111	102

Year	Date	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1964	5	73	60	42	34	34	34	36	38	464	515	111	101
1964	6	72	56	34	37	32	33	33	37	635	452	111	101
1964	7	72	52	51	36	35	33	33	35	922	392	121	99
1964	8	72	55	50	32	35	34	32	35	1,220	356	125	96
1964	9	70	51	50	33	35	35	34	34	832	336	121	94
1964	10	70	52	47	34	35	35	35	35	760	324	116	94
1964	11	69	52	48	34	35	35	35	36	778	320	118	93
1964	12	68	46	42	32	34	34	33	35	615	287	118	93
1964	13	68	42	46	33	34	33	31	44	575	269	127	91
1964	14	66	41	47	35	33	32	30	72	660	250	116	85
1964	15	66	32	48	36	33	34	34	91	754	232	114	82
1964	16	70	37	34	37	35	33	37	112	998	222	112	82
1964	17	68	51	30	36	34	35	35	143	1,260	205	111	80
1964	18	65	54	50	36	33	35	31	171	1,190	195	107	80
1964	19	62	51	55	36	34	32	31	198	802	190	111	84
1964	20	68	51	56	36	32	33	30	257	610	175	121	82
1964	21	66	49	52	36	32	33	30	358	560	169	121	80
1964	22	66	48	52	36	32	33	29	537	630	159	118	79
1964	23	63	48	58	36	32	31	32	585	600	151	112	80
1964	24	63	48	51	35	32	30	36	464	640	145	109	79
1964	25	62	49	43	36	32	35	39	505	802	139	105	78
1964	26	61	48	40	36	32	36	36	555	910	137	104	79
1964	27	61	47	57	36	34	35	32	565	1,080	131	104	78
1964	28	60	47	48	36	34	35	31	766	1,210	123	109	78
1964	29	60	46	44	36	33	36	34	610	1,020	118	129	76
1964	30	62	47	43	36		36	41	460	832	114	116	76
1964	31	63		47	36		37		364		111	120	
1965	1	80	50	45	43	40	31	52	78	476	525	129	97
1965	2	80	50	45	43	38	32	50	86	680	535	124	96
1965	3	82	50	48	47	41	36	42	68	778	468	120	94
1965	4	79	50	48	48	42	36	41	69	856	412	124	95
1965	5	78	50	46	44	40	35	40	79	630	404	131	95
1965	6	78	50	45	43	40	35	42	77	585	392	128	96
1965	7	77	50	44	43	39	35	41	55	690	352	123	97
1965	8	76	48	43	42	39	35	41	63	790	324	119	94
1965	9	74	50	44	41	39	34	42	58	1,150	314	116	94
1965	10	72	50	45	42	37	34	40	55	1,200	302	113	93
1965	11	72	46	46	41	31	34	39	57	1,270	278	110	91
1965	12	71	48	45	42	38	35	39	73	1,310	260	107	89
1965	13	71	43	44	42	38	35	40	89	1,920	248	105	90
1965	14	70	52	40	43	38	35	38	99	1,460	230	108	91
1965	15	70	52	32	43	36	35	39	101	1,090	213	109	104
1965	16	70	50	36	42	37	34	39	116	1,150	200	108	101
1965	17	70	49	40	41	37	29	40	142	1,010	192	110	100
1965	18	69	50	40	41	37	27	37	141	1,120	186	109	96
1965	19	69	49	44	41	38	32	40	143	946	182	111	91
1965	20	68	47	45	40	36	37	44	163	880	224	126	88
1965	21	68	47	44	41	35	37	45	165	868	190	124	89
1965	22	69	45	43	41	36	36	47	167	784	174	117	89
1965	23	68	42	42	36	29	35	46	213	868	166	110	85

Year	Date	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1965	24	65	49	40	44	38	34	43	210	820	160	106	85
1965	25	65	48	41	41	37	34	47	179	964	158	105	88
1965	26	58	45	39	40	36	35	45	169	904	165	104	89
1965	27	52	46	41	41	37	36	44	157	705	166	103	95
1965	28	51	43	42	40	35	35	48	151	560	151	100	97
1965	29	52	45	41	41		36	54	188	520	141	99	93
1965	30	52	46	42	41		45	65	263	495	139	99	85
1965	31	51		40	40		58		372		135	100	
1966	1	39	31	33	40	37	35	42	36	434	91	65	37
1966	2	41	39	36	36	37	36	41	42	322	94	65	38
1966	3	40	38	40	43	36	31	37	59	298	84	64	39
1966	4	39	37	36	41	37	35	36	87	250	78	65	40
1966	5	40	36	36	40	37	36	36	123	172	73	67	39
1966	6	40	39	34	40	37	37	36	160	142	71	65	37
1966	7	39	38	37	40	37	36	36	277	142	68	65	35
1966	8	39	37	35	40	36	36	35	398	140	66	60	35
1966	9	38	30	28	40	36	36	36	530	146	62	54	34
1966	10	38	32	33	39	36	36	39	565	164	78	55	34
1966	11	38	30	39	39	36	36	43	382	195	74	58	34
1966	12	38	32	38	39	36	35	37	212	162	78	69	33
1966	13	39	34	36	39	35	36	36	148	128	90	67	38
1966	14	37	35	35	39	36	36	35	115	116	77	61	42
1966	15	36	35	34	39	35	36	36	94	130	73	59	42
1966	16	39	35	35	36	36	36	40	100	138	71	58	40
1966	17	40	36	36	38	36	35	40	115	127	67	57	40
1966	18	39	37	36	39	36	34	35	116	132	76	57	39
1966	19	38	37	36	38	35	36	33	98	140	79	61	38
1966	20	40	39	35	33	35	35	36	122	148	74	70	38
1966	21	40	40	36	36	35	35	36	350	142	74	72	37
1966	22	35	38	35	39	35	33	36	695	148	76	74	37
1966	23	41	36	31	39	35	33	35	378	185	72	70	37
1966	24	39	35	36	37	35	37	35	202	158	70	56	37
1966	25	38	36	33	37	35	36	37	241	136	69	45	41
1966	26	38	37	32	38	35	36	38	470	113	69	40	44
1966	27	38	35	33	37	35	38	37	580	102	66	38	41
1966	28	38	37	30	38	35	39	36	575	97	65	39	40
1966	29	38	38	32	38		40	36	430	92	64	39	39
1966	30	37	36	33	37		41	35	550	90	63	37	40
1966	31	37		34	37		43		560		64	36	
1967	1	86	72	52	35	26	30	33	35	699	605	132	98
1967	2	85	60	51	33	26	31	31	34	1,020	531	122	96
1967	3	85	46	57	33	27	31	30	33	1,150	490	116	95
1967	4	83	64	55	33	27	30	33	32	874	464	113	99
1967	5	82	53	54	33	26	28	38	34	1,020	452	112	98
1967	6	90	63	53	31	26	30	35	34	1,100	419	110	97
1967	7	86	66	51	28	26	25	34	36	874	401	127	96
1967	8	85	73	52	33	26	35	35	39	607	390	106	95
1967	9	84	75	50	32	28	34	33	47	547	371	101	84
1967	10	83	71	52	28	28	34	33	55	506	330	97	83
1967	11	82	69	52	27	28	34	34	50	569	302	95	81

Year	Date	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1967	12	85	68	47	27	28	33	35	47	658	285	92	89
1967	13	84	65	41	27	28	32	34	44	744	346	94	94
1967	14	86	64	41	26	28	31	36	42	769	313	92	93
1967	15	84	64	49	26	26	31	36	42	786	294	94	92
1967	16	81	62	54	26	27	31	35	45	731	267	91	98
1967	17	81	60	52	26	29	32	33	56	830	243	87	93
1967	18	81	59	48	25	29	34	34	85	900	222	84	95
1967	19	81	61	46	27	29	34	38	98	1,010	204	83	90
1967	20	79	59	46	27	28	32	39	82	1,100	191	80	91
1967	21	80	57	44	27	29	32	35	118	930	180	80	97
1967	22	79	46	48	28	30	33	34	168	1,030	168	78	102
1967	23	79	61	48	27	30	35	34	236	1,110	161	77	98
1967	24	75	58	45	26	30	35	34	329	733	154	76	93
1967	25	76	55	45	26	30	32	34	511	668	148	77	89
1967	26	75	46	46	26	30	33	33	1,010	624	144	76	88
1967	27	68	37	45	27	30	32	33	769	656	142	80	86
1967	28	80	57	46	27	30	32	35	609	778	134	82	84
1967	29	71	60	45	27		35	40	706	639	128	81	83
1967	30	68	63	44	27		36	34	695	629	122	82	82
1967	31	74		44	27		32		647		120	86	
1968	1	101	85	74	45	39	38	38	60	428	349	115	129
1968	2	105	85	68	38	39	38	38	69	569	311	111	143
1968	3	98	85	69	45	39	37	37	64	961	291	109	162
1968	4	98	85	70	46	39	37	36	74	1,980	302	108	167
1968	5	97	81	68	45	39	38	38	90	1,770	338	107	174
1968	6	96	80	67	40	38	38	38	89	1,360	315	105	188
1968	7	95	75	65	45	39	37	36	69	1,330	297	102	185
1968	8	95	70	67	44	39	37	36	65	1,180	338	102	175
1968	9	95	86	65	43	38	36	36	61	1,160	286	106	161
1968	10	95	79	65	43	38	37	36	68	1,000	270	143	151
1968	11	95	76	65	42	38	36	38	60	918	291	115	143
1968	12	95	81	64	41	38	36	40	78	1,160	269	108	138
1968	13	95	79	60	43	37	37	39	107	1,460	218	104	134
1968	14	95	59	63	42	38	37	36	99	979	225	103	131
1968	15	95	71	62	42	38	36	38	93	792	210	105	131
1968	16	95	81	61	42	38	36	38	79	800	200	109	135
1968	17	95	65	61	41	38	37	36	79	983	202	103	133
1968	18	95	69	61	40	38	37	36	72	1,260	196	125	129
1968	19	95	91	59	41	39	36	37	70	1,320	179	138	123
1968	20	95	83	57	41	39	34	37	75	1,240	163	154	119
1968	21	90	81	56	41	38	33	37	83	1,070	152	184	119
1968	22	90	78	51	40	39	37	36	146	956	144	162	114
1968	23	90	75	52	40	38	37	35	148	1,030	138	211	111
1968	24	90	74	54	41	38	37	37	116	904	135	210	109
1968	25	90	74	54	41	38	37	37	127	612	131	207	108
1968	26	90	64	54	40	38	37	37	142	506	129	180	105
1968	27	90	74	54	37	38	36	36	127	499	139	159	104
1968	28	90	66	54	37	38	37	36	145	580	129	155	102
1968	29	90	63	52	38	38	38	40	268	491	124	154	102
1968	30	85	76	48	43		40	47	379	400	121	145	101

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1968	31	85		52	41		37		404		120	136	
1969	1	64	55	47	54	44	40	45	110	318	402	103	89
1969	2	68	49	47	54	44	39	46	109	274	430	100	87
1969	3	81	48	46	54	43	39	47	142	253	426	98	86
1969	4	74	60	46	55	43	39	47	198	271	406	97	85
1969	5	71	56	46	54	43	39	50	268	342	346	94	84
1969	6	71	54	41	54	43	39	58	362	362	310	92	83
1969	7	71	54	38	53	43	39	59	390	354	304	109	82
1969	8	71	54	37	49	43	41	50	274	301	289	110	81
1969	9	71	50	43	46	43	43	49	274	271	259	109	80
1969	10	69	53	47	46	43	43	57	354	286	235	107	81
1969	11	63	54	44	46	42	43	65	366	310	218	106	81
1969	12	52	55	47	47	42	43	65	418	265	205	123	81
1969	13	53	50	46	49	42	42	80	565	256	193	120	81
1969	14	52	41	46	49	42	42	90	690	238	185	107	70
1969	15	60	56	45	48	41	43	70	726	215	183	104	68
1969	16	61	52	45	47	41	43	61	505	195	173	103	67
1969	17	60	46	45	46	41	43	60	525	183	166	104	66
1969	18	60	29	45	46	41	44	65	530	180	156	103	65
1969	19	58	54	45	47	41	43	68	655	178	150	101	65
1969	20	60	58	46	46	41	42	72	480	208	144	100	61
1969	21	60	54	45	46	41	41	74	466	218	138	100	63
1969	22	60	52	46	41	41	42	112	358	213	132	100	65
1969	23	60	48	45	33	40	42	175	362	223	127	98	62
1969	24	58	49	44	35	41	41	286	515	218	122	95	61
1969	25	58	47	40	35	41	41	229	645	262	118	95	60
1969	26	57	48	47	40	40	41	150	635	286	118	94	59
1969	27	56	45	45	45	40	41	128	680	286	112	94	59
1969	28	60	48	40	45	39	41	130	680	402	109	91	58
1969	29	55	47	39	45		41	128	462	382	107	92	58
1969	30	55	47	45	44		43	127	426	390	106	97	58
1969	31	55		45	44		44		402		104	92	
1970	1	62	44	44	45	42	37	33	36	358	354	111	87
1970	2	62	42	42	43	40	37	36	37	382	309	110	84
1970	3	61	43	45	42	40	36	35	42	531	282	109	81
1970	4	56	40	44	41	38	36	35	48	857	264	108	78
1970	5	53	44	40	37	39	37	37	60	959	252	107	77
1970	6	56	44	45	35	39	35	40	73	974	238	104	82
1970	7	53	43	43	34	39	37	44	95	995	232	101	88
1970	8	50	43	44	34	38	37	40	96	1,040	220	101	78
1970	9	53	42	43	36	38	37	39	72	1,090	208	101	76
1970	10	56	44	42	38	39	30	40	69	1,090	195	98	76
1970	11	53	39	41	43	38	33	41	72	690	198	96	74
1970	12	56	45	36	41	38	37	37	72	504	185	106	78
1970	13	54	42	38	41	39	37	36	64	560	175	110	78
1970	14	47	41	43	40	38	36	38	63	680	168	108	80
1970	15	44	40	43	40	38	36	37	61	630	157	107	76
1970	16	50	42	44	38	38	36	32	80	550	148	107	76
1970	17	47	42	42	37	39	36	37	135	516	142	104	76
1970	18	46	42	40	42	38	34	36	192	550	140	102	73

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1970	19	48	42	35	42	37	36	35	230	680	137	101	71
1970	20	46	42	37	41	37	34	35	285	700	135	101	71
1970	21	46	40	42	40	37	36	35	351	756	135	100	72
1970	22	43	24	41	40	37	36	34	309	726	142	98	69
1970	23	45	36	37	40	38	36	35	306	798	137	96	69
1970	24	47	61	41	40	38	37	35	321	762	121	95	71
1970	25	46	49	40	40	36	35	35	351	780	112	94	67
1970	26	37	46	41	39	38	35	36	420	560	108	94	67
1970	27	41	45	41	40	38	33	37	644	492	102	92	67
1970	28	47	44	41	39	37	36	40	853	690	130	91	66
1970	29	47	44	42	32		36	37	629	476	115	89	64
1970	30	47	47	40	30		35	36	537	428	120	88	63
1970	31	45		41	45		34		424		112	88	
1971	1	64			39	39	35	34	48	529	230	135	77
1971	2	66			35	38	34	32	62	553	218	131	76
1971	3	62			38	38	36	35	73	621	225	130	81
1971	4	63			36	30	36	33	88	740	220	141	85
1971	5	67			36	34	35	34	108	608	198	139	82
1971	6	64			37	32	34	36	113	577	182	133	80
1971	7	63			40	35	35	37	108	578	172	131	78
1971	8	61			40	42	36	37	115	577	165	139	78
1971	9	60			40	39	36	37	123	917	159	137	74
1971	10	58			40	41	36	41	113	952	150	130	73
1971	11	57			39	39	36	41	121	1,060	142	128	72
1971	12	57			39	38	37	38	148	948	139	124	71
1971	13	57			40	39	38	35	188	960	133	123	69
1971	14	63			40	38	35	39	238	894	128	121	69
1971	15	63			40	38	34	43	246	846	124	120	69
1971	16	63			40	37	35	42	246	780	120	118	71
1971	17	66			40	36	34	42	232	834	116	118	68
1971	18	69			40	38	34	45	274	768	116	118	64
1971	19	63			40	36	35	45	204	710	113	115	66
1971	20	62			40	35	35	44	176	585	108	98	64
1971	21	63			38	28	35	45	165	570	107	91	64
1971	22	58			36	37	35	43	183	545	116	89	63
1971	23	60			41	38	35	43	196	530	116	89	63
1971	24	60			39	37	37	49	220	472	110	88	62
1971	25	64			39	37	38	47	271	420	121	88	61
1971	26	60			39	36	42	45	348	382	123	85	62
1971	27	56			39	35	37	45	517	340	110	85	62
1971	28	39			38	36	35	43	802	312	104	85	62
1971	29	45			38		35	43	1,360	282	98	81	61
1971	30	56			39		39	43	951	252	94	87	61
1971	31	64			39		37		646		130	80	
1972	1						41	41	56	1,110	255	120	107
1972	2						39	42	52	1,230	276	200	102
1972	3						40	40	54	1,170	282	267	98
1972	4						39	42	61	1,090	273	198	96
1972	5						39	42	72	1,070	258	157	92
1972	6						43	44	66	974	240	137	106

Year	Date	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1972	7						38	44	64	1,010	230	128	112
1972	8						37	44	66	1,080	220	121	108
1972	9						45	43	73	988	210	120	101
1972	10						44	44	85	912	200	118	100
1972	11						44	44	77	822	190	112	97
1972	12						43	49	78	762	185	108	92
1972	13						44	45	73	655	178	107	89
1972	14						44	43	88	545	172	104	88
1972	15						42	45	121	500	168	104	87
1972	16						43	47	148	472	159	100	84
1972	17						46	49	185	448	165	100	82
1972	18						47	47	246	428	161	95	81
1972	19						48	45	285	456	140	96	81
1972	20						46	44	340	452	145	100	81
1972	21						43	45	452	400	155	96	80
1972	22						44	45	452	368	140	123	80
1972	23						49	43	508	340	130	128	78
1972	24						46	45	472	340	120	148	78
1972	25						43	50	516	354	115	131	82
1972	26						44	47	480	344	112	121	78
1972	27						37	46	420	318	110	115	87
1972	28						39	50	393	288	110	106	84
1972	29						39	62	504	270	105	101	81
1972	30						43	71	670	261	100	98	81
1972	31						43		906		105	104	
1973	1						39	40	45	870	330	89	94
1973	2						40	40	45	1,270	282	89	97
1973	3						40	40	45	750	235	115	95
1973	4						39	40	54	393	210	116	94
1973	5						39	41	61	358	195	120	89
1973	6						40	41	69	535	182	115	81
1973	7						40	39	76	816	168	108	77
1973	8						40	32	84	995	159	106	87
1973	9						41	40	78	1,200	152	101	89
1973	10						42	41	69	1,210	139	100	81
1973	11						42	41	80	960	130	98	81
1973	12						42	42	89	750	128	101	78
1973	13						41	43	112	685	123	100	77
1973	14						39	44	131	640	116	94	81
1973	15						42	41	172	858	112	92	85
1973	16						43	41	249	468	107	91	82
1973	17						43	42	390	396	104	89	81
1973	18						43	41	732	386	100	88	81
1973	19						43	38	858	334	97	89	78
1973	20						43	39	1,100	327	100	87	76
1973	21						42	43	1,160	340	102	85	67
1973	22						42	44	710	396	98	91	64
1973	23						41	43	585	472	116	87	61
1973	24						41	45	472	500	118	85	66
1973	25						42	46	635	456	112	84	64

Year	Date	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1973	26						42	43	550	412	98	87	64
1973	27						41	45	344	396	101	87	62
1973	28						41	53	303	365	89	88	60
1973	29						41	51	261	340	89	87	58
1973	30						41	46	238	390	95	84	58
1973	31						40		460		88	82	
1974	1							37	87	390	240	133	104
1974	2							36	92	444	240	131	100
1974	3							35	84	685	282	130	98
1974	4							35	87	930	252	130	94
1974	5							35	101	942	215	128	92
1974	6							38	126	620	202	126	94
1974	7							39	148	464	195	124	91
1974	8							38	161	382	185	130	88
1974	9							40	175	337	168	133	87
1974	10							41	185	340	165	140	85
1974	11							39	142	424	159	130	92
1974	12							39	133	780	152	121	91
1974	13							38	133	1,140	139	120	89
1974	14							37	118	1,330	137	118	92
1974	15							38	104	1,210	131	116	89
1974	16							40	88	1,080	128	113	85
1974	17							42	85	1,050	130	108	84
1974	18							44	104	995	128	106	82
1974	19							50	165	870	130	102	81
1974	20							56	235	798	165	104	80
1974	21							45	188	710	200	107	80
1974	22							41	140	500	152	104	78
1974	23							48	131	468	135	101	78
1974	24							63	157	456	123	100	77
1974	25							108	220	412	118	98	77
1974	26							131	539	368	112	95	76
1974	27							120	1,020	337	108	95	76
1974	28							95	1,470	300	131	94	77
1974	29							85	1,490	276	135	94	77
1974	30							84	732	252	133	94	76
1974	31								452		133	94	
1975	1							37	33	153	1,260	173	114
1975	2							37	33	220	1,170	161	115
1975	3							37	33	289	1,050	151	114
1975	4							37	40	316	1,030	144	114
1975	5							38	45	412	974	138	112
1975	6							38	42	566	780	133	112
1975	7							38	40	752	715	127	110
1975	8							36	41	870	671	124	109
1975	9							35	40	599	657	120	108
1975	10							35	45	444	657	118	106
1975	11							35	43	377	500	114	106
1975	12							34	50	440	436	110	106
1975	13							35	59	608	394	110	106

Year	Date	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1975	14							36	75	858	367	114	104
1975	15							36	102	807	346	110	102
1975	16							36	136	846	334	109	99
1975	17							35	183	594	316	112	97
1975	18							33	205	500	301	133	92
1975	19							33	179	522	275	133	87
1975	20							33	140	582	230	132	87
1975	21							33	124	758	248	132	85
1975	22							35	115	680	228	128	84
1975	23							37	106	801	232	127	82
1975	24							37	99	1,310	215	128	82
1975	25							40	99	1,450	199	127	81
1975	26							42	93	1,070	189	126	81
1975	27							40	93	1,130	178	121	82
1975	28							36	97	1,090	177	120	82
1975	29							35	187	1,140	171	115	82
1975	30							34	177	1,250	173	115	84
1975	31								149		183	114	
1976	1							44	42	715	415	136	96
1976	2							44	47	918	405	171	93
1976	3							42	58	1,010	328	177	92
1976	4							44	69	1,140	292	149	89
1976	5							46	69	1,120	267	138	87
1976	6							50	59	1,580	262	134	86
1976	7							52	62	1,510	260	130	103
1976	8							48	80	1,350	248	130	93
1976	9							51	99	807	223	128	89
1976	10							47	118	730	199	128	86
1976	11							47	139	626	197	127	87
1976	12							49	120	586	191	126	89
1976	13							52	116	496	183	122	93
1976	14							53	147	454	171	121	86
1976	15							49	157	426	159	118	84
1976	16							52	137	472	151	118	84
1976	17							46	155	433	142	115	82
1976	18							46	228	402	139	114	81
1976	19							43	292	391	134	120	87
1976	20							42	401	426	134	114	85
1976	21							42	419	578	128	110	81
1976	22							41	408	657	121	109	80
1976	23							41	391	644	116	109	84
1976	24							41	419	475	114	109	82
1976	25							44	530	408	110	106	82
1976	26							48	508	370	136	105	84
1976	27							45	617	340	140	108	82
1976	28							43	758	316	138	105	80
1976	29							42	942	331	134	100	79
1976	30							40	752	346	134	100	79
1976	31								653		134	99	
1977	1							37	272	351	109	84	80

Year	Date	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1977	2							37	304	611	108	82	72
1977	3							37	304	640	104	84	64
1977	4							38	232	650	114	84	61
1977	5							39	165	572	121	87	60
1977	6							40	142	486	114	84	59
1977	7							42	182	402	104	84	73
1977	8							45	329	402	102	87	60
1977	9							48	436	398	99	85	55
1977	10							50	700	370	97	81	53
1977	11							49	731	316	96	81	53
1977	12							46	430	343	90	79	58
1977	13							44	422	316	89	78	56
1977	14							46	489	260	104	76	54
1977	15							49	506	232	103	78	48
1977	16							55	307	210	102	76	46
1977	17							63	260	197	99	75	46
1977	18							59	215	183	97	74	48
1977	19							51	201	175	96	74	53
1977	20							49	173	173	102	82	64
1977	21							46	161	179	97	74	62
1977	22							51	167	165	97	78	56
1977	23							62	195	149	96	76	56
1977	24							80	319	142	96	72	53
1977	25							96	396	133	103	70	48
1977	26							114	394	127	100	81	44
1977	27							145	340	121	92	85	42
1977	28							165	292	115	91	76	41
1977	29							202	235	114	89	73	40
1977	30							245	195	110	86	70	51
1977	31								191		85	69	
1978	1							44	72	319	720	167	124
1978	2							46	72	283	666	161	121
1978	3							46	86	283	640	157	118
1978	4							40	78	313	574	145	118
1978	5							39	70	422	506	138	116
1978	6							33	66	593	450	132	116
1978	7							36	66	768	408	127	114
1978	8							39	63	741	402	122	114
1978	9							40	60	930	458	120	110
1978	10							37	70	1,210	426	118	109
1978	11							37	79	824	370	112	124
1978	12							35	73	586	349	108	134
1978	13							34	70	671	322	115	124
1978	14							36	103	1,160	298	169	124
1978	15							39	163	1,290	275	167	127
1978	16							37	225	1,160	262	157	133
1978	17							40	235	812	265	173	126
1978	18							35	197	736	252	169	126
1978	19							35	189	894	232	161	121
1978	20							36	197	697	218	151	116

Year	Date	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1978	21							40	222	747	258	144	114
1978	22							39	275	1,030	272	140	114
1978	23							36	343	1,050	232	138	112
1978	24							36	458	1,050	201	136	114
1978	25							40	500	988	189	134	112
1978	26							43	482	705	177	133	108
1978	27							70	472	626	167	133	103
1978	28							87	468	780	171	130	102
1978	29							75	492	888	185	128	100
1978	30							74	478	812	169	127	99
1978	31								388		177	126	
1979	1							44	76	343	260	159	139
1979	2							44	78	337	212	159	136
1979	3							43	74	391	210	157	133
1979	4							44	80	590	258	157	133
1979	5							44	103	840	260	151	133
1979	6							46	130	888	225	151	132
1979	7							46	103	506	250	151	130
1979	8							46	97	402	220	159	127
1979	9							47	89	346	189	157	127
1979	10							48	80	337	179	157	127
1979	11							46	97	405	169	151	126
1979	12							44	79	653	161	153	127
1979	13							45	76	967	155	203	126
1979	14							43	84	900	147	195	122
1979	15							46	161	690	142	167	120
1979	16							49	218	489	138	159	115
1979	17							54	248	440	133	157	115
1979	18							67	235	436	128	157	114
1979	19							69	265	388	126	159	112
1979	20							58	310	346	126	157	110
1979	21							58	377	346	124	159	110
1979	22							59	454	391	159	163	110
1979	23							66	416	364	173	167	109
1979	24							73	834	337	167	163	108
1979	25							69	988	328	165	159	106
1979	26							58	1,050	331	169	149	104
1979	27							61	1,080	316	171	147	104
1979	28							62	1,060	301	165	147	103
1979	29							68	1,110	283	163	144	102
1979	30							72	542	272	161	140	102
1979	31								349		163	140	
1980	1							37	139	328	193	104	80
1980	2							38	149	328	185	103	75
1980	3							37	116	337	173	102	75
1980	4							38	120	419	169	103	73
1980	5							38	124	538	153	100	72
1980	6							38	130	461	140	97	70
1980	7							39	175	426	133	97	68
1980	8							36	193	419	130	96	69

Year	Date	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1980	9							39	235	454	138	96	69
1980	10							40	322	514	126	93	67
1980	11							39	235	644	116	92	70
1980	12							39	183	626	112	92	73
1980	13							39	159	534	108	92	72
1980	14							41	147	450	124	92	68
1980	15							44	139	478	132	96	66
1980	16							41	139	391	126	127	86
1980	17							43	157	325	121	109	79
1980	18							45	171	349	121	94	81
1980	19							46	189	349	116	92	90
1980	20							53	215	337	115	96	79
1980	21							61	465	361	112	92	78
1980	22							73	852	334	109	87	76
1980	23							81	906	292	114	86	76
1980	24							79	730	260	114	85	80
1980	25							85	503	235	122	82	79
1980	26							96	349	220	128	84	79
1980	27							79	364	205	114	84	75
1980	28							82	391	189	109	84	75
1980	29							102	380	177	108	80	74
1980	30							104	370	175	108	79	73
1980	31								343		106	80	
1981	1							29	321	554	151	106	79
1981	2							30	332	475	167	102	76
1981	3							28	238	554	157	100	75
1981	4							26	159	546	149	99	74
1981	5							28	144	536	142	97	74
1981	6							30	177	695	136	97	84
1981	7							28	145	724	132	108	74
1981	8							27	114	832	124	114	70
1981	9							28	99	912	120	115	68
1981	10							28	102	500	114	112	67
1981	11							28	104	402	109	109	66
1981	12							29	89	408	134	106	64
1981	13							29	86	590	200	103	63
1981	14							28	84	436	140	104	62
1981	15							31	108	370	126	103	62
1981	16							32	199	349	120	102	61
1981	17							93	235	349	114	102	60
1981	18							54	260	310	116	96	60
1981	19							66	243	286	112	96	59
1981	20							61	398	325	108	94	59
1981	21							59	346	355	102	99	59
1981	22							48	283	301	97	93	58
1981	23							47	383	310	94	92	58
1981	24							70	438	301	116	85	56
1981	25							138	542	270	132	92	59
1981	26							237	765	242	140	85	62
1981	27							251	1,140	248	136	84	59

Year	Date	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1981	28							169	930	232	120	82	56
1981	29							154	768	208	115	80	54
1981	30							231	685	187	110	80	60
1981	31								730		109	79	
1982	1							28	53	265	552	117	92
1982	2							27	68	265	528	113	92
1982	3							27	129	293	425	107	90
1982	4							28	151	343	394	103	89
1982	5							27	110	340	401	100	92
1982	6							28	104	319	343	96	90
1982	7							28	103	276	301	93	88
1982	8							25	101	273	290	93	88
1982	9							27	106	239	340	106	87
1982	10							28	123	249	300	99	88
1982	11							30	106	273	249	90	103
1982	12							37	97	349	246	89	93
1982	13							34	99	488	246	87	92
1982	14							33	97	948	220	85	93
1982	15							33	96	923	224	83	96
1982	16							29	96	835	222	81	96
1982	17							28	111	893	205	80	94
1982	18							31	160	568	188	79	92
1982	19							28	214	651	174	79	89
1982	20							28	188	807	149	79	88
1982	21							28	164	858	154	76	88
1982	22							32	237	932	151	76	87
1982	23							33	313	1,040	147	104	87
1982	24							38	293	1,060	152	103	87
1982	25							43	244	864	160	100	87
1982	26						28	44	306	920	147	99	96
1982	27						29	44	507	744	182	97	116
1982	28						29	41	561	759	130	99	104
1982	29						30	49	439	738	129	96	103
1982	30						29	47	319	647	129	94	90
1982	31						28		260		122	93	
1983	1							37	45	355	418	110	96
1983	2							36	45	381	415	107	94
1983	3							36	45	457	368	103	94
1983	4							35	70	560	307	101	92
1983	5							35	93	439	270	100	92
1983	6							31	97	384	262	97	89
1983	7							35	88	394	273	94	87
1983	8							36	90	512	265	92	85
1983	9							35	96	715	252	90	88
1983	10							36	84	736	257	94	84
1983	11							36	83	1,080	236	134	84
1983	12							35	83	1,170	210	126	84
1983	13							34	81	668	190	123	84
1983	14							32	78	509	178	120	84
1983	15							36	79	497	162	120	84

Year	Date	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1983	16							35	76	601	190	120	82
1983	17							36	75	658	182	119	82
1983	18							36	75	711	164	119	81
1983	19							39	75	705	152	119	81
1983	20							40	76	597	145	117	76
1983	21							41	76	624	142	116	76
1983	22							42	76	751	139	117	74
1983	23							46	84	737	142	113	74
1983	24							54	116	742	147	110	72
1983	25							61	165	749	134	106	72
1983	26							52	242	610	129	104	69
1983	27							47	348	524	125	103	69
1983	28							48	388	439	120	101	67
1983	29							46	461	421	117	101	67
1983	30							46	421	439	114	100	64
1983	31								352		110	97	
1984	1							32	42	810	430	124	99
1984	2							32	40	514	352	130	97
1984	3							32	40	468	343	118	96
1984	4							33	40	419	319	122	93
1984	5							34	40	492	289	115	92
1984	6							35	40	405	275	114	90
1984	7							35	38	367	262	108	93
1984	8							34	37	325	252	121	92
1984	9							35	40	298	238	118	92
1984	10							33	79	275	220	112	89
1984	11							33	84	316	203	106	87
1984	12							33	109	283	191	106	86
1984	13							33	133	372	179	104	84
1984	14							33	175	850	171	104	82
1984	15							33	274	1,390	163	103	80
1984	16							37	393	1,310	155	102	78
1984	17							41	444	1,120	149	103	75
1984	18							44	468	900	142	100	74
1984	19							44	436	954	142	97	73
1984	20							44	458	988	139	100	72
1984	21							66	566	988	136	96	80
1984	22							56	426	995	140	93	79
1984	23							49	370	705	139	93	86
1984	24							45	496	534	139	109	84
1984	25							42	374	554	132	108	79
1984	26							32	275	586	126	110	81
1984	27							31	235	526	121	106	84
1984	28							40	210	514	118	104	79
1984	29							41	258	472	116	102	76
1984	30							44	446	496	116	100	80
1984	31								783		114	100	
1985	1							25	180	214	104	101	82
1985	2							31	272	258	109	88	81
1985	3							35	516	245	103	93	77

Year	Date	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1985	4							27	690	206	95	92	75
1985	5							27	432	242	93	87	71
1985	6							25	268	305	88	85	69
1985	7							24	327	343	85	85	66
1985	8							25	522	424	85	75	64
1985	9							35	569	325	87	72	59
1985	10							46	492	253	81	71	56
1985	11							53	361	209	78	70	54
1985	12							51	240	176	77	71	58
1985	13							43	178	160	77	78	58
1985	14							52	160	176	74	77	53
1985	15							64	162	176	70	74	51
1985	16							76	192	174	68	70	50
1985	17							92	174	166	68	69	49
1985	18							108	162	152	72	68	49
1985	19							108	164	136	78	66	64
1985	20							78	232	132	70	65	58
1985	21							70	266	150	65	65	57
1985	22							69	334	150	75	65	57
1985	23							66	274	130	88	64	54
1985	24							62	390	122	95	64	55
1985	25							51	503	135	88	59	55
1985	26							50	484	136	88	57	57
1985	27							48	424	130	87	56	55
1985	28							55	376	120	87	56	51
1985	29							76	349	112	90	55	55
1985	30							119	297	108	93	75	47
1985	31								227		112	81	
1986	1							28	48	1,280	199	111	98
1986	2							29	70	1,290	194	108	102
1986	3							27	129	1,260	190	105	96
1986	4							27	239	1,860	178	128	93
1986	5							27	221	1,480	132	133	93
1986	6							28	162	1,320	129	124	102
1986	7							32	150	1,160	146	121	99
1986	8							37	138	1,570	146	119	93
1986	9							40	136	1,240	150	126	95
1986	10							42	133	816	157	119	102
1986	11							37	131	709	170	114	99
1986	12							33	122	701	178	116	96
1986	13							37	122	690	157	119	95
1986	14							29	119	653	140	114	93
1986	15							32	114	631	135	113	92
1986	16							37	113	581	133	108	88
1986	17							39	106	530	128	106	86
1986	18							33	110	472	122	106	88
1986	19							33	119	432	118	105	91
1986	20							33	163	435	114	103	86
1986	21							35	269	389	113	105	84
1986	22							54	324	337	110	106	82

Year	Date	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1986	23							76	244	301	106	103	81
1986	24							78	207	277	103	102	90
1986	25							66	226	259	102	101	105
1986	26							66	328	247	105	99	93
1986	27							55	485	237	105	98	91
1986	28							52	582	229	110	96	95
1986	29							52	846	224	108	95	89
1986	30							47	1,130	214	106	93	88
1986	31								1,170		114	96	
1987	1							33	503	319	106	91	84
1987	2							29	471	254	105	82	82
1987	3							33	241	219	102	80	84
1987	4							35	186	197	101	76	89
1987	5							40	229	192	101	98	102
1987	6							43	299	190	96	96	89
1987	7							44	332	197	92	110	91
1987	8							45	360	433	88	116	88
1987	9							42	363	443	89	101	85
1987	10							37	381	415	108	98	84
1987	11							37	327	317	165	98	82
1987	12							35	303	273	155	98	81
1987	13							33	332	239	128	96	80
1987	14							34	288	221	113	95	78
1987	15							40	294	201	103	99	80
1987	16							49	303	190	98	98	85
1987	17							58	536	176	105	95	85
1987	18							81	357	168	116	92	81
1987	19							82	280	176	103	91	81
1987	20							55	237	175	95	89	80
1987	21							52	234	155	91	88	78
1987	22							70	199	150	99	91	77
1987	23							102	172	155	103	89	76
1987	24							158	161	140	95	89	76
1987	25							227	176	133	86	101	76
1987	26							286	172	124	85	108	76
1987	27							411	199	119	98	99	74
1987	28							505	214	114	101	92	74
1987	29							451	269	114	108	89	76
1987	30							464	279	110	106	88	74
1987	31								306		96	86	
1988	1							15	106	515	146	86	63
1988	2							19	89	529	133	88	62
1988	3							23	78	556	126	92	61
1988	4							22	81	693	119	91	61
1988	5							18	106	708	116	82	59
1988	6							18	142	673	106	81	57
1988	7							23	122	497	103	82	55
1988	8							28	106	385	99	82	55
1988	9							22	99	332	96	80	55
1988	10							16	106	297	95	78	55

Year	Date	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1988	11							24	138	267	99	76	67
1988	12							38	229	256	91	76	62
1988	13							55	437	303	85	77	59
1988	14							72	760	253	82	74	59
1988	15							92	627	219	80	73	57
1988	16							103	653	197	103	76	54
1988	17							121	1,280	185	103	72	54
1988	18							128	1,370	176	105	70	61
1988	19							126	604	168	105	70	62
1988	20							107	356	159	101	68	61
1988	21							105	306	151	99	68	55
1988	22							80	358	146	96	70	53
1988	23							67	595	142	95	68	52
1988	24							63	854	133	95	69	51
1988	25							58	1,070	128	93	68	49
1988	26							44	1,230	128	92	68	48
1988	27							83	1,170	121	92	67	47
1988	28							98	1,070	159	91	67	48
1988	29							85	1,120	292	86	67	47
1988	30							101	1,070	168	86	66	46
1988	31								798		85	65	
1989	1							20	48	256	172	92	81
1989	2							20	48	282	164	91	81
1989	3							19	52	297	155	88	80
1989	4							17	47	256	148	88	80
1989	5							21	43	239	142	91	78
1989	6							21	51	332	136	93	77
1989	7							21	77	396	131	96	73
1989	8							21	110	524	126	98	85
1989	9							15	127	451	122	96	102
1989	10							13	187	493	135	95	99
1989	11							22	234	547	126	93	88
1989	12							21	272	467	128	92	88
1989	13							22	342	339	151	91	86
1989	14							25	234	297	142	89	86
1989	15							29	192	310	131	89	81
1989	16							31	192	415	124	88	74
1989	17							31	221	435	121	86	68
1989	18							31	306	336	118	89	71
1989	19							33	467	316	116	91	68
1989	20							40	332	326	114	88	65
1989	21							52	294	294	108	85	63
1989	22							71	381	270	102	74	62
1989	23							76	542	250	108	70	61
1989	24							77	566	234	108	70	58
1989	25							76	326	221	99	70	58
1989	26							86	239	206	98	76	55
1989	27							72	234	204	96	77	55
1989	28							61	309	192	93	78	55
1989	29							51	515	187	93	76	55

Year	Date	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1989	30							52	515	183	99	81	54
1989	31								332		93	81	
1990	1							33	72	928	339	140	71
1990	2							34	74	588	320	126	69
1990	3							36	73	455	317	110	69
1990	4							38	73	549	291	103	68
1990	5							34	72	914	251	103	68
1990	6							80	86	838	221	98	69
1990	7							37	129	821	204	93	68
1990	8							34	110	815	195	95	66
1990	9							38	98	847	193	119	66
1990	10							36	96	1,050	195	119	67
1990	11							35	100	1,340	183	126	67
1990	12							37	97	748	172	123	66
1990	13							35	97	551	164	121	65
1990	14							36	92	501	166	119	65
1990	15							38	94	561	159	116	65
1990	16							42	90	719	141	105	65
1990	17							38	88	592	138	106	65
1990	18							44	97	546	137	106	63
1990	19							60	109	643	135	105	66
1990	20							67	116	622	154	103	74
1990	21							108	136	715	201	102	68
1990	22							132	160	583	183	102	66
1990	23							121	208	580	159	100	65
1990	24							119	302	616	149	100	63
1990	25							111	381	612	147	99	62
1990	26							104	339	560	140	96	61
1990	27							91	332	509	137	95	63
1990	28							90	363	473	142	92	61
1990	29							77	489	357	144	90	60
1990	30							78	673	354	145	90	60
1990	31								962		147	76	
Mean		56	46	40	36	34	34	51	272	516	169	95	74
Max		120	91	74	56	50	63	505	1,490	1,980	1,260	267	188
Min		8	7	5	4	4	3	3	30	39	24	11	6
Median		53	45	41	37	35	34	39	189	442	135	92	74
Mode		60	40	40	36	34	33	36	73	337	116	100	81
Std Dev		18	13	10	8	7	7	46	240	311	115	26	24

Appendix E-Gage at Shell 06299000

Monthly Flows | **Shell Creek @ Shell** | USGS Gage Data

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Average Annual Flow, cfs	Annual Discharge, ac-ft
1913							156	1,413	1,311	322	175	170		
1914	196	150	120	110	100	100	413	499	937	459	209	220	293	211,989
1915	163	132	110	100	100	100	184	434	1,291	388	179	134	276	200,004
1916	158	140	120	100	100	100	121	444	1,331	518	190	176	291	210,933
1917	161	150	120	110	110	130	136	371	2,114	406	244	225	355	257,169
1918	204	167	120	110	110	124	192	687	297	131	114	97	197	142,534
1919	115		100	100	100	120	125	316	1,639	477	223	193		
1920	151	144	135	123	103	87	78	609	909	229	138	113	235	170,200
1921	108	110	100	80	90	90	100	539	1,036	317	215	150	245	177,194
1922	134	136	124	104	104	90	74	480	1,374	384	235	244	290	209,850
1923									1,571	460	135	194		
Mean	155	141	116	104	102	105	158	579	1,255	372	187	174	273	197,484
Max	204	167	135	123	110	130	413	1,413	2,114	518	244	244	355	257,169
Min	108	110	100	80	90	87	74	316	297	131	114	97	197	142,534

Appendix F-Lake Adelaide Study WIRSOS Data

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Average Annual Flow, cfs	Annual Discharge, ac-ft
1943	10	6	5	3	2	2	6	191	338	58	14	12	54	39,080
1944	10	6	5	3	2	2	3	150	266	45	11	9	43	31,012
1945	10	6	5	3	2	2	3	190	336	58	14	12	54	38,767
1946	4	4	3	3	2	2	6	113	202	34	9	7	32	23,432
1947	12	7	6	2	2	2	2	168	298	51	13	10	48	34,533
1948	9	6	4	3	3	3	8	127	283	65	15	12	45	32,425
1949	11	7	5	3	2	2	4	117	207	35	9	7	34	24,578
1950	10	6	5	3	2	2	4	181	321	55	14	11	51	37,009
1951	9	6	4	2	2	2	2	186	330	57	14	12	52	37,786
1952	8	5	4	3	2	2	3	88	157	26	7	6	26	18,637
1953	8	5	4	2	2	2	2	120	213	36	9	7	34	24,820
1954	8	6	4	3	2	2	4	105	186	31	8	7	30	22,065
1955	13	8	6	3	2	2	5	147	262	45	11	9	43	30,994
1956	12	7	5	3	3	2	6	103	183	31	8	6	31	22,278
1957	7	5	5	3	3	3	5	51	329	61	11	13	41	29,728
1958	10	9	7	5	4	3	3	364	124	49	25	8	51	37,270
1959	7	7	5	4	3	3	3	37	319	41	9	6	37	26,599
1960	6	5	5	4	4	4	9	108	204	24	9	7	32	23,229
1961	5	5	3	2	2	1	2	179	136	13	5	9	30	21,986
1962	20	11	12	4	4	4	20	93	324	59	17	10	48	34,718
1963	7	5	4	3	2	2	2	266	358	23	5	6	57	41,179
1964	5	4	3	2	2	2	2	144	336	110	14	15	53	38,517
1965	8	6	4	4	3	3	4	77	381	103	14	7	51	36,836
1966	9	5	3	3	3	3	3	127	85	17	8	5	23	16,388
1967	5	4	3	2	2	2	4	181	377	108	14	12	59	43,093
1968	17	8	4	2	2	2	2	75	445	85	56	56	63	45,296
1969	18	10	7	4	3	3	9	322	128	76	12	7	50	36,450
1970	8	6	2	2	2	2	1	107	353	57	11	6	46	33,466
1971	5	4	3	2	2	1	2	117	343	48	14	6	46	32,924
1972	7	4	4	2	2	2	3	112	297	55	35	21	45	32,750
1973	13	9	5	3	2	2	3	88	305	41	14	23	42	30,476
1974	10	6	5	3	2	3	7	93	330	50	13	8	44	31,837
1975	56	5	4	3	2	2	2	17	298	236	15	5	54	35,843
1976	4	3	3	2	2	2	2	114	306	76	15	10	45	32,376
1977	11	6	3	2	2	2	15	152	224	22	11	11	38	27,830
1978	13	8	5	4	3	3	4	70	402	150	30	24	60	43,086
1979	17	8	6	4	3	3	3	140	218	50	24	13	41	29,490
1980	7	5	3	2	1	2	6	144	180	28	10	19	34	24,576
1981	17	8	4	2	2	2	10	141	212	27	9	6	37	26,545
1982	7	5	3	2	2	2	3	75	295	88	16	12	42	30,667
Mean	11	6	4	3	2	2	5	134	272	58	14	11	44	31,514
Max	56	11	12	5	4	4	20	364	445	236	56	56	63	45,296
Min	4	3	2	2	1	1	1	17	85	13	5	5	23	16,388

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Average Annual Flow, cfs	Annual Discharge, ac-ft
1943	41	41	39	36	35	36	63	53	394	150	60	59	84	60,547
1944	40	40	32	33	33	32	34	233	405	173	64	66	99	71,568
1945	46	42	35	35	34	32	32	44	301	247	82	93	85	61,841
1946	68	52	47	40	40	46	133	197	438	120	69	91	112	80,831
1947	69	48	48	43	43	39	45	221	277	199	77	74	98	72,127
1948	59	56	52	46	41	38	37	282	62	57	60	42	69	50,500
1949	39	40	38	35	32	32	50	299	310	79	56	58	89	64,442
1950	41	38	33	32	32	29	41	20	256	114	73	64	64	46,583
1951	60	46	37	31	31	31	38	171	70	144	91	59	67	49,078
1952	48	41	38	37	35	32	89	303	260	127	80	53	95	69,175
1953	39	35	34	36	35	34	33	4	506	97	71	53	81	58,636
1954	36	37	38	36	34	32	37	244	126	63	52	30	64	46,420
1955	23	25	27	27	29	31	34	170	346	106	58	41	76	55,290
1956	32	35	34	34	39	36	37	312	214	52	48	38	76	55,196
1957	31	32	30	27	27	28	30	120	(48)	91	72	54	41	30,124
1958	41	36	33	30	30	31	31	91	133	68	69	62	54	39,453
1959	39	35	34	32	29	30	35	83	302	79	80	66	70	50,691
1960	47	36	34	29	30	26	35	95	104	46	61	42	49	35,371
1961	42	30	29	27	25	25	27	152	140	43	57	41	53	38,581
1962	35	39	29	30	30	29	73	244	299	110	62	61	87	62,934
1963	49	47	40	33	33	31	38	54	353	90	72	53	74	53,682
1964	43	40	35	34	33	32	32	122	462	182	85	74	98	70,717
1965	60	45	43	38	35	33	40	68	588	161	85	86	107	77,081
1966	60	434	40	36	34	34	34	183	91	44	43	43	90	40,940
1967	40	32	32	26	27	31	31	74	475	180	64	80	91	65,800
1968	66	53	45	40	38	35	36	56	604	133	72	84	105	75,803
1969	78	68	54	43	39	39	84	166	157	133	77	65	83	60,636
1970	55	45	42	38	37	34	36	141	388	116	79	69	90	65,032
1971	45	39	39	37	35	35	39	186	341	88	89	63	86	62,488
1972	55	38	34	31	31	41	44	170	392	115	82	70	92	66,453
1973	43	42	42	37	37	40	40	260	346	90	71	55	92	66,615
1974	48	45	41	37	37	35	48	219	358	107	90	78	95	68,954
1975	49	44	41	36	35	35	35	78	466	263	93	92	105	76,355
1976	58	52	47	42	41	40	44	199	404	115	95	76	101	73,217
1977	48	46	44	38	38	37	57	191	90	66	60	45	63	46,031
1978	35	34	33	30	30	29	40	163	432	198	95	89	101	72,854
1979	48	49	45	41	40	39	51	241	274	122	125	106	98	71,386
1980	48	44	41	36	36	34	50	178	215	90	75	56	75	54,586
1981	38	39	39	35	34	33	63	230	240	90	41	59	78	59,295
1982	48	44	41	36	36	35	30	131	354	170	64	81	89	64,660
Mean	47	52	38	35	34	34	45	161	298	118	72	64	83	59,799
Max	78	434	54	46	43	46	133	312	604	263	125	106	112	80,831
Min	23	25	27	26	25	25	27	4	(48)	43	41	30	41	30,124

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Average Annual Flow, cfs	Annual Discharge, ac-ft
1943	51	47	44	39	37	38	70	244	732	208	75	71	138	99,627
1944	50	46	37	35	36	34	38	382	671	218	75	75	142	102,580
1945	72	56	49	43	42	48	139	310	640	154	78	98	144	104,263
1946	81	65	54	45	45	41	47	388	574	249	90	84	147	10,660
1947	68	61	56	49	44	40	45	409	345	123	76	54	114	82,925
1948	50	46	43	37	34	34	54	416	517	114	65	65	123	89,020
1949	51	44	38	35	34	31	44	201	577	169	87	76	116	83,592
1950	69	52	42	33	32	33	40	357	400	200	105	70	119	86,864
1951	56	47	41	39	37	33	92	391	417	153	87	59	121	87,812
1952	47	41	38	38	37	36	36	124	719	132	80	61	116	83,456
1953	45	43	42	39	36	34	42	349	312	94	60	36	94	68,485
1954	37	32	33	30	32	33	39	318	609	145	69	50	119	86,264
1955	44	42	40	37	41	39	44	415	398	83	56	45	107	77,474
1956	38	37	35	31	31	31	34	171	281	152	83	67	83	59,852
1957	51	44	40	35	33	34	34	456	257	117	94	70	105	76,723
1958	46	42	39	36	32	33	38	120	621	120	89	72	107	77,290
1959	53	41	39	32	34	30	43	203	308	70	69	49	81	58,600
1960	47	34	33	29	27	26	29	34	276	56	61	51	59	60,567
1961	56	50	42	33	34	33	94	337	622	169	78	71	135	97,652
1962	56	52	44	35	35	33	40	320	710	112	77	59	131	94,861
1963	47	45	38	36	35	34	34	266	797	292	99	88	151	109,234
1964	38	50	47	42	38	36	44	145	968	263	98	93	155	113,917
1965	70	49	43	39	36	36	37	309	176	61	51	38	79	57,328
1966	45	36	35	29	28	32	35	255	853	288	78	92	151	108,893
1967	82	61	49	42	40	37	38	131	1,050	219	128	139	168	121,099
1968	96	77	61	47	42	42	92	488	285	209	89	72	133	97,086
1969	63	51	45	39	38	36	37	248	741	173	90	75	136	98,498
1970	50	43	41	39	37	36	41	303	684	136	103	70	132	95,412
1971	61	42	38	44	42	43	47	282	689	170	117	91	139	99,203
1972	56	51	47	40	39	41	43	348	651	131	86	78	134	97,091
1973	58	51	46	40	39	38	55	311	688	157	104	86	139	100,791
1974	55	49	44	38	37	36	36	96	764	499	108	99	155	112,198
1975	62	55	50	44	43	41	46	313	710	191	110	86	146	105,593
1976	59	52	47	41	40	39	73	343	314	88	71	55	102	73,861
1977	48	43	38	33	32	32	44	233	834	348	125	113	160	115,940
1978	65	57	51	44	43	42	54	381	492	171	149	119	139	100,876
1979	55	48	44	38	37	36	56	322	395	118	85	75	109	79,162
1980	54	48	43	37	36	35	72	372	452	117	90	65	118	85,840
1981	55	49	44	39	38	36	33	206	649	258	80	93	132	95,327
1982	55	49	44	39	38	36	33	194	624	258	80	93	129	93,078
Mean	56	48	43	38	37	36	50	287	570	175	87	75	125	88,725
Max	96	77	61	49	45	48	139	488	1,050	499	149	139	168	121,099
Min	37	32	33	29	27	26	29	34	176	56	51	36	59	10,660

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Average Annual Flow, cfs	Annual Discharge, ac-ft
1943	10	6	5	3	2	2	6	154	305	58	14	12	48	34,799
1944	10	6	5	3	2	2	3	147	266	45	11	9	43	30,855
1945	10	6	5	3	2	2	3	187	336	58	14	12	53	38,605
1946	4	4	3	3	2	2	6	111	202	34	9	7	32	23,270
1947	12	7	6	2	2	2	2	165	298	51	13	10	47	34,371
1948	9	6	4	3	3	3	8	125	283	94	15	12	47	34,025
1949	11	7	5	3	2	2	4	95	197	73	9	7	34	24,984
1950	10	6	5	3	2	2	4	146	316	55	14	11	48	34,555
1951	9	6	4	2	2	2	2	184	330	57	14	12	52	37,625
1952	8	5	4	3	2	2	3	85	157	26	7	6	26	18,475
1953	8	5	4	2	2	2	2	117	213	55	9	7	36	25,820
1954	8	6	4	3	2	2	4	86	184	88	8	13	34	24,631
1955	13	8	6	3	2	2	5	120	224	46	11	9	37	27,087
1956	12	7	5	3	3	2	6	99	183	99	8	6	36	26,249
1957	7	5	5	3	3	3	5	43	264	62	11	13	35	25,451
1958	10	9	7	5	4	3	3	361	124	83	25	8	54	39,215
1959	7	7	5	4	3	3	3	33	286	73	9	6	36	26,265
1960	6	5	5	4	4	4	9	88	189	93	9	7	35	25,386
1961	5	5	3	2	2	1	2	145	111	71	5	9	30	21,896
1962	19	11	12	4	4	4	19	27	270	59	17	10	38	30,378
1963	7	5	4	3	2	2	2	263	358	62	5	6	60	43,428
1964	5	4	3	2	2	2	2	117	321	110	14	15	50	35,974
1965	8	6	4	4	3	3	4	75	381	103	14	7	51	36,676
1966	9	5	3	3	3	3	3	124	85	86	8	5	28	20,470
1967	5	4	3	2	2	2	4	146	340	108	14	12	53	38,751
1968	16	8	4	2	2	2	2	73	445	85	56	55	63	45,140
1969	18	10	7	4	3	3	9	320	128	76	12	7	50	36,288
1970	8	6	2	2	2	2	1	104	353	57	11	6	46	33,304
1971	5	4	3	2	2	1	2	115	343	63	14	6	47	33,719
1972	7	4	4	2	2	2	3	94	297	55	35	21	44	31,638
1973	13	9	5	3	2	2	3	85	305	61	14	23	44	31,587
1974	10	6	5	3	2	3	7	76	323	50	13	8	42	30,412
1975	6	5	4	3	2	2	2	17	296	236	15	5	49	35,682
1976	4	3	3	2	2	2	2	111	306	76	15	10	45	32,214
1977	11	6	3	2	2	2	15	149	224	85	11	11	43	31,546
1978	13	8	5	4	3	3	4	59	347	150	30	24	54	39,096
1979	17	8	6	4	3	3	3	138	218	50	24	13	40	29,336
1980	7	5	3	2	1	2	6	142	180	61	10	19	36	26,445
1981	16	8	4	2	2	2	10	115	204	61	9	6	37	26,477
1982	7	5	3	2	2	2	3	62	270	88	16	12	39	28,418
Mean	9	6	4	3	2	2	5	123	261	75	14	11	43	31,264
Max	19	11	12	5	4	4	19	361	445	236	56	55	63	45,140
Min	4	3	2	2	1	1	1	17	85	26	5	5	26	18,475

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Average Annual Flow, cfs	Annual Discharge, ac-ft
1943	41	41	39	36	35	36	63	53	394	150	60	59	84	60,547
1944	40	40	32	33	33	32	34	233	405	173	64	66	99	71,568
1945	46	42	35	35	34	32	32	44	301	247	82	93	85	61,841
1946	68	52	47	40	40	46	133	197	438	120	69	91	112	80,831
1947	69	58	48	43	43	39	45	221	277	199	77	74	99	72,127
1948	59	56	52	46	41	38	37	282	62	57	60	42	69	50,500
1949	39	40	38	35	32	32	50	299	310	79	56	58	89	64,442
1950	41	38	33	32	32	29	41	20	256	114	73	64	64	46,583
1951	60	46	37	31	31	31	38	171	70	144	91	59	67	49,078
1952	48	41	38	37	35	32	89	303	260	127	80	53	95	69,175
1953	39	35	34	36	35	34	33	4	506	97	71	53	81	58,636
1954	36	37	38	36	34	32	37	244	126	63	52	30	64	46,420
1955	23	25	27	27	29	31	34	170	346	106	58	41	76	55,290
1956	32	35	34	34	39	36	37	312	214	52	48	38	76	55,196
1957	31	32	30	27	27	28	30	120	(48)	91	72	54	41	30,124
1958	41	36	33	30	30	31	31	91	133	68	69	62	54	39,453
1959	39	35	34	32	29	30	35	83	302	79	80	66	70	50,691
1960	47	36	34	29	30	26	35	95	104	46	61	42	49	35,371
1961	42	30	29	27	25	25	27	152	140	43	57	41	53	38,581
1962	35	39	30	30	30	29	73	244	299	110	62	61	87	62,934
1963	49	47	40	33	33	31	38	54	353	90	72	53	74	53,682
1964	43	40	35	34	33	32	32	122	462	182	85	74	98	70,717
1965	60	45	43	38	35	33	40	68	588	161	85	86	107	77,081
1966	60	43	40	36	34	34	34	183	91	44	43	33	56	40,940
1967	40	32	32	26	27	31	31	74	475	180	64	80	91	65,800
1968	66	53	45	40	38	35	36	56	604	133	72	84	105	75,803
1969	78	68	54	43	39	39	84	166	157	133	77	65	83	60,636
1970	55	45	42	38	37	34	36	141	388	116	79	69	90	65,032
1971	45	39	39	37	35	35	39	186	341	88	89	63	86	62,488
1972	54	38	34	31	31	41	44	170	392	115	82	70	92	66,453
1973	43	42	42	37	37	40	40	260	346	90	71	55	92	66,615
1974	48	45	41	37	37	35	48	219	358	107	90	78	95	68,954
1975	49	44	41	36	35	35	35	78	466	263	93	92	105	76,355
1976	58	52	47	42	41	40	44	199	404	115	95	76	101	73,217
1977	48	46	44	38	38	37	47	191	90	66	60	45	62	46,031
1978	35	34	33	30	30	29	40	163	432	198	95	89	101	72,854
1979	48	49	45	41	40	39	51	241	274	122	125	106	98	71,386
1980	48	44	41	36	36	34	50	178	215	90	75	56	75	54,586
1981	38	39	39	35	34	33	63	230	240	90	81	59	82	59,295
1982	48	44	41	36	36	35	30	131	354	170	64	81	89	64,660
Mean	47	42	39	35	34	34	45	161	298	118	73	64	83	59,799
Max	78	68	54	46	43	46	133	312	604	263	125	106	112	80,831
Min	23	25	27	26	25	25	27	4	(48)	43	43	30	41	30,124

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	Average Annual Flow, cfs	Annual Discharge, ac-ft
1943	51	47	44	39	37	38	70	207	698	208	75	71	132	95,346
1944	50	46	37	35	36	34	38	380	671	218	75	75	141	102,423
1945	56	49	40	38	37	35	35	231	637	305	96	105	139	100,446
1946	72	56	49	43	42	48	139	308	640	154	78	98	144	104,101
1947	81	65	54	45	45	41	47	386	574	249	90	84	147	106,498
1948	68	61	56	49	44	40	45	407	345	151	76	54	116	84,525
1949	50	46	43	37	34	34	54	394	507	151	65	65	123	89,426
1950	51	44	38	35	34	31	44	166	572	169	87	76	112	81,138
1951	69	52	42	33	32	33	40	355	400	200	105	70	119	86,703
1952	56	47	41	39	37	33	92	389	417	153	87	59	121	87,650
1953	47	41	38	38	37	36	36	121	719	151	80	61	117	84,456
1954	45	43	42	39	36	34	42	330	310	151	60	42	98	71,051
1955	37	32	33	30	32	33	39	290	570	152	69	50	114	82,377
1956	44	42	40	37	41	39	44	410	398	151	56	45	112	81,445
1957	38	37	35	31	31	31	34	163	217	152	83	67	77	55,575
1958	51	44	40	35	33	34	34	453	257	151	94	70	108	78,668
1959	46	42	39	36	32	33	38	116	587	151	89	72	107	76,956
1960	53	41	39	32	34	30	43	184	293	139	69	49	84	60,757
1961	47	34	33	29	27	26	29	296	250	114	61	51	83	60,477
1962	55	50	42	33	34	33	93	321	569	169	78	71	129	93,312
1963	56	52	44	35	35	33	40	318	710	151	77	59	134	97,110
1964	47	45	38	36	35	34	34	238	783	292	99	88	147	106,691
1965	68	50	47	42	38	36	44	143	968	263	98	93	158	113,757
1966	70	49	43	39	36	36	37	307	176	130	51	38	84	61,410
1967	45	36	35	29	28	32	35	220	816	288	78	92	145	104,551
1968	82	61	49	42	40	37	38	128	1,050	219	128	139	168	120,943
1969	95	77	61	47	42	42	92	486	285	209	89	71	133	96,924
1970	63	41	45	39	38	36	37	245	741	173	90	75	135	98,336
1971	50	43	41	39	37	36	41	301	684	151	103	70	133	96,207
1972	61	42	38	34	32	43	47	264	689	170	117	91	136	98,091
1973	56	51	47	40	39	41	43	345	651	151	86	78	136	98,202
1974	58	51	46	40	39	38	55	295	680	157	104	86	137	99,366
1975	55	49	44	38	37	36	36	95	762	499	108	97	155	112,037
1976	62	55	50	44	43	41	46	310	710	191	110	86	146	105,431
1977	59	52	47	41	40	39	73	340	314	151	71	55	107	77,577
1978	48	43	38	33	32	32	44	221	779	348	125	113	155	111,950
1979	64	57	51	44	43	42	54	379	492	171	149	119	139	100,722
1980	55	48	44	38	37	36	56	319	395	151	85	75	112	81,031
1981	54	48	43	37	36	35	72	345	443	151	90	65	118	85,772
1982	55	49	44	39	38	36	33	194	624	258	80	93	129	93,078
Mean	57	48	43	38	36	36	50	285	559	193	88	75	126	91,063
Max	95	77	61	49	45	48	139	486	1,050	499	149	139	168	120,943
Min	37	32	33	29	27	26	29	95	176	114	51	38	77	55,575

Appendix G-Game and Fish Report

WYOMING GAME AND FISH DEPARTMENT

FISH DIVISION

ADMINISTRATIVE REPORT

TITLE: Shell Creek Instream Flow Report, Segment Number 1

PROJECT: IF-2289-07-8903

AUTHOR: Gerald F. Vogt, Jr. and Thomas C. Annear

DATE: October 1993

INTRODUCTION

Data were collected during the 1985 field season to conduct instream flow analyses for a segment of Shell Creek located near Shell, Wyoming. The study and this report were prepared to support an instream flow water right application.

The goal of this study was to determine instream flows necessary to maintain or improve the existing trout fishery. The specific objectives of this study were to determine instream flows necessary to 1) maintain or improve hydraulic characteristics year-round that are important for survival of trout, fish passage and aquatic insect production, 2) maintain or improve physical habitat for rainbow trout spawning during the spring, and 3) maintain or improve adult trout production during the late summer months. Three habitat models were used to make these determinations.

METHODS

Study Area

The section of Shell Creek from Shell Falls upstream to the mouth of Adelaide Creek is considered a Class 3 trout stream by the Wyoming Game and Fish Department (WGFD). Trout stream classifications throughout Wyoming range from Class 1 (highest rating) to Class 5 (lowest rating). Class 3 trout streams are generally considered important trout fisheries on a regional basis within the state.

Shell Creek above Shell Falls contains naturally reproducing populations of rainbow trout (Oncorhynchus mykiss) and brook trout (Salvelinus fontinalis). The stream is currently managed as a basic yield fishery for the former species. This stream segment periodically receives plants of catchable rainbow trout. The entire segment of Shell Creek above Shell Falls is contained within the Big Horn National Forest and is highly accessible to the public. Because this section of Shell Creek supports an important trout fishery and has public access, the segment of Shell Creek from Shell Falls upstream to the mouth of Adelaide Creek was identified as a critical reach.

Data Collection

All of the field data used in this study were collected from a 310 foot long study site located within the Big Horn National Forest. This site is located approximately 15 miles east of the town of Shell (Figure 1). This was a fairly high gradient site that contained a combination of pool and riffle habitat for trout that was representative of trout habitat features found throughout this portion of the stream. Results and recommendations were applied to a portion of the stream extending from Shell Falls in Section 7, Township 53N, Range 89W upstream to the mouth of Adelaide Creek in the southeast 1/4 of Section 27, Township 53N, Range 88W. This is a distance of approximately 10.5 stream miles.

Models

A Habitat Retention Method (Nehring 1979; Annear and Conder 1984) was used to identify a maintenance flow. A maintenance flow is defined as a continuous flow that will maintain minimum hydraulic criteria at riffle areas in a stream segment. These criteria are important at all times of year to maintain passage between different habitat types for all life stages of trout. These criteria are also important for maintaining survival rates of fish and aquatic macroinvertebrates during the winter that approximate rates observed under natural stream flow conditions.

Data from single transects placed across three riffles within the study area were analyzed with the AVDEPTH computer program (Milhous et al. 1989). Flow data were collected at three different flow levels (Table 1). Based on extensive research on instream flow methods on Wyoming streams by Annear and Conder (1984), the maintenance flow is specifically defined as the discharge at which two of the three criteria in Table 2 are met for all riffles in the study area. Maintenance flows apply to all times of the year except when higher stream flows are required to meet other fishery management objectives.

Table 1. Dates and discharges when instream flow data were collected at Shell Creek instream flow segment.

Date	Discharge (cfs)
05-19-85	100
07-10-85	48
09-24-85	23

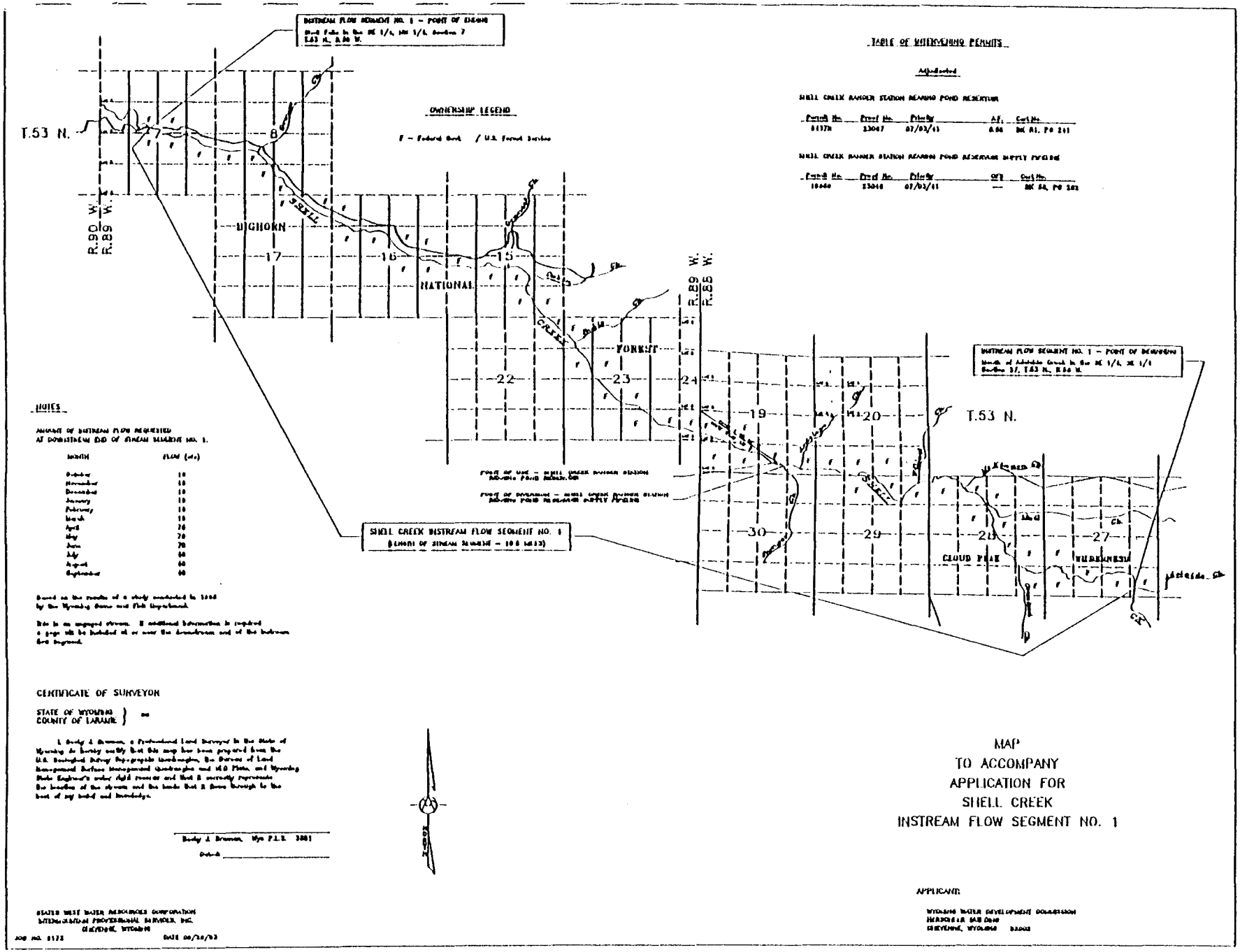

Figure 1. Shell Creek instream flow reach segment 1.

Table 2. Hydraulic criteria used to obtain an instream flow recommendation using the Habitat Retention Method.

Category	Criteria
Average Depth (ft)	Top width[1] x 0.01
Average Velocity (ft/sec)	1.00
Wetted Perimeter (percent)[2]	60

1 - At average daily flow
2 - Compared to wetted perimeter at bank full conditions

A physical habitat simulation model (PHABSIM) developed by the Instream Flow Service Group of the U.S. Fish and Wildlife Service (Bovee and Milhous 1978) was used to quantify incremental changes in the amount of physical habitat available for rainbow trout spawning at various discharge rates. This model reflects state-of-the-art technology for evaluating fisheries physical habitat changes with changes in stream flows and is widely used throughout North America (Reiser et al. 1989).

The amount of physical habitat at a given discharge is expressed in terms of weighted usable area (WUA) and reflects the composite suitability of depth, velocity and substrate at a given flow. Depth, velocity and substrate data were collected at seven transects as described in Bovee and Milhous (1978). Dates and discharge rates when data were collected are given in Table 1. The WUA for rainbow trout was simulated for flows ranging from 10 to 300 cubic feet per second (cfs) using calibration and modeling techniques outlined in Milhous (1984), Milhous et al. (1984) and Milhous et al. (1989).

Because this fishery depends upon natural reproduction for continuation, it is important to maintain physical habitat for rainbow trout spawning. Maintenance of suitable physical habitat for this life stage is a critical part of ensuring adequate recruitment to this fishery. Rainbow trout begin spawning in early April and their eggs incubate through June. Results from the PHABSIM analysis were used to identify the flows needed to maintain or improve physical habitat for the rainbow trout spawning from April 1 to June 30.

The Habitat Quality Index (HQI) developed by the Wyoming Game and Fish Department (Binns and Eiserman 1979; Binns 1982) was used to estimate potential changes in trout habitat units over a range of average late summer flow conditions. This model was developed by the WGFD after several years of testing and model refinement. The HQI has been reliably used on many Wyoming streams to assess HU gains or losses associated with projects that modify instream flow regimes. This model incorporates seven attributes that address chemical, physical and biological components of trout habitat. Results are expressed in habitat units (HU). One HU is generally defined as the amount of habitat quality which will support approximately 1 pound of trout. Analyses obtained from this method apply to the time of year that governs trout production. On Shell Creek this time period is between July 1 and September 30.

By measuring habitat attributes at various flow events as if associated habitat features were typical of average late summer flow conditions, HU estimates can be made for a range of theoretical summer flows (Conder and Annear 1987). Habitat

attributes on Shell Creek were measured on the same dates and flow levels that data were collected for the PHABSIM and Habitat Retention models (Table 1). To better define the relationship of discharge and trout production, some attributes were derived mathematically or obtained from existing gage data for flows in addition to those shown in Table 1. Other data were obtained from a U.S. Geological Survey gage (# 0627830) located on Shell Creek above Shell Creek Reservoir for the period 1957 to 1987.

RESULTS/DISCUSSION

Results from the Habitat Retention model showed that the hydraulic criteria in Table 2 are met at flows of 19, 13, and 4 cfs for riffles 1, 2, and 3, respectively (Table 3). The maintenance flow derived from this method is defined as the flow at which two of the three hydraulic criteria are met for all riffles in the study site which in this case is 19 cfs.

Table 3. Simulated hydraulic criteria for three riffles on Shell Creek. Estimated average daily flow = 57 cfs. Bank full discharge = 369 cfs.

Average Depth (ft)	Average Velocity (ft/sec)	Wetted Perimeter (ft)	Discharge (cfs)
	Riffle 1		
1.52	2.6	95.2	369
1.35	2.3	92.4	282
1.27	2.2	91.2	246
1.09	2.0	89.0	185
0.92	1.8	86.9	136
0.79	1.6	84.0	106
0.63	1.4	64.7	57
0.63	1.3	57.1[1]	48
0.56	1.0[1]	34.1	19[2]
0.45[1]	0.4	13.4	3
	Riffle 2		
2.32	3.9	48.7	369
2.16	3.3	45.6	286
2.03	2.8	43.0	215
1.80	2.3	42.4	158
1.57	1.9	41.7	113
1.38	1.6	41.2	84
1.17	1.3	40.2	57
1.00	1.0[1]	36.3	33
0.70	0.6	29.2[1]	13[2]
0.45[1]	0.31	18.2	3

Table 3. (continued)

Average Depth (ft)	Average Velocity (ft/sec)	Wetted Perimeter (ft)	Discharge (cfs)
	Riffle 3		
2.65	3.2	47.6	369
2.38	2.6	46.2	280
2.08	2.1	44.1	184
1.96	1.9	42.3	146
1.68	1.4	39.4	88
1.53	1.1	35.9	57
1.51	1.0[1]	34.4	50
1.16	0.6	32.7	23
0.54	0.2	28.6[1]	4[2]
0.45[1]	0.2	23.5	3

1 - Minimum hydraulic criteria met
2 - Discharge at which 2 of 3 hydraulic criteria are met

The maintenance flow is defined as a continuous flow that will maintain minimum hydraulic criteria in riffle areas within a stream segment. These criteria are important at all times of year to maintain passage between different habitat types for all life stages of trout. These criteria are also important for maintaining survival rates of fish and aquatic macroinvertebrates during the winter that approximate rates observed under natural stream flow conditions.

Low flow conditions during winter months (October through March) naturally limit the survival and growth of many trout populations. The extent of these impacts is dependent upon several factors including but not limited to snow fall, cold intensity and the duration of intense cold periods. These factors vary from year to year and affect fish populations depending on the amount of frazile ice and anchor ice formation (which can plug the gills of fish), the extent of snow bank collapse (and stream damming) and increased metabolic demands on fish (and increased stress).

Kurtz (1980) found that the loss of winter habitat due to low flow conditions was an important factor affecting mortality rates of trout in the upper Green River, with mortality approaching 90% during some years. Needham et al. (1945) documented average overwinter brown trout mortality of 60% and extremes as high as 80% in a California stream. Butler (1979) reported significant trout and aquatic insect losses caused by anchor ice formation. Reimers (1957) considered anchor ice, collapsing snow banks and fluctuating flows resulting from the periodic formation and breakup of ice dams as the primary causes of winter trout mortality.

The causes of winter mortality discussed above are all greatly influenced by the quantity of winter flow in terms of its ability to minimize anchor ice formation (increased velocity and temperature loading) and dilute and prevent snow bank collapses and ice dam formation respectively. Any reduction of natural winter stream flows would increase trout mortality and effectively reduce the number of fish that

the stream could support. Therefore protection of natural winter stream flows up to the recommended maintenance flow for each stream segment is necessary to maintain existing survival rates of trout populations.

It is possible that the discharge of 19 cfs identified by the Habitat Retention Method may not be present at times during the winter. Because the existing fishery is adapted to natural flow patterns, occasional periods of natural shortfall during the winter do not necessarily imply the need for additional storage. Instead, they illustrate the need to maintain all natural winter streamflows, up to 19 cfs, in order to maintain existing survival rates of trout populations.

Physical habitat for rainbow trout spawning is maximized at a discharge of 70 cfs (Figure 2). Gage data indicate that existing mean daily flows during the spring (April 1 to June 30) approximate 110 cfs. At this discharge, PHABSIM analyses indicate that physical habitat for rainbow trout spawning is reduced to 60% of the maximum amount available. Sharp reductions in WUA occur at flows below 70 cfs. Increases in discharge above the existing flow of 110 result in reductions in WUA from existing average levels. An instream flow of 70 cfs is therefore recommended for the period of April 1 and June 30 to improve physical habitat for rainbow trout spawning.

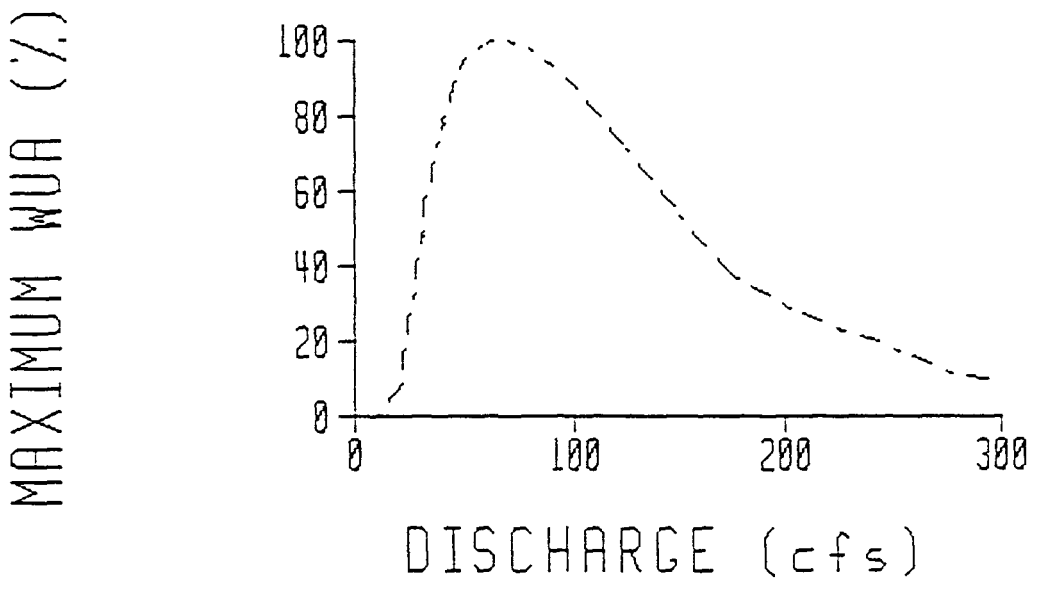

Figure 2. Percent of maximum weighted usable area for spawning life stage of rainbow trout.

Flows measured at the study site were regressed against flows determined at the USGS gage near Shell (#0627850) to determine average late summer flow levels at the study site. This regression indicated that late summer flows at the site approximate 53 cfs. Results from the HQI analyses (Figure 3) indicate that at a discharge of 53 cfs the stream presently supports about 80 HUs. The current fishery management objective is to maintain or improve the existing number of HUs. A discharge of 40 cfs is the minimum flow that will accomplish this objective. At average late summer

flows below 40 cfs, the model indicates that reductions in the present fishery would occur. These reductions would largely be the result of reduced critical period stream flows. Artificial increases in stream flow to 60 cfs or higher would also result in reductions of trout HUs over present conditions.

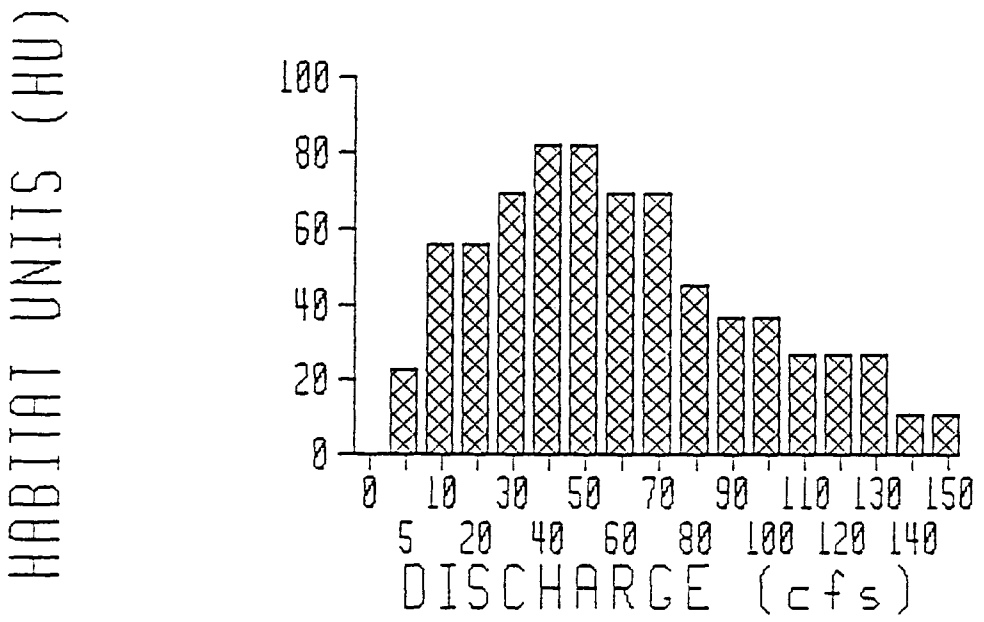

Figure 3. Number of potential trout habitat units at several average late summer flow levels in Shell Creek instream flow segment.

Based on the results from the HQI analysis, a late summer flow of 40 cfs will maintain existing levels of trout production between July 1 and September 30 and will meet or exceed the hydraulic criteria addressed by the Habitat Retention Method.

CONCLUSIONS

Based on the analyses and results contained in this report, the instream flow recommendations (Table 4) apply to a 10.5 mile segment of Shell Creek extending from Shell Falls in Section 7, Township 53N, Range 89W upstream to the mouth of Adelaide Creek in the southeast 1/4 of Section 27, Township 53N, Range 88W.

This analysis does not consider flushing flow needs for maintenance of channel geomorphology and trout habitat characteristics. Because this stream is presently unregulated, flushing flow needs are adequately met by natural runoff patterns. If the stream is regulated in the future, additional studies and recommendations may be appropriate for establishing flushing flow needs for channel maintenance.

Table 4. Summary of instream flow recommendations to maintain the existing trout fishery in Shell Creek above Shell Falls.

Time Period	Instream Flow Recommendation (cfs)
October 1 to March 31	19[1]
April 1 to June 30	70
July 1 to September 30	40

1 - To maintain existing natural stream flows

REFERENCES

Annear, T.C. and A.L. Conder. 1984. Relative bias of several fisheries instream flow methods. North American Journal of Fisheries Management. 4: 531-539.

Binns, N. and F. Eiserman. 1979. Quantification of fluvial trout habitat in Wyoming. Transactions of the American Fisheries Society 108:215-228.

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Butler, R. 1979. Anchor ice, its formation and effects on aquatic life. Science in Agriculture, Vol XXVI, Number 2, Winter, 1979.

Conder, A.L. and T.C. Annear. 1987. Test of weighted usable area estimates derived from a PHABSIM model for instream flow studies on trout streams. North American Journal of Fisheries Management. 7(3):339-350.

Kurtz, J. 1980. Fishery management investigations - a study of the upper Green River fishery, Sublette County, Wyoming (1975-1979). Completion Report. Wyoming Game and Fish Department, Fish Division, Cheyenne.

Milhous, R.T. 1984. PHABSIM technical notes. Unpublished. U.S. Fish and Wildlife Service, Fort Collins, Colorado.

_____, D.L. Wegner, and T. Waddle. 1984. User's guide to the physical habitat simulation system. Instream Flow Paper 11, FWS/OBS-81/43, U.S. Fish and Wildlife Service, Fort Collins, Colorado.

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Needham, P., J. Moffett, and D. Slater. 1945. Fluctuations in wild brown trout populations in Convict Creek, California. Journal of Wildlife Management 9(1):9-25.

Nehring, R. 1979. Evaluation of instream flow methods and determination of water quantity needs for streams in the state of Colorado. Colorado Division of Wildlife, Fort Collins.

Reimers, N. 1957. Some aspects of the relation between stream foods and trout survival. California Fish and Game 43(1):43-69.

Reiser, D.W., T.A. Wesche, and C. Estes. 1989. Status of instream flow legislation and practices in North America. Fisheries 14(2): 22-29.

Form S.W. 1
Rev. 9-88

NOTE: Do not fold this form. Use typewriter or print neatly with black ink.

STATE OF WYOMING

OFFICE OF THE STATE ENGINEER

APPLICATION FOR PERMIT TO APPROPRIATE SURFACE WATER

THIS SECTION IS NOT TO BE FILLED IN BY APPLICANT

Filing/Priority Date

THE STATE OF WYOMING, STATE ENGINEER'S OFFICE } SS.

This instrument was received and filed for record on the _____ day of _____, A.D. 19 _____, at _____ o'clock _____ M.

_____
State Engineer

Recorded in Book _____ of Ditch Permits, on Page _____.

Fee Paid $_____. Map Filed _____

WATER DIVISION NO. _____ DISTRICT NO. _____ Temp. Filing No. _____

PERMIT NO. _____

NAME OF FACILITY SHELL CREEK INSTREAM FLOW SEGMENT NO. 1

1. Name(s), mailing address and phone no. of applicant(s) is/are Wyoming Water Development Commission, Herschler Building, Cheyenne, WY 82002

(If more than one applicant, designate one to act as Agent for the others)

2. Name & address of agent to receive correspondence and notices Wyoming Game and Fish Department 5400 Bishop Blvd., Cheyenne, WY 82002

3. (a) The use to which the water is to be applied is Instream Flow

(b) If more than one beneficial use of water is applied for, the location and ownership of the point of use must be shown in item 10 of the application and the details of the facilities used to divert and convey the appropriation must be shown on the map in sufficient detail to allow the State Engineer to establish the amount of appropriation. In multiple use applications, stock and domestic purposes are limited to 0.056 cubic feet per second.

4. The source of the proposed appropriation is Shell Creek, tributary Bighorn River

5. The segment of the instream flow is from the mouth of Adelaide Creek in the SE¼ SE¼ of Section 27 T. 53 N., R. 88 W., to Shell Falls in the SE¼NW¼ of Section 7 T. 53 N., R. 89 W.

6. Are any of the lands crossed by the proposed facility owned by the State or Federal Government? If so, describe lands and indicate whether State or Federally owned.

All lands are federally owned, U.S. Forest Service.

7. The carrying capacity of the ditch, canal, pipeline or other facility at the point of diversion is see remarks cubic feet per second.

8. The accompanying map is prepared in accordance with the State Engineer's Manual of Regulations and Instructions for filing applications and is hereby declared a part of this application. The State Engineer may require the filing of detailed construction plans.

9. The estimated time required for the commencement of work is 30 days, for completion of construction is 30 days, and to complete the applicaton of water to the beneficial uses stated in this application is 30 days from issue.

Permit No. _____ Page No. _____
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10. The land to be irrigated under this permit is described in the following tabulation. (Give irrigable acreage in each 40-acre subdivision. Designate ownership of land, Federal, State or private. If private, list names of owners and land owned separately.) If application is for stock, domestic, or for purposes other than irrigation, indicate point of use by 40-acre subdivision and owner.

Township	Range	Sec.	NE ¼				NW ¼				SW ¼				SE ¼				TOTALS
			NE ¼	NW ¼	SW ¼	SE ¼	NE ¼	NW ¼	SW ¼	SE ¼	NE ¼	NW ¼	SW ¼	SE ¼	NE ¼	NW ¼	SW ¼	SE ¼	
53N	88W	27										X	X	X			X	X	
		28		X	X		X	X		X					X	X		X	
		29	X	X			X												
		20											X	X			X		
		19										Lot 3 X	Lot 4 X	X			X	X	
53N	89W	24											Lot 4 X						
		23						X	X	X	X					X	X	X	
		22	X																
		15									X	X				X	X	X	
		16			X	X		X	X	X					X	X			
		17	X	X															
		8									X	X		X			X		
		7			X					X	X				X	X			

Number of acres to receive original supply _____

Number of acres to receive supplemental supply _____

Total number of acres to be irrigated _____

REMARKS

Item # 7 - Based on the results of a study conducted in 1985 by the Wyoming Game and Fish Department:

Instream Flow	October 1 - March 31	19cfs
	April 1 - June 30	70cfs
	July 1 - September 30	40cfs

Stream length - 10.5 miles

Intervening permits - see accompanying maps

Instream flow gage is not identified. If one is needed it will be installed near the downstream end of the instream flow reach.

Under penalties of perjury, I declare that I have examined this application and to the best of my knowledge and belief it is true, correct and complete.

Signature of Applicant or Agent

Date

WYOMING GAME AND FISH DEPARTMENT

FISH DIVISION

ADMINISTRATIVE REPORT

TITLE: Shell Creek Instream Flow Report, Segment Number 2

PROJECT: IF-2290-07-9001

AUTHOR: Gerald F. Vogt, Jr. and Thomas C. Annear

DATE: October, 1993

INTRODUCTION

Data were collected during the 1990 field season to conduct instream flow analyses for a segment of Shell Creek located near Shell, Wyoming. The study and this report were prepared to support an application for an instream flow water right.

The goal of this study was to determine instream flows necessary to maintain or improve the existing trout fishery. The specific objectives of this study were to determine instream flows necessary to 1) maintain or improve hydraulic characteristics year-round that are important for survival of trout, fish passage and aquatic insect production and 2) maintain or improve adult trout production during the late summer months. Two habitat models were used to make these determinations.

METHODS

Study Area

The section of Shell Creek from the U.S. Forest Service boundary upstream to Shell Falls is considered a Class 3 trout stream by the Wyoming Game and Fish Department (WGFD). Trout stream classifications throughout Wyoming range from Class 1 (highest rating) to Class 5 (lowest rating). Class 3 trout streams are generally considered important trout fisheries on a regional basis within the state.

Shell Creek below Shell Falls contains naturally reproducing populations of rainbow trout (Oncorhynchus mykiss) and brown trout (Salmo trutta). The stream is currently managed as a basic yield fishery for both species. This stream segment periodically receives plants of sub-catchable brown trout. The entire segment of Shell Creek from the U.S. Forest Service boundary upstream to Shell Falls is contained within the Big Horn National Forest and is highly accessible to the public. Because this section of Shell Creek supports an important trout fishery and has public access, the segment of Shell Creek from the U.S. Forest Service boundary upstream to Shell Falls was identified as a critical reach.

Data Collection

All of the field data used in this study were collected from a 336 foot long study site located within the Big Horn National Forest. This site is located approximately 5 miles east of the town of Shell (Figure 1). This was a fairly high gradient site that contained a combination of pool and riffle habitat for trout that was representative of trout habitat features found throughout this portion of the stream. Results and recommendations were applied to a portion of the stream extending from the boundary of the Bighorn National Forest in Section 16, Township 53N, Range 90W upstream to Shell Falls in Section 7, Township 53N, Range 89W. This is a distance of approximately 6.1 stream miles.

Models

A Habitat Retention Method (Nehring 1979; Annear and Conder 1984) was used to identify a maintenance flow. A maintenance flow is defined as a continuous flow that will maintain minimum hydraulic criteria at riffle areas in a stream segment. These criteria are important at all times of year to maintain passage between different habitat types for all life stages of trout. These criteria are also important for maintaining survival rates of fish and aquatic macroinvertebrates during the winter that approximate rates observed under natural stream flow conditions.

Data from single transects placed across 2 riffles within the study area were analyzed with the AVDEPTH computer program (Milhous et al. 1989). Flow data were collected at three different flow levels (Table 1). Based on extensive research on instream flow methods on Wyoming streams by Annear and Conder (1984), the maintenance flow is specifically defined as the discharge at which two of the three criteria in Table 2 are met for all riffles in the study area. Maintenance flows apply to all times of the year except when higher stream flows are required to meet other fishery management objectives.

Table 1. Dates and discharges when instream flow data were collected at Shell Creek instream flow segment.

Date	Discharge (cfs)
07-06-90	207
08-23-90	97
10-12-90	45

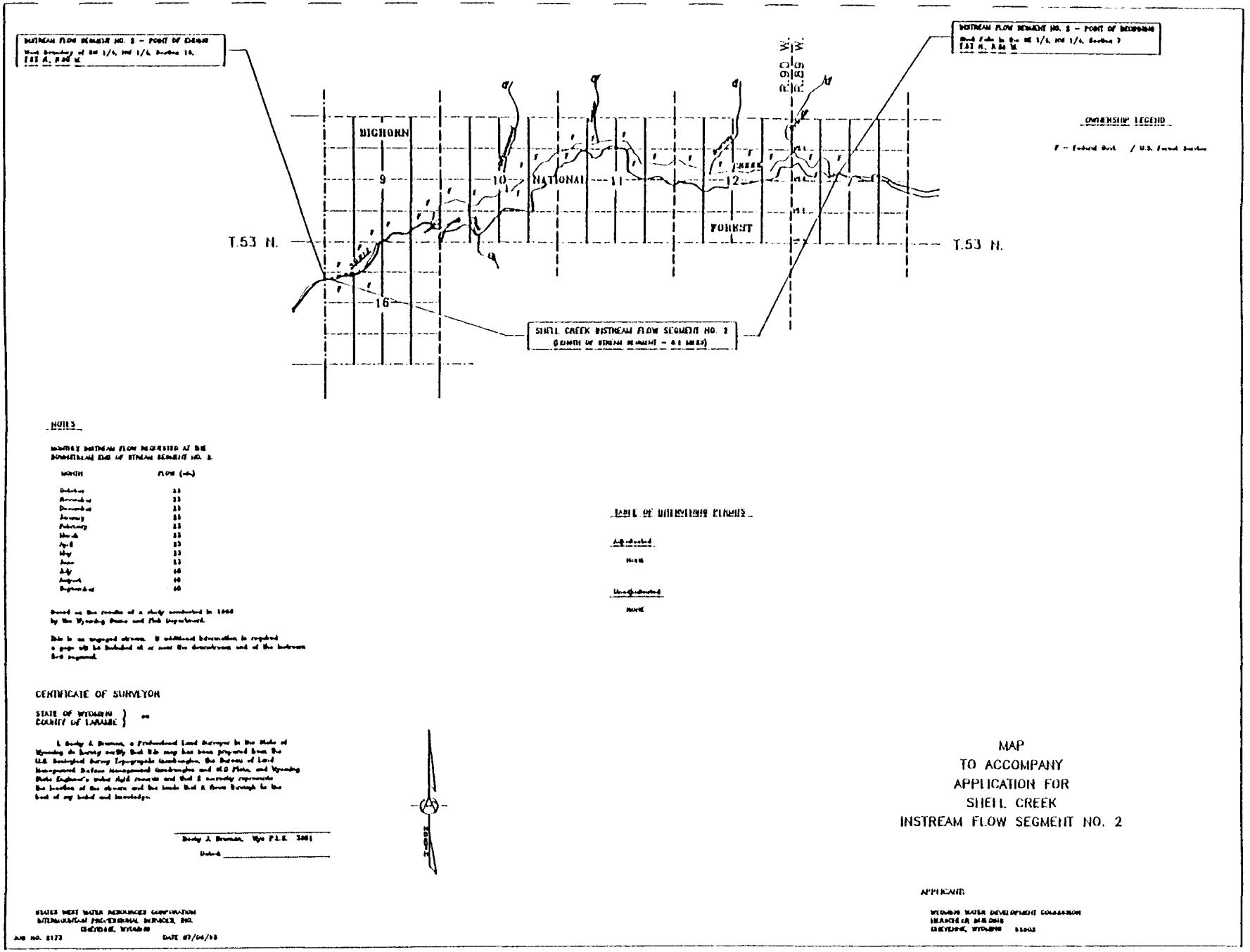

Figure 1. Shell Creek instream flow reach segment 2.

Table 2. Hydraulic criteria used to obtain an instream flow recommendation using the Habitat Retention Method.

Category	Criteria
Average Depth (ft)	Top width[1] x 0.01
Average Velocity (ft/sec)	1.00
Wetted Perimeter (percent)[2]	60

1 - At average daily flow
2 - Compared to wetted perimeter at bank full conditions

The Habitat Quality Index (HQI) developed by the Wyoming Game and Fish Department (Binns and Eiserman 1979; Binns 1982) was used to estimate potential changes in trout habitat units over a range of average late summer flow conditions. This model was developed by the WGFD after several years of testing and model refinement. The HQI has been reliably used on many Wyoming streams to assess HU gains or losses associated with projects that modify instream flow regimes. This model incorporates seven attributes that address chemical, physical and biological components of trout habitat. Results are expressed in habitat units (HU). One HU is generally defined as the amount of habitat quality which will support about 1 pound of trout. Analyses obtained from this method apply to the time of year that governs trout production. On Shell Creek this time period is between July 1 and September 30.

By measuring habitat attributes at various flow events as if associated habitat features were typical of average late summer flow conditions, HU estimates can be made for a range of theoretical summer flows (Conder and Annear 1987). Habitat attributes on Shell Creek were measured on the same dates and flow levels that data were collected for the Habitat Retention Method (Table 1). To better define the relationship of discharge and trout production, some attributes were derived mathematically or obtained from existing gage data for flows in addition to those shown in Table 1. Other data were obtained from a U.S. Geological Survey gage (# 0627850) located on Shell Creek near the town of Shell for the period 1941 to 1986.

RESULTS/DISCUSSION

Results from the Habitat Retention model showed that the hydraulic criteria in Table 2 are met at flows of 23 and 4 cfs for riffles 1 and 2, respectively (Table 3). The maintenance flow derived from this method is defined as the flow at which two of the three hydraulic criteria are met for all riffles in the study site which in this case is 23 cfs.

Table 3. Simulated hydraulic criteria for two riffles on Shell Creek. Estimated average daily flow = 117 cfs. Bank full discharge = 757 cfs.

Average Depth (ft)	Average Velocity (ft/sec)	Wetted Perimeter (ft)	Discharge (cfs)
	Riffle 1		
2.16	5.7	71.0	757
1.83	4.2	70.0	500
1.70	3.7	69.6	400
1.54	3.1	69.0	300
1.14	1.7	63.9	117
0.99	1.4	62.4	80
0.89	1.2	61.3	60
0.79	1.0[1]	60.3	45
0.59[1]	0.7	56.8	23[2]
0.35	0.4	42.6[1]	4
	Riffle 2		
2.60	6.3	52.3	757
2.21	4.9	49.2	500
2.06	4.3	48.0	400
1.89	3.6	46.6	300
1.43	2.1	41.1	117
1.27	1.7	39.3	80
1.14	1.4	38.8	60
0.89	1.0[1]	36.9	32
0.39[1]	0.5	32.6	4[2]
0.32	0.4	31.4[1]	1

1 - Minimum hydraulic criteria met
2 - Discharge at which 2 of 3 hydraulic criteria are met

The mainterance flow is defined as a continuous flow that will maintain minimum hydraulic criteria in riffle areas within a stream segment. These criteria are important at all times of year to maintain passage between different habitat types for all life stages of trout. These criteria are also important for maintaining survival rates of fish and aquatic macroinvertebrates during the winter that approximate rates observed under natural stream flow conditions.

Low flow conditions during winter months (October through March) naturally limit the survival and growth of many trout populations. The extent of these impacts is dependent upon several factors including but not limited to snow fall, cold intensity and the duration of intense cold periods. These factors vary from year to year and affect fish populations depending on the amount of frazile ice and anchor ice formation (which can plug the gills of fish), the extent of snow bank collapse (and stream damming) and increased metabolic demands on fish (and increased stress).

Kurtz (1980) found that the loss of winter habitat due to low flow conditions was an important factor affecting mortality rates of trout in the upper Green River, with mortality approaching 90% during some years. Needham et al. (1945) documented average overwinter brown trout mortality of 60% and extremes as high as 80% in a California stream. Butler (1979) reported significant trout and aquatic insect losses caused by anchor ice formation. Reimers (1957) considered anchor ice, collapsing snow banks and fluctuating flows resulting from the periodic formation and breakup of ice dams as the primary causes of winter trout mortality.

The causes of winter mortality discussed above are all greatly influenced by the quantity of winter flow in terms of its ability to minimize anchor ice formation (increased velocity and temperature loading) and dilute and prevent snow bank collapses and ice dam formation respectively. Any reduction of natural winter stream flows would increase trout mortality and effectively reduce the number of fish that the stream could support. Therefore protection of natural winter stream flows up to the recommended maintenance flow for each stream segment is necessary to maintain existing survival rates of trout populations.

It is possible that the discharge of 23 cfs identified by the Habitat Retention Method may not be present at times during the winter. Because the existing fishery is adapted to natural flow patterns, occasional periods of natural shortfall during the winter do not necessarily imply the need for storage. Instead, they illustrate the need to maintain all natural winter streamflows, up to 23 cfs, in order to maintain existing survival rates of trout populations.

Results from the HQI analyses (Figure 2) indicate that under existing average late summer flow conditions (approximately 90 cfs), the stream presently supports about 160 HUs. The current fishery management objective is to maintain or improve the existing number of HUs. A discharge of 40 cfs is the minimum flow that will accomplish this objective. At average late summer flows below 40 cfs, the model indicates that reductions in the present fishery would occur. These reductions would largely be the result of reduced critical period stream flows. Increases in stream flow above 100 cfs would also result in reductions of trout HUs over present conditions.

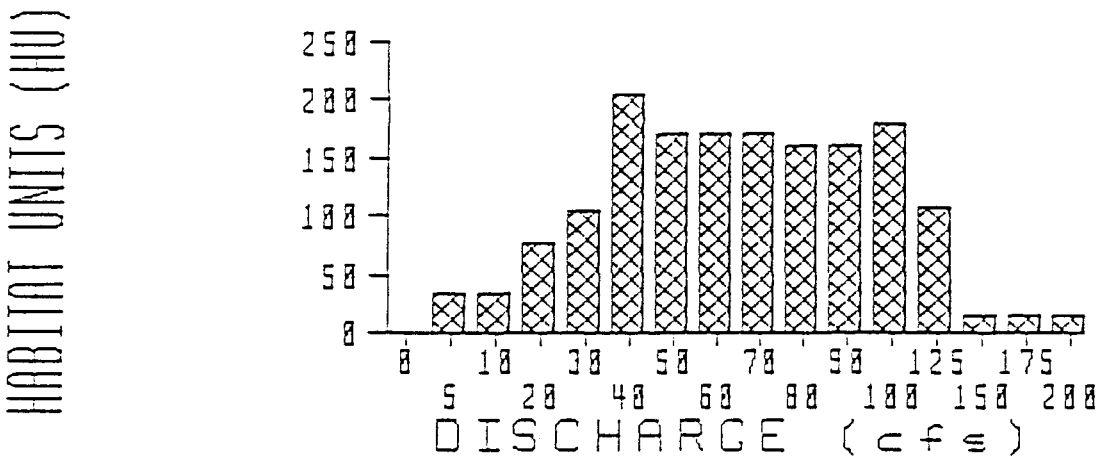

Figure 2. Number of potential trout habitat units at several average late summer flow levels in Shell Creek instream flow segment.

Based on the results from the HQI analysis, a late summer flow of 40 cfs will maintain existing levels of trout production between July 1 and September 30 and will meet or exceed the hydraulic criteria addressed by the Habitat Retention Method.

CONCLUSIONS

Based on the analyses and results contained in this report, the instream flow recommendations (Table 4) apply to a 6.1 mile segment of Shell Creek extending from the boundary of the Bighorn National Forest in Section 16, Township 53N, Range 90W upstream to Shell Falls in Section 7, Township 53N, Range 89W.

This analysis does not consider flushing flow needs for maintenance of channel geomorphology and trout habitat characteristics. Because this stream is presently unregulated, flushing flow needs are adequately met by natural runoff patterns. If the stream is regulated in the future, additional studies and recommendations may be appropriate for establishing flushing flow needs for channel maintenance.

Table 4. Summary of instream flow recommendations to maintain the existing trout fishery in Shell Creek.

Time Period	Instream Flow Recommendation (cfs)
October 1 to June 30	23[1]
July 1 to September 30	40

1 - To maintain existing natural stream flows

REFERENCES

Annear, T.C. and A.L. Conder. 1984. Relative bias of several fisheries instream flow methods. North American Journal of Fisheries Management. 4: 531-539.

Binns, N. and F. Eiserman. 1979. Quantification of fluvial trout habitat in Wyoming. Transactions of the American Fisheries Society 108:215-228.

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Form S.W. 1
Rev. 9-88

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STATE OF WYOMING

OFFICE OF THE STATE ENGINEER

APPLICATION FOR PERMIT TO APPROPRIATE SURFACE WATER

THIS SECTION IS NOT TO BE FILLED IN BY APPLICANT

Filing/Priority Date

THE STATE OF WYOMING, STATE ENGINEER'S OFFICE } SS.

This instrument was received and filed for record on the _____ day of _____, A.D. 19 _____, at _____ o'clock _____ M.

_____
State Engineer

Recorded in Book _____ of Ditch Permits, on Page _____.

Fee Paid $_____. Map Filed _____

WATER DIVISION NO. _____ DISTRICT NO. _____ Temp. Filing No. _____

PERMIT NO. _____

NAME OF FACILITY SHELL CREEK INSTREAM FLOW SEGMENT NO. 2

1. Name(s), mailing address and phone no. of applicant(s) is/are Wyoming Water Development Commission, Herschler Building, Cheyenne, WY 82002

(If more than one applicant, designate one to act as Agent for the others)

2. Name & address of agent to receive correspondence and notices Wyoming Game & Fish Department 5400 Bishop Boulevard, Cheyenne, WY 82002

3. (a) The use to which the water is to be applied is Instream Flow

(b) If more than one beneficial use of water is applied for, the location and ownership of the point of use must be shown in item 10 of the application and the details of the facilities used to divert and convey the appropriation must be shown on the map in sufficient detail to allow the State Engineer to establish the amount of appropriation. In multiple use applications, stock and domestic purposes are limited to 0.056 cubic feet per second.

4. The source of the proposed appropriation is Shell Creek, tributary Bighorn River

5. The segment of the instream flow is from Shell Falls in the SE¼ NW¼ of Section 7 T. 53 N., R. 89 W., to the west boundary of SW¼ NW¼ of Section 16 T. 53 N., R. 90 W.

6. Are any of the lands crossed by the proposed facility owned by the State or Federal Government? If so, describe lands and indicate whether State or Federally owned.

All lands are federally owned, U.S. Forest Service

7. The carrying capacity of the ditch, canal, pipeline or other facility at the point of diversion is see remarks cubic feet per second.

8. The accompanying map is prepared in accordance with the State Engineer's Manual of Regulations and Instructions for filing applications and is hereby declared a part of this application. The State Engineer may require the filing of detailed construction plans.

9. The estimated time required for the commencement of work is 30 days, for completion of construction is 30 days, and to complete the applicaton of water to the beneficial uses stated in this application is 30 days from issue.

10. The land to be irrigated under this permit is described in the following tabulation. (Give irrigable acreage in each 10-acre subdivision. Designate ownership of land, Federal, State or private. If private, list names of owners and land owned separately.) If application is for stock, domestic, or for purposes other than irrigation, indicate point of use by 40-acre subdivision and owner.

			NE ¼				NW ¼				SW ¼				SE ¼				
Township	Range	Sec.	NE ¼	NW ¼	SW ¼	SE ¼	NE ¼	NW ¼	SW ¼	SE ¼	NE ¼	NW ¼	SW ¼	SE ¼	NE ¼	NW ¼	SW ¼	SE ¼	TOTALS
53N	89W	7							x	x									
53N	90W	12			x	x			x	x									
		11		x	x	x	x	x	x										
		10			x	x					x	x				x			
		9												x	x		x	x	
		16					x	x	x	x									

Number of acres to receive original supply _____

Number of acres to receive supplemental supply _____

Total number of acres to be irrigated _____

REMARKS

Item #7 - Based on the results of a study conducted in 1985 by the Wyoming Game & Fish Dept.:

Instream Flow October 1 - June 30 23 cfs.
July 1 - September 30 40 cfs.

Stream length 6.1 miles

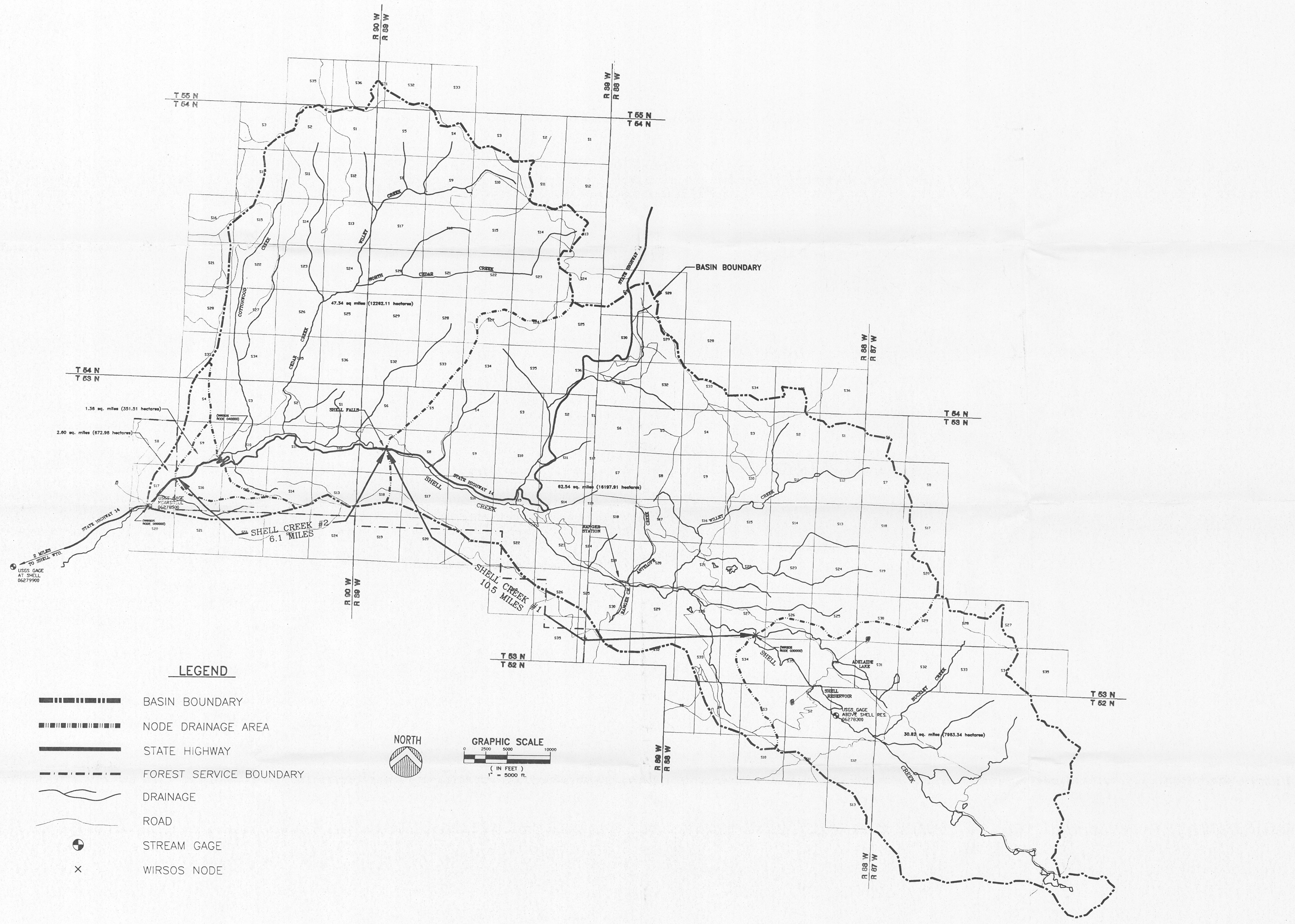
Intervening permits - none

Instream flow gage is not identified. If one is needed it will be installed near downstream end of the instream flow reach.

Under penalties of perjury, I declare that I have examined this application and to the best of my knowledge and belief it is true, correct and complete.

Signature of Applicant or Agent

Date



PROJECT TITLE:
INSTREAM FLOW STUDY
SHELL CREEK
WYOMING WATER DEVELOPMENT COMMISSION
BIGHORN COUNTY, WYOMING

DRAWING TITLE:
SHELL
DRAINAGE BASIN

REFERENCE:

DRAWN BY:
GKK

SCALE:
1" = 5000'

DATE:
2 MAY 94

PROJECT NO:
3606-94E

SHEET NO:
1

JOHNSON-FERMELIA Co, Inc
CONSULTING ENGINEERS, ARCHITECTS AND SURVEYORS
1515 NINTH STREET
ROCK SPRINGS, WYOMING 82901
307/362-7519