Appendix D

HYDROLOGY

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HYDROLOGY

The Bureau of Reclamation has been asked to perform studies related to the potential removal of Savage Rapids Dam, on the Rogue River upstream from Grants Pass, Oregon. Among the many significant concerns with this project is the disposition of sediment accumulated behind the structure. This report provides hydrologic flow data for use in the proposed sediment models for this project.

Flow Frequency Data

Lost Creek Dam and Reservoir were completed by the Corps of Engineers (Corps) on the Rogue River in 1977. Lost Creek Dam controls the upper 686 square miles of the Rogue River watershed. This large flood control reservoir can have a dramatic impact on flood peaks in the downstream areas, including the Savage Rapids Dam and Grants Pass, Oregon, areas. Flood peaks in Grants Pass typically occur from November through March, with most occurring in December and January. The Rogue River has five gauging stations on the main stem, which record peak and daily discharges between Lost Creek Dam and Agness, Oregon. There are no significant river diversions below Lost Creek Dam that affect flood peaks during the winter. Peak flow and daily flow values for the Rogue River were available from the U.S. Geological Survey (USGS) water data web site, http://waterdata.usgs.gov/nwis-w/OR/

The Corps, Portland District Office, was contacted [1] and asked for information about regulated flows on the Rogue River. That office has provided estimated regulated frequency curves for three locations on the Rogue River. Regulated flow frequency curves attempt to predict what the flow at a specific point in the river will be, given a flood of some specific return period and the estimated flood peak reduction due to the upstream flood control dam. For the Rogue River, the Corps has provided estimated unregulated and regulated flow frequency curves for the main stem of the Rogue River at the Lost Creek Dam, Dodge Bridge, Raygold, and Grants Pass gauge site locations.

The regulated peak flow frequency curves supplied by the Corps were prepared in 1991, with peak flow data available through 1989. Since the preparation of these curves, the largest flood since Lost Creek Dam began regulation occurred in January 1997. The regulated peak flow curves should be redone and updated with the more recent data; however, they are considered adequate for the purposes of this study. These curves will provide a consistent set of flows for each of the gauge sites to estimate the reaches of the Rogue River most likely to experience sediment deposition following the removal of Savage Rapids Dam. This is accomplished in a preliminary sense through the use of the stream power plot developed as part of this study. Additional, more detailed studies will depict the potential sediment deposition at various locations in the river by using the daily flow hydrographs developed as part of this study.

Table 1 (at the end of this appendix) lists the regulated discharges for various return periods at four of the gauging stations located downstream from Lost Creek Dam. These discharges were taken from the regulated flow frequency curves supplied by the Corps and by a simple application of the log-Pearson III statistical technique to the Rogue River peak flows at Agness for the regulated years 1977 through 1998. Flows at Agness are considered to be far enough downstream and to have enough uncontrolled drainage area that any peak flow regulation effects of Lost Creek Dam are minimal. Also listed in table 1 are the drainage area and gauge datum elevation for each gauge location and the locations of other large tributaries. Included in table 1 is a list of river miles associated with each gauge site and each tributary. These gauge characteristics come from the available USGS water supply paper [2].

Figure 1 (at the end of this appendix) displays the gauge datum elevation plotted with river miles for five stations. Figure 2 displays the computed 2-, 5-, 10-, 25-, 50-, and 100-year discharges for the four gauges farthest downstream in this river. The Mcleod gauge data were not included in this graph since the computed values for the various return periods at Mcleod did not follow the pattern established by the more down-stream gauges. The Mcleod gauge data for this analysis showed a positive skew value, due largely to the influence of Lost Creek Dam, only 3 miles upstream. All other gauges show negative skew values, indicating the influence of Lost Creek Dam is not as great on the distribution of flood peak values farther downstream. The other downstream gauges also have the influence of many more unregulated tributary flows. The Mcleod gauge is too far upstream to have any impact on the sediment modeling farther down-stream near Savage Rapids Dam and the Grants Pass gauge site. The Mcleod gauge data, except for drainage area, elevation, and river mile, were not used in any other computation in this report.

Figure 2 displays the discharges for the five return periods, plotted as a function of drainage area at the gauge sites. This plot provides a smooth family of curves and provides some good visual confirmation of the validity of the calculated return period flows for the four gauge stations farthest downstream. This figure is not particularly useful for any location on the main stem of the Rogue River since river miles and the locations of the tributaries are not indicated.

Figure 3 is a plot of the various return period discharges as a function of river mile. This plot also shows the Corps regulated peak flood frequency for the three gauges farthest upstream. Again, the downstream gauges appear to show a nice family of curves for all return periods. The Corps curves show a strong influence by the Lost Creek Dam regulation. This figure also shows the relative difference in magnitude between the Corps regulated peak flow curves and the analysis of the last 21 years of regulated flows below Lost Creek Dam. Possible reasons for these differences were discussed earlier in this report. The location of the tributaries is needed on this plot to make it useful in determining a flow for a given return period for a specific location on the Rogue River.

Figure 4 is a plot of drainage area versus river mile for all locations on the Rogue River, including the location of the tributary inflows. Data for this graph were calculated by computing the change in drainage area for each gauge location and then subtracting any major tributary drainage area in the reach. The difference in drainage areas, less the tributary area, was divided by the difference in river miles for the known gauge site locations. This rate of change of drainage area was applied for all river miles between the two sites. At the location of the major tributaries, the area of the tributary is added to the plot. This is reflected by the jumps in drainage area at the tributary locations on the plot.

Figure 5 is a plot of the discharge for various return periods as a function of river mile. Data for this plot were created similarly to the plot for drainage area versus river mile. Unit discharges for drainage areas at the gauge sites were computed. The unit discharge was multiplied by the drainage areas for each river mile location determined in the previous calculation, and the plot of discharge versus river mile, with appropriate jumps at the tributary locations, was created. Table 1 provides details related to the calculation of values on this plot.

Figure 6 is a plot of total stream power (discharge times slope) versus river mile of the stream for the four gauge sites where elevation and discharge data are known. The slope used in the calculations for this plot was calculated by digitizing the water surface profile of the river from USGS quadrangle maps.

Daily Flow Hydrographs

In addition to peak flows, hydrographs representing the following four conditions were requested.

Daily flow hydrograph conditions for Savage Rapids Dam Sediment Evaluation Study
1 – High winter flows and high summer flows
2 – High winter flows and low summer flows
3 – Low winter flows and high summer flows
4 – Low winter flows and low summer flows

Daily data for the Grants Pass gauging station was retrieved for the regulated flow years 1977 through 1998 from the USGS water data web site, http://waterdata.usgs.gov/nwis-w/OR/

The yearly data were divided into seasons. The winter season was considered to be November 1 through May 31 each year, and the summer season was considered to be July 1 through September 30 each year. The months of June and October were

considered to be transition months and not considered as part of either season. Computations were made to determine the maximum 120-day flow values in each season of each year. These values were then ranked. The highest value indicated the highest year for each season, and the lowest value indicated the lowest year for each season. For the years 1977 through 1998, the highest winter season was 1997, the highest summer season was 1984, and both the lowest winter and lowest summer were in 1992. This information was verified by a simple visual inspection of the daily values plot available from the web site.

To create the high-winter/high-summer hydrograph, the 1997 data for the months of December 1 through May 31 were used, and the summer values for the year 1984 from June 1 through November 30 were combined in a single hydrograph. The low-winter and high-summer values were October 1 through May 31, 1992, and June 1 through September 30, 1984, respectively. High-winter and low-summer values were December 1 through May 31, 1997, and June 1 through September 30, respectively. The low-winter/low-summer hydrograph was the entire water year of 1992. These dates for the conditions selected were determined in such a way as to make the hydrographs appear reasonable and still maintain the conditions used to describe each hydrograph. Figures 7, 8, and 9 display these hydrographs. Table 2 displays the ordinates for these hydrographs.

Acknowledgments

This report was prepared by Kenneth L. Bullard, Hydraulic Engineer, Flood Hydrology Group, Bureau of Reclamation, Technical Service Center, Denver, Colorado. Peer review was provided by Tim Randle, Hydraulic Engineer, River Sedimentation and Hydraulics Group, Bureau of Reclamation, Technical Service Center, Denver, Colorado.

References

1. Personal communication, June 21, 1999, Mr. Ron Mason, Hydraulic Engineer, Portland District, U. S. Army Corps of Engineers, Portland, Oregon.

2. U.S. Geological Survey, March 31, 1999, *Water Resources Data for Oregon, Water Year 1998*. Water Data Report OR-98-1.

Table 1
Rogue River - Savage Rapids Dam Removal and Sedimentation Study
Stream Flow and Gauge Statistics Summary

2 Year Return Period

			Corps of Engineers Regulated Flows				Slopes calculated from digitized water surface profile on USGS Quadrangle Maps			
Location	River Mile	Elevation (ft)	DA	Q	Q/DA	Mile Q	distance (ft)	elev diff (ft)	slope (ft/ft)	disch*slope
McLeod	154.0	1489.08	686.00	NA	NA	NA	NA	NA	NA	NA
	151.9		958.18			15221				
Elk Creek	151.9		1087.18			17270	.			
Dodge Bridge	138.6	1271.99	1215.00	19300	15.88	19300	81312	217.09	0.00267	51.53
	126.8		1721.11			27339				
Bear Creek	126.8		2010.11			25457				
Raygold	125.8	1121.78	2053.00	26000	12.66	26000	67584	150.21	0.00222	57.79
Grants Pass	101.8	884.28	2459.00	37500	15.25	37500	126720	237.50	0.00187	70.28
	94.6		2537.09			38691				
Applegate River	94.6		3235.09			49335				
Agness	29.7	113.81	3939.00	53644	13.62	53644	380688	770.47	0.00202	108.57

5 Year Return Period

			Corps of Engineers Regulated Flows				Slopes calculated from digitized water surface profile on USGS Quadrangle Maps			
Location	River Mile	Elevation (ft)	DA	Q	Q/DA	Mile Q	distance (ft)	elev diff (ft)	slope (ft/ft)	disch*slope
McLeod	154.0	1489.08	686.00	NA	NA	NA	NA	NA	NA	NA
	151.9		958.18			16009.1				
Elk Creek	151.9		1087.18			18164.4	.			
Dodge Bridge	138.6	1271.99	1215.00	20300	16.71	20300.0	81312	217.09	0.00267	54.20
	126.8		1721.11			28756.0				
Bear Creek	126.8		2010.11			36814.5				
Raygold	125.8	1121.78	2053.00	37600	18.31	37600.0	67584	150.21	0.00222	83.57
Grants Pass	101.8	884.28	2459.00	58600	23.83	58600.0	126720	237.50	0.00187	109.83
	94.6		2537.09			60461.0				
Applegate River	94.6		3235.09			77094.9				
Agness	29.7	113.81	3939.00	100723	25.57	100723.0	380688	770.47	0.00202	203.85

10-Year Return Period

			Corps of Engineers Regulated Flows				Slopes calculated from digitized water surface profile on USGS Quadrangle Maps			
Location	River Mile	Elevation (ft)	DA	Q	Q/DA	Mile Q	distance (ft)	elev diff (ft)	slope (ft/ft)	disch*slope
McLeod	154.0	1489.08	686.00	NA	NA	NA	NA	NA	NA	NA
	151.9		958.18			17586				
Elk Creek	151.9		1087.18			19954	.			
Dodge Bridge	138.6	1271.99	1215.00	22300	18.35	22300	81312	217.09	0.00267	59.54
	126.8		1721.11			31589				
Bear Creek	126.8		2010.11			43570				
Raygold	125.8	1121.78	2053.00	44500	21.68	44500	67584	150.21	0.00222	98.90
Grants Pass	101.8	884.28	2459.00	73300	29.81	73300	126720	237.50	0.00187	137.38
	94.6		2537.09			75628				
Applegate River	94.6		3235.09			96434				
Agness	29.7	113.81	3939.00	138496	35.16	138496	380688	770.47	0.00202	280.30

25-year Return Period

Location	River Mile	Elevation (ft)	Corps of Engineers Regulated Flows: DA	Q	Q/DA	Mile Q	Slopes calculated from digitized water surface profile on USGS Quadrangle Maps: distance (ft)	elev diff (ft)	slope (ft/ft)	disch*slope
McLeod	154.0	1489.08	686.00	NA	NA	NA	NA	NA	NA	NA
	151.9		958.18			21293				
Elk Creek	151.9		1087.18			24160	.			
Dodge Bridge	138.6	1271.99	1215.00	27000	22.22	27000	81312	217.09	0.00267	72.09
	126.8		1721.11			38247				
Bear Creek	126.8		2010.11			56788				
Raygold	125.8	1121.78	2053.00	58000	28.25	58000	67584	150.21	0.00222	128.91
Grants Pass	101.8	884.28	2459.00	97400	39.61	97400	126720	237.50	0.00187	182.55
	94.6		2537.09			100493				
Applegate River	94.6		3235.09			128141				
Agness	29.7	113.81	3939.00	192936	48.98	192936	380688	770.47	0.00202	390.48

Table 1 (cont)
Rogue River - Savage Rapids Dam Removal and Sedimentation Study
Stream Flow and Gauge Statistics Summary

50-Year Return Period

Location	River Mile	Elevation (ft)	Corps of Engineers Regulated Flows: DA	Q	Q/DA	Mile Q	Slopes calculated from digitized water surface profile on USGS Quadrangle Maps: distance (ft)	elev diff (ft)	slope (ft/ft)	disch*slope
McLeod	154.0	1489.08	686.00	NA	NA	NA	NA	NA	NA	NA
	151.9		958.18			27839				
Elk Creek	151.9		1087.18			31586	.			
Dodge Bridge	138.6	1271.99	1215.00	35300	29.05	35300	81312	217.09	0.00267	94.25
	126.8		1721.11			50004				
Bear Creek	126.8		2010.11			73041				
Raygold	125.8	1121.78	2053.00	74600	36.34	74600	67584	150.21	0.00222	165.80
Grants Pass	101.8	884.28	2459.00	121500	49.41	121500	126720	237.50	0.00187	227.72
	94.6		2537.09			125359				
Applegate River	94.6		3235.09			159847				
Agness	29.7	113.81	3939.00	237966	60.41	237966	380688	770.47	0.00202	481.62

100-Year Return Period

Location	River Mile	Elevation (ft)	Corps of Engineers Regulated Flows: DA	Q	Q/DA	Mile Q	Slopes calculated from digitized water surface profile on USGS Quadrangle Maps: distance (ft)	elev diff (ft)	slope (ft/ft)	disch*slope
McLeod	154.0	1489.08	686.00	NA	NA	NA	NA	NA	NA	NA
	151.9		958.18			35409				
Elk Creek	151.9		1087.18			40177	.			
Dodge Bridge	138.6	1271.99	1215.00	44900	36.95	44900	81312	217.09	0.00267	119.88
	126.8		1721.11			63603				
Bear Creek	126.8		2010.11			95953				
Raygold	125.8	1121.78	2053.00	98000	47.74	98000	67584	150.21	0.00222	217.81
Grants Pass	101.8	884.28	2459.00	151500	61.61	151500	126720	237.50	0.00187	283.94
	94.6		2537.09			156311				
Applegate River	94.6		3235.09			199315				
Agness	29.7	113.81	3939.00	286544	72.75	286544	380688	770.47	0.00202	579.93

Table 2
Savage Rapids Dam Removal and Sedimentation Study Hydrographs

Date	Day	High Winter High Summer	High Winter Low Summer	Low Winter igh Summer	Low Winter Low Summer
1-Oct	1	2350	1010	1010	1010
2-Oct	2	2300	1020	1020	1020
3-Oct	3	2260	1040	1040	1040
4-Oct	4	2250	1050	1050	1050
5-Oct	5	2240	1060	1060	1060
6-Oct	6	2160	1070	1070	1070
7-Oct	7	2150	1080	1080	1080
8-Oct	8	2160	1050	1050	1050
9-Oct	9	2220	1080	1080	1080
10-Oct	10	2260	1090	1090	1090
11-Oct	11	2240	1120	1120	1120
12-Oct	12	2210	1120	1120	1120
13-Oct	13	2210	1130	1130	1130
14-Oct	14	2180	1130	1130	1130
15-Oct	15	2160	1140	1140	1140
16-Oct	16	2180	1140	1140	1140
17-Oct	17	2320	1140	1140	1140
18-Oct	18	2310	1170	1170	1170
19-Oct	19	2310	1120	1120	1120
20-Oct	20	2310	1110	1110	1110
21-Oct	21	2290	1400	1400	1400
22-Oct	22	2320	1550	1550	1550
23-Oct	23	2450	1250	1250	1250
24-Oct	24	2420	1270	1270	1270
25-Oct	25	2350	1330	1330	1330
26-Oct	26	2340	1310	1310	1310
27-Oct	27	2330	1260	1260	1260
28-Oct	28	2340	1150	1150	1150
29-Oct	29	2330	1170	1170	1170
30-Oct	30	2340	1190	1190	1190
31-Oct	31	2440	1150	1150	1150
1-Nov	32	2570	1130	1130	1130
2-Nov	33	2770	1120	1120	1120
3-Nov	34	2770	1110	1110	1110
4-Nov	35	2860	1110	1110	1110
5-Nov	36	3060	1110	1110	1110
6-Nov	37	3420	1100	1100	1100
7-Nov	38	3760	1090	1090	1090
8-Nov	39	3340	1110	1110	1110
9-Nov	40	3250	1140	1140	1140
10-Nov	41	3340	1130	1130	1130
11-Nov	42	3610	1130	1130	1130
12-Nov	43	3720	1130	1130	1130
13-Nov	44	5440	1160	1160	1160
14-Nov	45	5890	1210	1210	1210
15-Nov	46	4490	1200	1200	1200
16-Nov	47	3870	1140	1140	1140
17-Nov	48	5870	1500	1500	1500
18-Nov	49	5310	2280	2280	2280
19-Nov	50	5850	1780	1780	1780
20-Nov	51	7450	1570	1570	1570
21-Nov	52	6180	1870	1870	1870
22-Nov	53	5290	1590	1590	1590
23-Nov	54	6150	1430	1430	1430
24-Nov	55	11200	1410	1410	1410
25-Nov	56	9040	1600	1600	1600
26-Nov	57	6570	1750	1750	1750
27-Nov	58	5520	2490	2490	2490
28-Nov	59	5030	2980	2980	2980
29-Nov	60	4700	2630	2630	2630
30-Nov	61	3920	5960	2530	2530

Table 2 (cont)
Savage Rapids Dam Removal and Sedimentation Study Hydrographs

Date	Day	High Winter High Summer	High Winter Low Summer	Low Winter igh Summer	Low Winter Low Summer
1-Dec	62	8750	8750	2430	2430
2-Dec	63	8740	8740	2410	2410
3-Dec	64	7990	7990	2380	2380
4-Dec	65	8660	8660	2320	2320
5-Dec	66	24000	24000	2250	2250
6-Dec	67	13600	13600	2630	2630
7-Dec	68	15300	15300	6390	6390
8-Dec	69	40200	40200	4510	4510
9-Dec	70	38500	38500	3670	3670
10-Dec	71	28100	28100	3310	3310
11-Dec	72	25000	25000	2860	2860
12-Dec	73	20800	20800	2490	2490
13-Dec	74	19500	19500	2370	2370
14-Dec	75	17200	17200	2210	2210
15-Dec	76	15200	15200	1980	1980
16-Dec	77	14100	14100	1870	1870
17-Dec	78	13100	13100	1820	1820
18-Dec	79	11700	11700	1950	1950
19-Dec	80	9460	9460	2580	2580
20-Dec	81	7650	7650	2350	2350
21-Dec	82	10800	10800	2080	2080
22-Dec	83	9330	9330	1980	1980
23-Dec	84	8440	8440	1940	1940
24-Dec	85	7970	7970	1870	1870
25-Dec	86	11200	11200	1810	1810
26-Dec	87	19000	19000	1770	1770
27-Dec	88	22600	22600	1730	1730
28-Dec	89	22200	22200	1720	1720
29-Dec	90	22000	22000	1670	1670
30-Dec	91	26600	26600	1650	1650
31-Dec	92	38400	38400	1600	1600
1-Jan	93	69000	69000	1580	1580
2-Jan	94	56000	56000	1520	1520
3-Jan	95	43500	43500	1510	1510
4-Jan	96	31000	31000	1590	1590
5-Jan	97	26000	26000	1750	1750
6-Jan	98	23500	23500	1720	1720
7-Jan	99	21800	21800	1740	1740
8-Jan	100	21700	21700	1710	1710
9-Jan	101	20800	20800	1650	1650
10-Jan	102	18900	18900	1640	1640
11-Jan	103	18100	18100	1690	1690
12-Jan	104	18300	18300	1730	1730
13-Jan	105	14700	14700	1630	1630
14-Jan	106	13400	13400	1580	1580
15-Jan	107	9600	9600	1550	1550
16-Jan	108	5930	5930	1540	1540
17-Jan	109	5840	5840	1650	1650
18-Jan	110	5880	5880	1720	1720
19-Jan	111	5850	5850	1640	1640
20-Jan	112	5850	5850	1580	1580
21-Jan	113	5870	5870	1530	1530
22-Jan	114	6220	6220	1480	1480
23-Jan	115	5960	5960	1370	1370
24-Jan	116	5960	5960	1290	1290
25-Jan	117	7630	7630	1310	1310
26-Jan	118	10200	10200	1310	1310
27-Jan	119	8880	8880	1320	1320
28-Jan	120	7670	7670	1470	1470
29-Jan	121	6950	6950	1800	1800
30-Jan	122	6800	6800	1670	1670
31-Jan	123	6960	6960	1570	1570

Table 2 (cont)
Savage Rapids Dam Removal and Sedimentation Study Hydrographs

Date	Day	High Winter High Summer	High Winter Low Summer	Low Winter igh Summer	Low Winter Low Summer
1-Feb	124	8740	8740	1650	1650
2-Feb	125	7960	7960	1720	1720
3-Feb	126	7250	7250	1610	1610
4-Feb	127	6870	6870	1510	1510
5-Feb	128	5930	5930	1470	1470
6-Feb	129	5920	5920	1400	1400
7-Feb	130	6060	6060	1370	1370
8-Feb	131	7220	7220	1340	1340
9-Feb	132	5640	5640	1320	1320
10-Feb	133	5200	5200	1300	1300
11-Feb	134	4730	4730	1280	1280
12-Feb	135	4750	4750	1240	1240
13-Feb	136	4560	4560	1250	1250
14-Feb	137	4180	4180	1270	1270
15-Feb	138	3770	3770	1410	1410
16-Feb	139	3580	3580	1420	1420
17-Feb	140	3840	3840	1490	1490
18-Feb	141	3980	3980	1490	1490
19-Feb	142	3920	3920	1520	1520
20-Feb	143	4100	4100	1820	1820
21-Feb	144	3830	3830	2400	2400
22-Feb	145	3630	3630	3120	3120
23-Feb	146	3420	3420	2620	2620
24-Feb	147	3260	3260	2200	2200
25-Feb	148	3130	3130	1960	1960
26-Feb	149	3200	3200	1780	1780
27-Feb	150	3650	3650	1630	1630
28-Feb	151	4130	4130	1530	1530
1-Mar	152	3660	3660	1470	1470
2-Mar	153	7880	7880	1380	1380
3-Mar	154	6540	6540	1250	1250
4-Mar	155	5570	5570	1200	1200
5-Mar	156	5010	5010	1180	1180
6-Mar	157	4610	4610	1220	1220
7-Mar	158	4400	4400	1230	1230
8-Mar	159	4310	4310	1190	1190
9-Mar	160	4220	4220	1170	1170
10-Mar	161	4500	4500	1130	1130
11-Mar	162	4390	4390	1110	1110
12-Mar	163	4600	4600	1090	1090
13-Mar	164	4380	4380	1060	1060
14-Mar	165	4220	4220	1040	1040
15-Mar	166	4250	4250	1040	1040
16-Mar	167	4330	4330	1050	1050
17-Mar	168	4930	4930	1070	1070
18-Mar	169	4790	4790	1100	1100
19-Mar	170	4530	4530	1100	1100
20-Mar	171	4540	4540	1060	1060
21-Mar	172	4630	4630	1040	1040
22-Mar	173	4470	4470	1010	1010
23-Mar	174	4340	4340	1020	1020
24-Mar	175	4240	4240	1040	1040
25-Mar	176	4200	4200	1030	1030
26-Mar	177	4460	4460	1000	1000
27-Mar	178	4410	4410	1050	1050
28-Mar	179	4420	4420	1050	1050
29-Mar	180	4670	4670	1020	1020
30-Mar	181	4590	4590	1030	1030
31-Mar	182	4600	4600	1050	1050

Table 2 (cont)
Savage Rapids Dam Removal and Sedimentation Study Hydrographs

Date	Day	High Winter High Summer	High Winter Low Summer	Low Winter igh Summer	Low Winter Low Summer
1-Apr	183	3970	3970	1070	1070
2-Apr	184	3530	3530	1070	1070
3-Apr	185	3330	3330	997	997
4-Apr	186	3040	3040	979	979
5-Apr	187	2830	2830	941	941
6-Apr	188	2750	2750	953	953
7-Apr	189	2760	2760	994	994
8-Apr	190	2790	2790	1040	1040
9-Apr	191	2940	2940	975	975
10-Apr	192	2870	2870	1040	1040
11-Apr	193	2760	2760	1160	1160
12-Apr	194	2580	2580	998	998
13-Apr	195	2520	2520	1590	1590
14-Apr	196	2560	2560	1260	1260
15-Apr	197	2500	2500	1420	1420
16-Apr	198	2430	2430	1380	1380
17-Apr	199	2460	2460	1400	1400
18-Apr	200	2810	2810	1840	1840
19-Apr	201	3430	3430	2140	2140
20-Apr	202	4570	4570	2010	2010
21-Apr	203	8390	8390	1830	1830
22-Apr	204	9200	9200	1700	1700
23-Apr	205	10500	10500	1580	1580
24-Apr	206	9390	9390	1490	1490
25-Apr	207	7060	7060	1440	1440
26-Apr	208	6070	6070	1420	1420
27-Apr	209	5700	5700	1310	1310
28-Apr	210	5560	5560	1310	1310
29-Apr	211	5860	5860	1310	1310
30-Apr	212	6310	6310	1110	1110
1-May	213	8050	8050	1180	1180
2-May	214	6870	6870	1560	1560
3-May	215	5540	5540	1610	1610
4-May	216	6470	6470	1740	1740
5-May	217	6210	6210	1760	1760
6-May	218	5940	5940	1700	1700
7-May	219	5170	5170	1540	1540
8-May	220	4620	4620	1570	1570
9-May	221	4210	4210	1550	1550
10-May	222	4130	4130	1550	1550
11-May	223	4120	4120	1580	1580
12-May	224	4440	4440	1560	1560
13-May	225	4690	4690	1520	1520
14-May	226	4610	4610	1490	1490
15-May	227	4490	4490	1450	1450
16-May	228	4040	4040	1410	1410
17-May	229	4080	4080	1740	1740
18-May	230	3840	3840	2010	2010
19-May	231	3700	3700	2070	2070
20-May	232	3620	3620	2180	2180
21-May	233	3430	3430	2540	2540
22-May	234	3020	3020	2190	2190
23-May	235	2940	2940	2110	2110
24-May	236	3750	3750	2250	2250
25-May	237	3610	3610	2320	2320
26-May	238	3400	3400	2240	2240
27-May	239	3370	3370	2180	2180
28-May	240	3640	3640	2110	2110
29-May	241	3720	3720	2080	2080
30-May	242	3530	3530	2040	2040
31-May	243	3440	3440	1990	1990

Table 2 (cont)
Savage Rapids Dam Removal and Sedimentation Study Hydrographs

Date	Day	High Winter High Summer	High Winter Low Summer	Low Winter igh Summer	Low Winter Low Summer
1-Jun	244	3335	1940	3335	1940
2-Jun	245	4680	2110	4680	2110
3-Jun	246	4220	2000	4220	2000
4-Jun	247	4070	2000	4070	2000
5-Jun	248	4360	2040	4360	2040
6-Jun	249	6560	1920	6560	1920
7-Jun	250	6510	1830	6510	1830
8-Jun	251	7530	1810	7530	1810
9-Jun	252	8600	1730	8600	1730
10-Jun	253	6480	1750	6480	1750
11-Jun	254	5740	1750	5740	1750
12-Jun	255	5160	1630	5160	1630
13-Jun	256	4730	1520	4730	1520
14-Jun	257	4520	1620	4520	1620
15-Jun	258	4400	1670	4400	1670
16-Jun	259	4230	1650	4230	1650
17-Jun	260	4200	1580	4200	1580
18-Jun	261	4170	1520	4170	1520
19-Jun	262	4120	1400	4120	1400
20-Jun	263	4070	1230	4070	1230
21-Jun	264	3980	1240	3980	1240
22-Jun	265	3890	1220	3890	1220
23-Jun	266	3810	1190	3810	1190
24-Jun	267	3470	1140	3470	1140
25-Jun	268	3070	1130	3070	1130
26-Jun	269	3030	1160	3030	1160
27-Jun	270	2930	1210	2930	1210
28-Jun	271	2930	1210	2930	1210
29-Jun	272	3360	1220	3360	1220
30-Jun	273	3360	1510	3360	1510
1-Jul	274	3390	1480	3390	1480
2-Jul	275	3290	1590	3290	1590
3-Jul	276	3060	1210	3060	1210
4-Jul	277	3140	1140	3140	1140
5-Jul	278	3110	1150	3110	1150
6-Jul	279	3110	1190	3110	1190
7-Jul	280	3080	1270	3080	1270
8-Jul	281	3090	1160	3090	1160
9-Jul	282	3080	1080	3080	1080
10-Jul	283	3100	990	3100	990
11-Jul	284	3060	1000	3060	1000
12-Jul	285	3020	998	3020	998
13-Jul	286	3020	995	3020	995
14-Jul	287	3030	992	3030	992
15-Jul	288	3050	991	3050	991
16-Jul	289	3040	986	3040	986
17-Jul	290	3030	980	3030	980
18-Jul	291	3010	976	3010	976
19-Jul	292	2990	995	2990	995
20-Jul	293	3010	990	3010	990
21-Jul	294	3130	976	3130	976
22-Jul	295	3170	1040	3170	1040
23-Jul	296	3230	1020	3230	1020
24-Jul	297	3210	1040	3210	1040
25-Jul	298	3220	1020	3220	1020
26-Jul	299	3220	1010	3220	1010
27-Jul	300	3220	1010	3220	1010
28-Jul	301	3210	1000	3210	1000
29-Jul	302	3230	1000	3230	1000
30-Jul	303	3270	1010	3270	1010
31-Jul	304	3270	1000	3270	1000

Table 2 (cont)
Savage Rapids Dam Removal and Sedimentation Study Hydrographs

Date	Day	High Winter High Summer	High Winter Low Summer	Low Winter igh Summer	Low Winter Low Summer
1-Aug	305	3250	1010	3250	1010
2-Aug	306	3330	1000	3330	1000
3-Aug	307	3340	1010	3340	1010
4-Aug	308	3320	1010	3320	1010
5-Aug	309	3310	1010	3310	1010
6-Aug	310	3330	1000	3330	1000
7-Aug	311	3300	1010	3300	1010
8-Aug	312	3280	1020	3280	1020
9-Aug	313	3220	1050	3220	1050
10-Aug	314	3210	1030	3210	1030
11-Aug	315	3190	1020	3190	1020
12-Aug	316	3210	1090	3210	1090
13-Aug	317	3230	1360	3230	1360
14-Aug	318	3280	1500	3280	1500
15-Aug	319	3260	2240	3260	2240
16-Aug	320	3220	2270	3220	2270
17-Aug	321	3010	2280	3010	2280
18-Aug	322	3030	2200	3030	2200
19-Aug	323	2980	2160	2980	2160
20-Aug	324	3020	2210	3020	2210
21-Aug	325	3040	2210	3040	2210
22-Aug	326	2820	2240	2820	2240
23-Aug	327	2800	2270	2800	2270
24-Aug	328	2820	2270	2820	2270
25-Aug	329	2820	2270	2820	2270
26-Aug	330	2810	2260	2810	2260
27-Aug	331	2830	2260	2830	2260
28-Aug	332	2800	2270	2800	2270
29-Aug	333	2770	2230	2770	2230
30-Aug	334	2800	2250	2800	2250
31-Aug	335	2860	2180	2860	2180
1-Sep	336	3240	2140	3240	2140
2-Sep	337	3180	2120	3180	2120
3-Sep	338	3100	1930	3100	1930
4-Sep	339	3050	1940	3050	1940
5-Sep	340	3000	1970	3000	1970
6-Sep	341	2980	1950	2980	1950
7-Sep	342	2950	1930	2950	1930
8-Sep	343	2850	1940	2850	1940
9-Sep	344	2840	1920	2840	1920
10-Sep	345	2820	1920	2820	1920
11-Sep	346	2790	1870	2790	1870
12-Sep	347	2610	1770	2610	1770
13-Sep	348	2630	1580	2630	1580
14-Sep	349	2630	1380	2630	1380
15-Sep	350	2400	1430	2400	1430
16-Sep	351	2420	1450	2420	1450
17-Sep	352	2260	1430	2260	1430
18-Sep	353	2190	1430	2190	1430
19-Sep	354	2030	1430	2030	1430
20-Sep	355	2000	1400	2000	1400
21-Sep	356	2090	1410	2090	1410
22-Sep	357	2180	1400	2180	1400
23-Sep	358	1920	1290	1920	1290
24-Sep	359	1850	1060	1850	1060
25-Sep	360	1830	1020	1830	1020
26-Sep	361	1620	1020	1620	1020
27-Sep	362	1570	1030	1570	1030
28-Sep	363	1580	1010	1580	1010
29-Sep	364	1570	1010	1570	1010
30-Sep	365	1590	998	1590	998

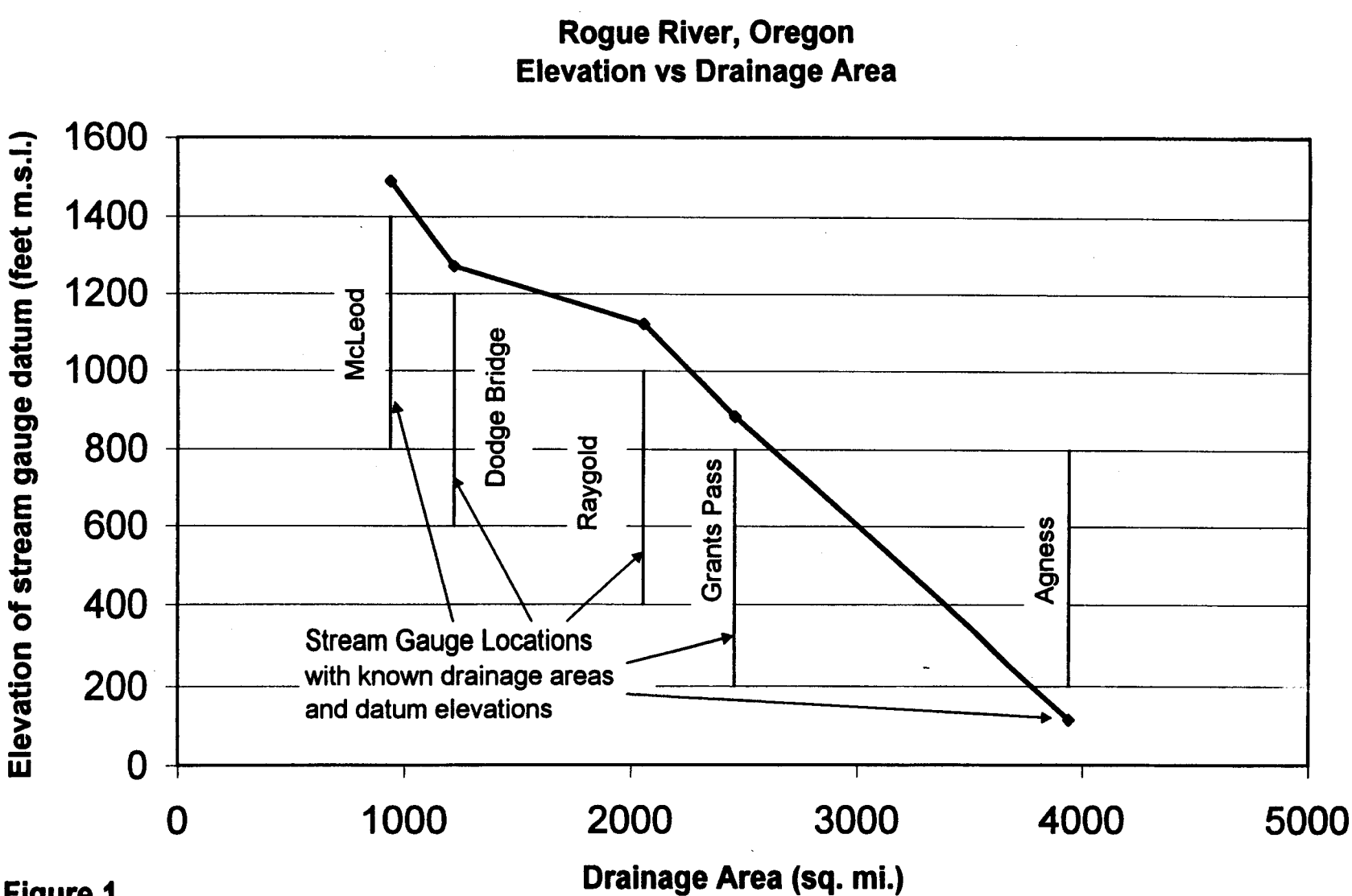
Rogue River, Oregon
Elevation vs Drainage Area
Elevation of stream gauge datum (feet m.s.l.)
1600
1400
1200
1000
800
600
400
200
0
0
1000
2000
3000
4000
5000
Drainage Area (sq. mi.)
McLeod
Dodge Bridge
Raygold
Grants Pass
Agness
Stream Gauge Locations
with known drainage areas
and datum elevations

Figure 1

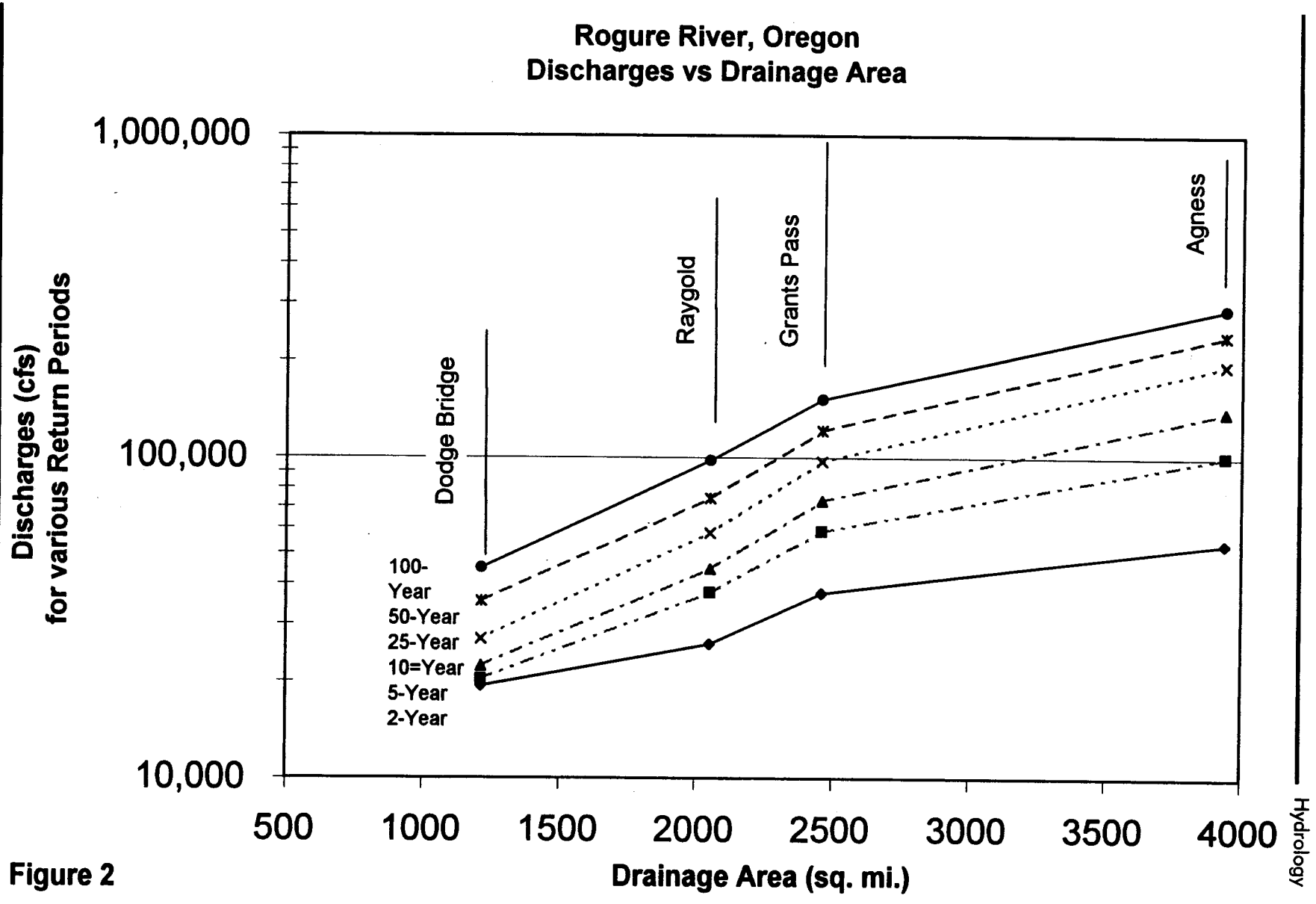
Rogure River, Oregon
Discharges vs Drainage Area
Discharges (cfs)
for various Return Periods
1,000,000
100,000
10,000
500
1000
1500
2000
2500
3000
3500
4000
Drainage Area (sq. mi.)
Dodge Bridge
Raygold
Grants Pass
Agness
100-Year
50-Year
25-Year
10=Year
5-Year
2-Year

Figure 2

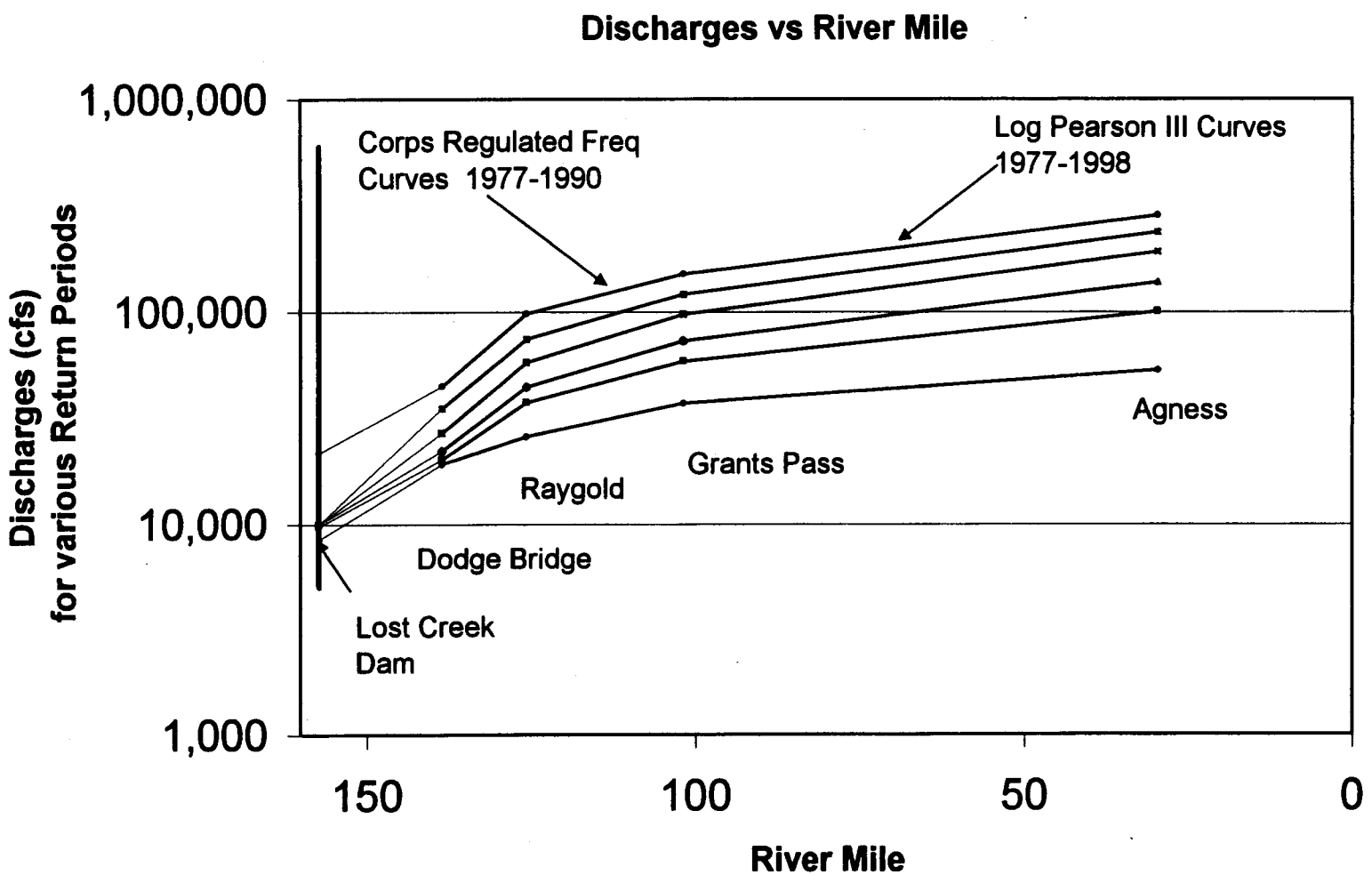
Discharges vs River Mile
Discharges (cfs)
for various Return Periods
1,000,000
100,000
10,000
1,000
150
100
50
0
River Mile
Corps Regulated Freq
Curves 1977-1990
Log Pearson III Curves
1977-1998
Agness
Grants Pass
Raygold
Dodge Bridge
Lost Creek
Dam

Figure 3

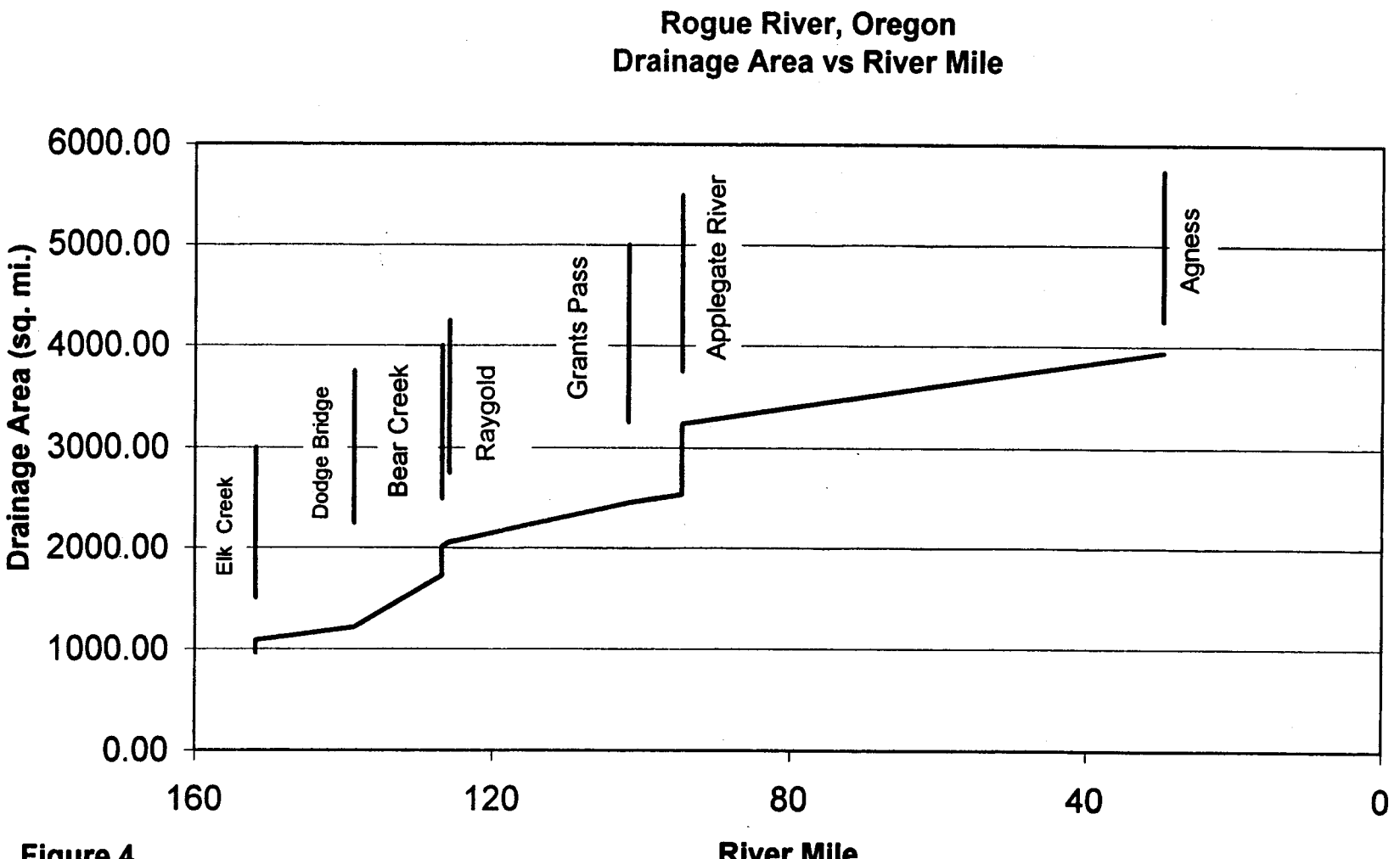
Rogue River, Oregon
Drainage Area vs River Mile
Drainage Area (sq. mi.)
6000.00
5000.00
4000.00
3000.00
2000.00
1000.00
0.00
160
120
80
40
0
River Mile
Elk Creek
Dodge Bridge
Bear Creek
Raygold
Grants Pass
Applegate River
Agness

Figure 4

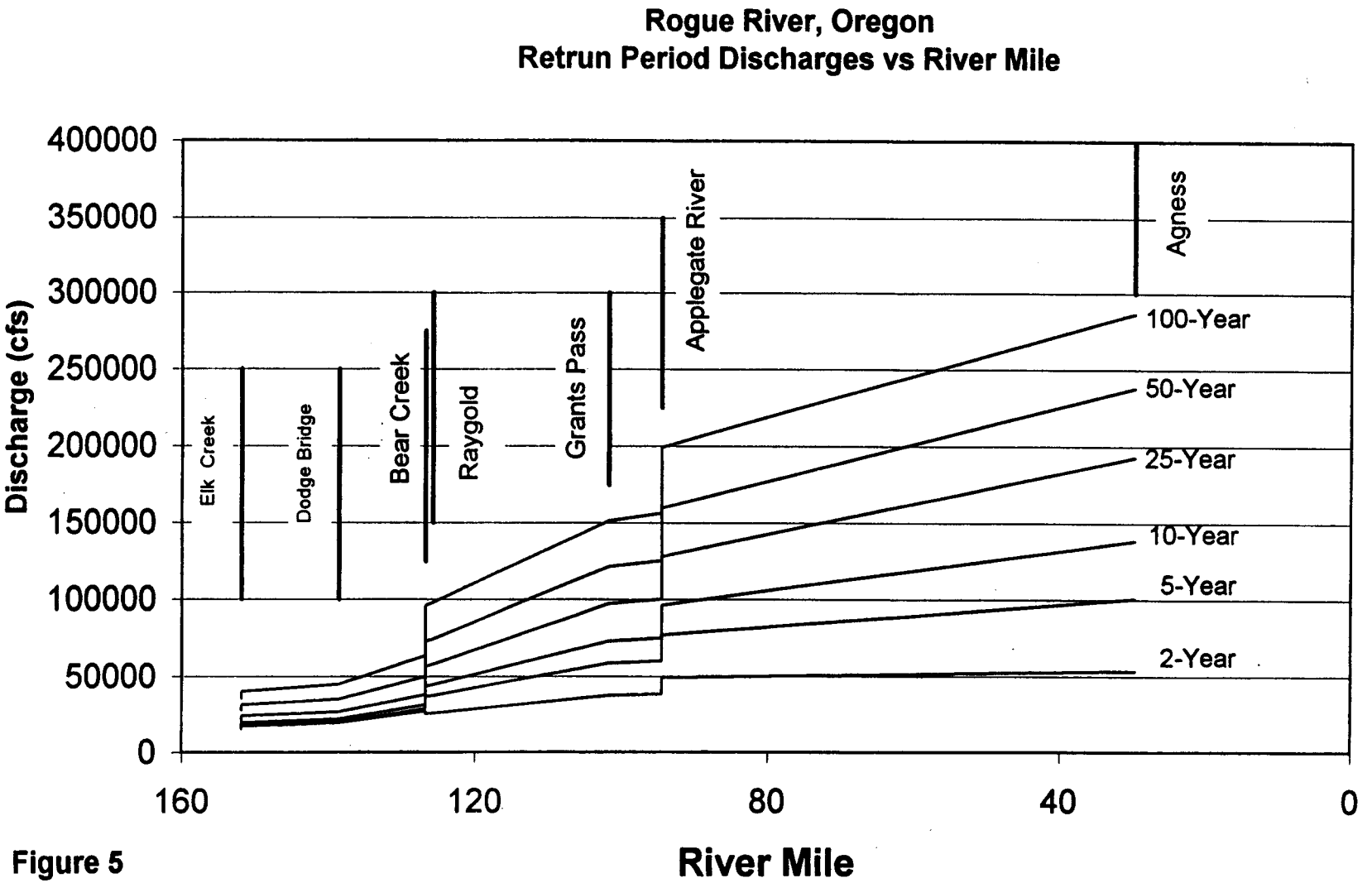
Rogue River, Oregon
Retrun Period Discharges vs River Mile
Discharge (cfs)
400000
350000
300000
250000
200000
150000
100000
50000
0
160
120
80
40
0
River Mile
Elk Creek
Dodge Bridge
Bear Creek
Raygold
Grants Pass
Applegate River
Agness
100-Year
50-Year
25-Year
10-Year
5-Year
2-Year

Figure 5

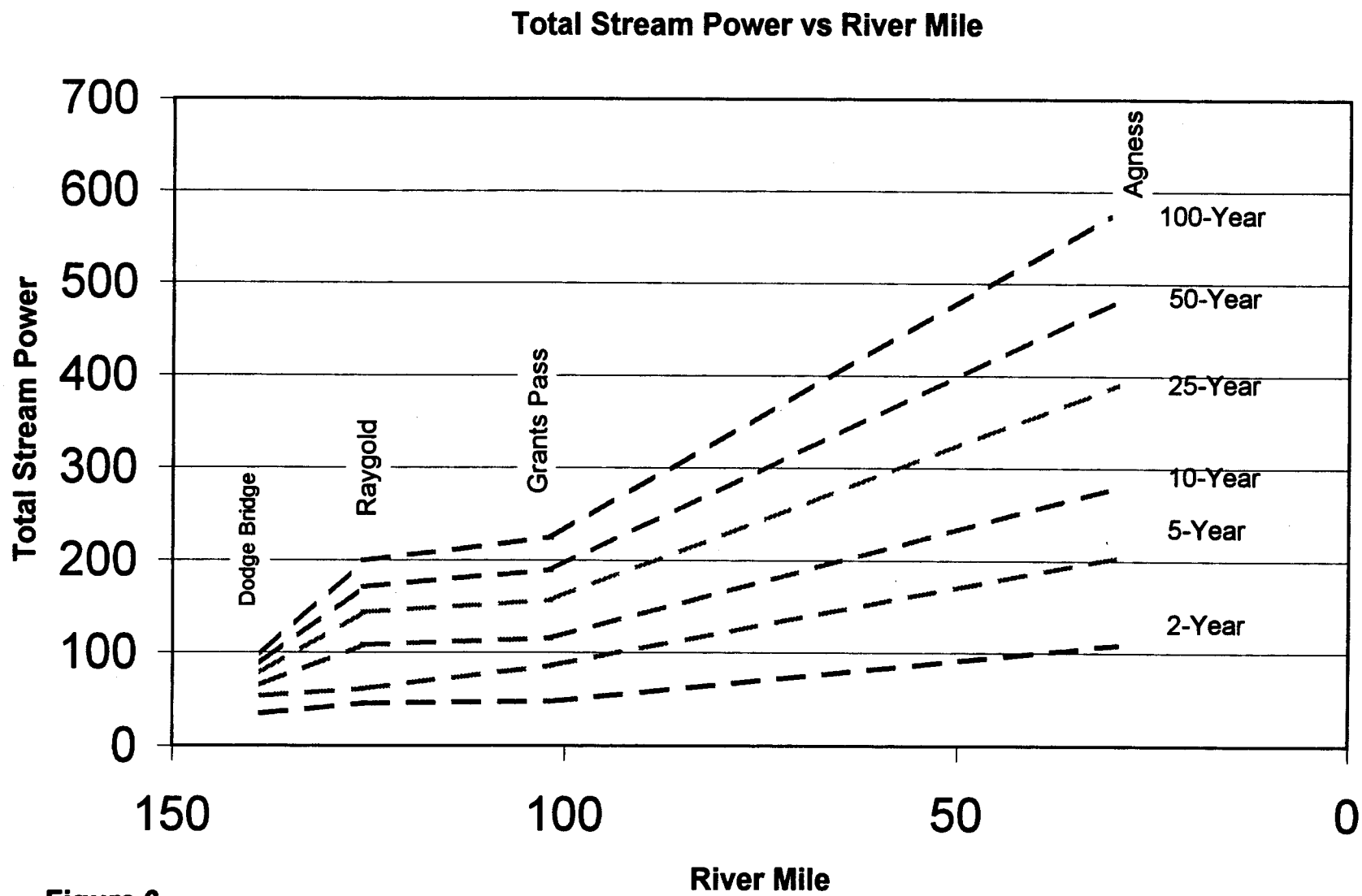
Total Stream Power vs River Mile
Total Stream Power
700
600
500
400
300
200
100
0
150
100
50
0
River Mile
Dodge Bridge
Raygold
Grants Pass
Agness
100-Year
50-Year
25-Year
10-Year
5-Year
2-Year

Figure 6

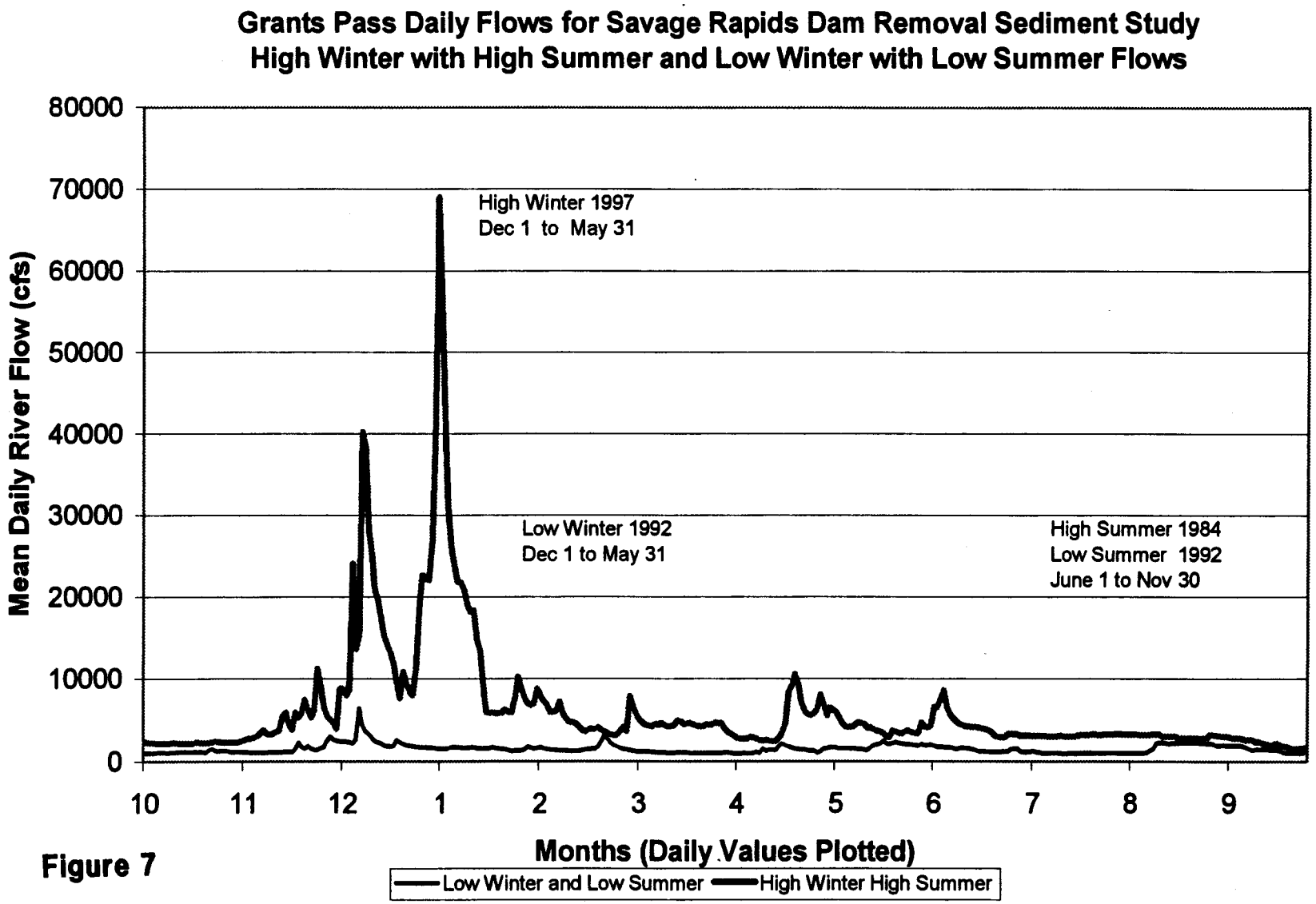
Grants Pass Daily Flows for Savage Rapids Dam Removal Sediment Study
High Winter with High Summer and Low Winter with Low Summer Flows
Mean Daily River Flow (cfs)
80000
70000
60000
50000
40000
30000
20000
10000
0
High Winter 1997
Dec 1 to May 31
Low Winter 1992
Dec 1 to May 31
High Summer 1984
Low Summer 1992
June 1 to Nov 30
10
11
12
1
2
3
4
5
6
7
8
9
Months (Daily Values Plotted)
Low Winter and Low Summer
High Winter High Summer

Figure 7

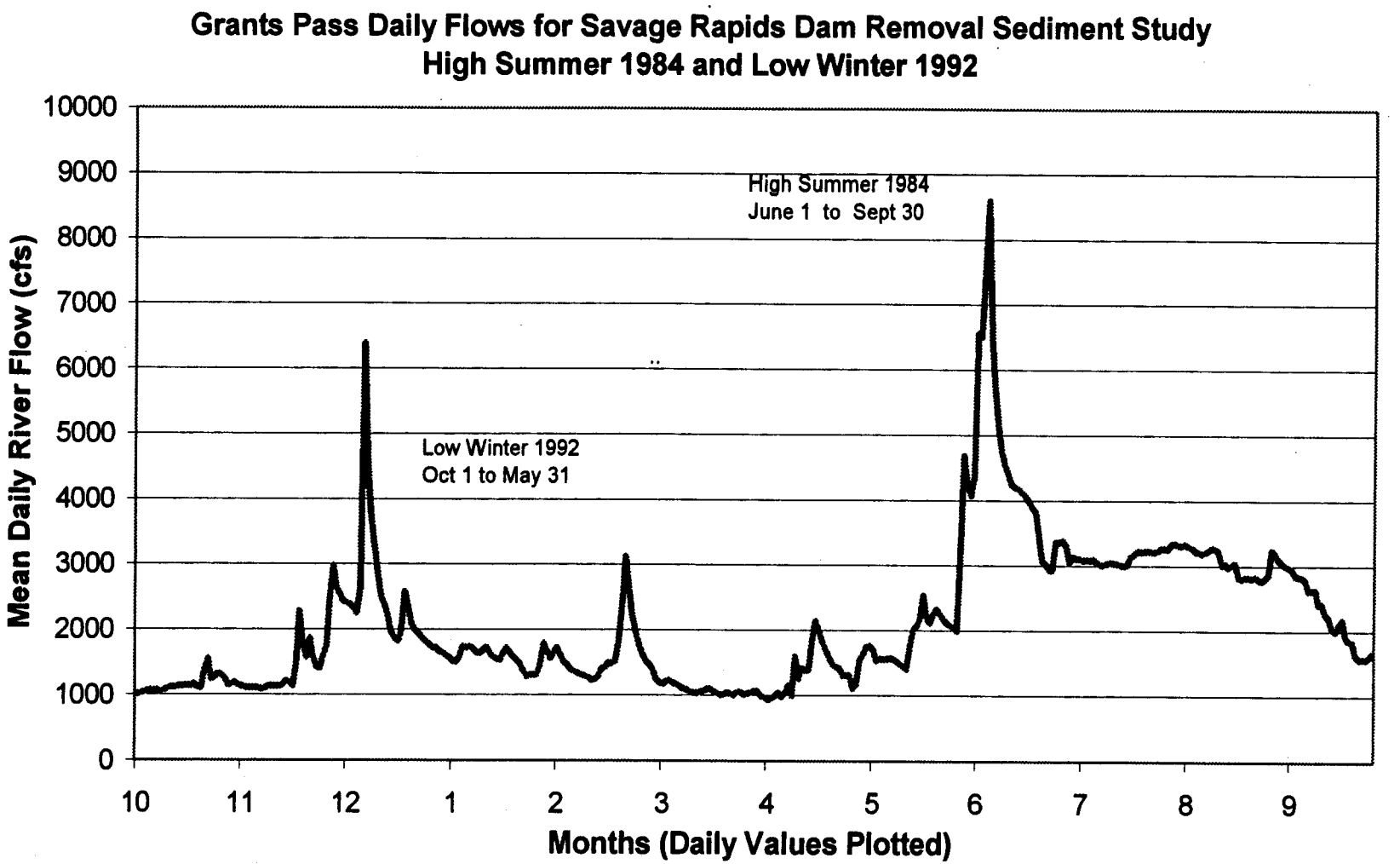
Grants Pass Daily Flows for Savage Rapids Dam Removal Sediment Study
High Summer 1984 and Low Winter 1992
Mean Daily River Flow (cfs)
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
High Summer 1984
June 1 to Sept 30
Low Winter 1992
Oct 1 to May 31
10
11
12
1
2
3
4
5
6
7
8
9
Months (Daily Values Plotted)

Figure 8

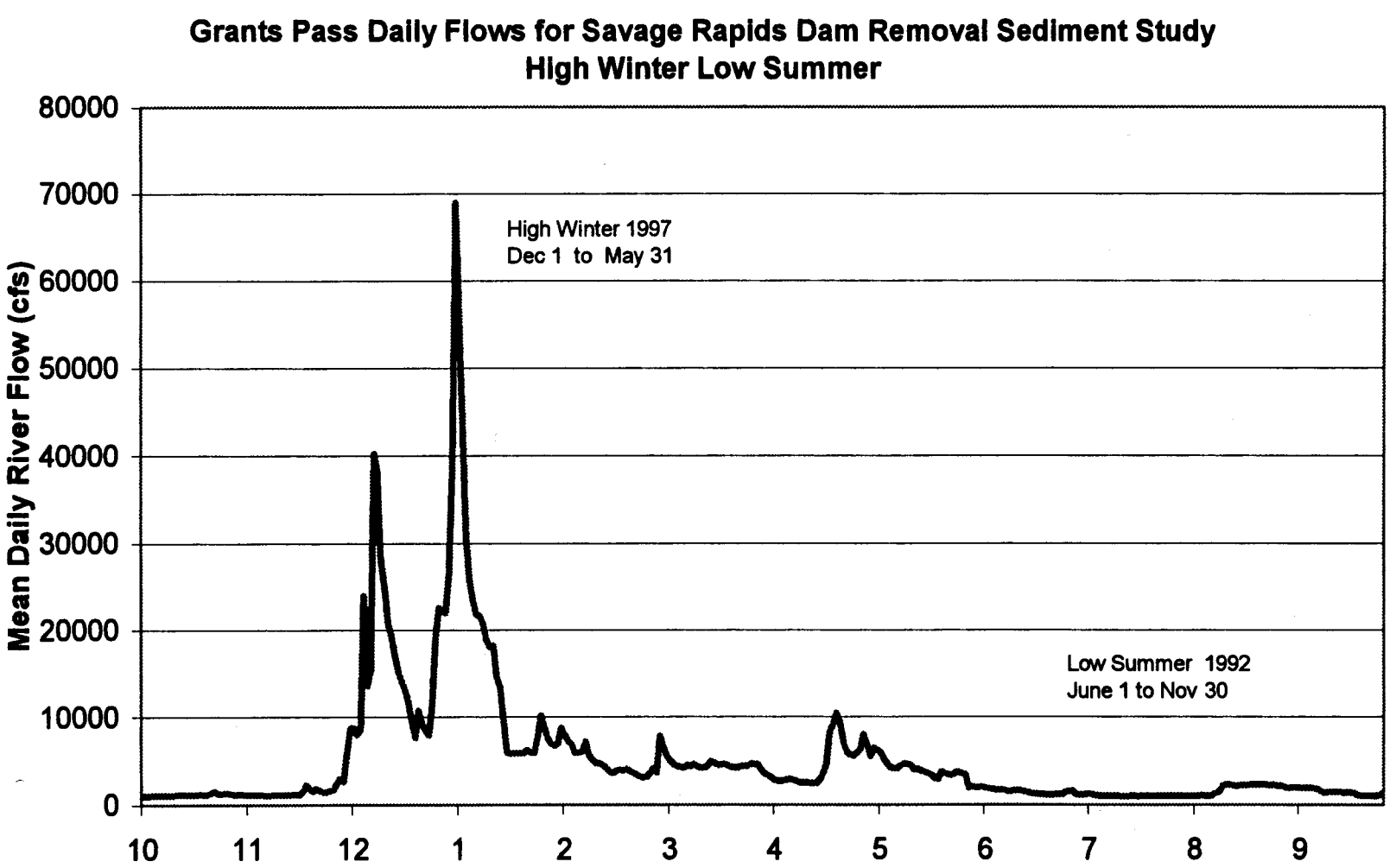
Grants Pass Daily Flows for Savage Rapids Dam Removal Sediment Study
High Winter Low Summer
Mean Daily River Flow (cfs)
80000
70000
60000
50000
40000
30000
20000
10000
0
High Winter 1997
Dec 1 to May 31
Low Summer 1992
June 1 to Nov 30
10
11
12
1
2
3
4
5
6
7
8
9
Months (Daily Values Plotted)

Figure 9