TECHNICAL MEMORANDUM TM001

MCMILLEN, LLC

To:	Morton D. McMillen, P.E.	Project:	Grant Lake Hydroelectric Project
From:	Andre Ball	Cc:	Cory Warnock File
Date:	May 30, 2014	Job No:	13-102
Subject:	Grant Creek Hydrologic Analysis		

1.0 INTRODUCTION

McMillen, LLC (McMillen) has been retained by Homer Electric Association, Inc. (HEA) to provide engineering support for the proposed Grant Lake Hydroelectric Project (Project) FERC application. The project would be located near the community of Moose Pass, Alaska, approximately 25 miles north of Seward, Alaska.

1.1 Purpose and Scope

The purpose of this Technical Memorandum (TM) is to present the analyses and results of a hydrologic analysis of the Grant Lake and Grant Creek basin. The analyses presented within this TM utilized the available gage data, information from previous studies, as well as standard hydrologic estimation techniques. The primary objectives of this TM are:

- Complete an independent review and analysis of previous hydrologic analyses completed for the Grant Lake Basin;
- Assemble the available gage data for Grant Creek to support the analyses;
- Determine the peak streamflow magnitude and frequency discharges for Grant Creek that can be used in the design of the Project;
- Complete a record extension for the Grant Creek streamflow gage record based on the USGS Kenai River at Cooper Landing streamflow gage;
- Complete flow duration and mean daily flow analyses to be used in determining the estimated Project energy production.

1.2 Project Description

As outlined in the application for a preliminary permit (HEA, 2011) the proposed Project consists of constructing a new 5-Megawatt (approximate) hydroelectric facility on Grant Lake and Grant Creek near Moose Pass, Alaska. The new Project would divert water from Grant Lake and deliver the flow to a powerhouse located near the outlet of the existing Grant Creek natural, incised rock canyon. The Project would include the following major components:

- Diversion structure at the natural outlet of Grant Lake. (under consideration)
- An intake structure in Grant Lake.
- A tunnel extending from the lake intake to just east of the powerhouse.
- A powerhouse with two Francis turbines providing an anticipated combined 5-Megawatt output. The maximum design flow will be approximately 385 cfs.
- Tailrace detention pond.
- Switchyard with disconnect switch and step-up transformer.
- An overhead or underground transmission line.
- A pole mounted disconnect switch where the transmission line intersects the main power distribution line.

1.3 Project Background

Grant Lake has been studied on multiple occasions since the 1950's as a potential hydropower site. The previous work efforts included:

- 1954 – R.W. Beck and Associates preliminary investigation
- 1955 – U.S. Geological Survey (USGS) geological investigations of proposed power sites at Cooper, Grant, Ptarmagin, and Crescent Lake
- 1980 – CH2M Hill prefeasibility study
- 1981 – U.S. Army Corps of Engineers (USACE) National Hydroelectric Power Resources Study
- 1984 – Ebasco Services Project Feasibility Analysis (Ebasco, 1984)
- 2010 – HDR Grant Lake/Falls Creek Hydroelectric Project – Environmental Baseline Studies (HDR, 2010)

On August 6, 2009, Kenai Hydro LLC filed a Pre-Application Document (PAD), along with a Notice of Intent to file an application for an original license for the Grant Lake/Falls Creek project. FERC subsequently approved the use of the Traditional License Process for development of the license application and supporting documents. In 2009-2010, HDR completed a series of environmental baseline studies which were summarized in their report dated January 2010. A second preliminary permit was issued by FERC in 2012.

As part of these previous studies, the hydrologic conditions within the Grant Creek basin were evaluated and flows available to support a hydroelectric facility were evaluated. The most expansive analysis was completed as part of the Ebasco feasibility study. These previous studies and available gage data were used as the basis for the current hydrologic analysis. The subsequent gage data collected in 2009 (HDR, 2010) and 2013 by McMillen, along with the original USGS stream gage data (USGS Station 15246000) served as the basis for the flow estimation.

1.4 Grant Creek Basin Description

Grant Lake and Grant Creek are located near Moose Pass, Alaska on the Kenai Peninsula (Figure 1). Grant Lake is an 'L'-shaped, natural impoundment with a drainage area of 44.2 square miles (Basin area shaded in Figure 1). The natural lake elevation is elevation 703 feet (NAVD88). The lake has a surface area of 1,790 acres (2.8 square miles) and an active storage volume of 15,900 acre-feet between the lake elevations 703 feet and 692 feet. The mountains surrounding the basin reach elevations of up to 5,900 feet, some of which have small glaciers on them. Inlet Creek is the primary tributary and flows into the east end of Grant Lake. Several other small streams flow into the lake from the steep valleys formed between the surrounding mountains.

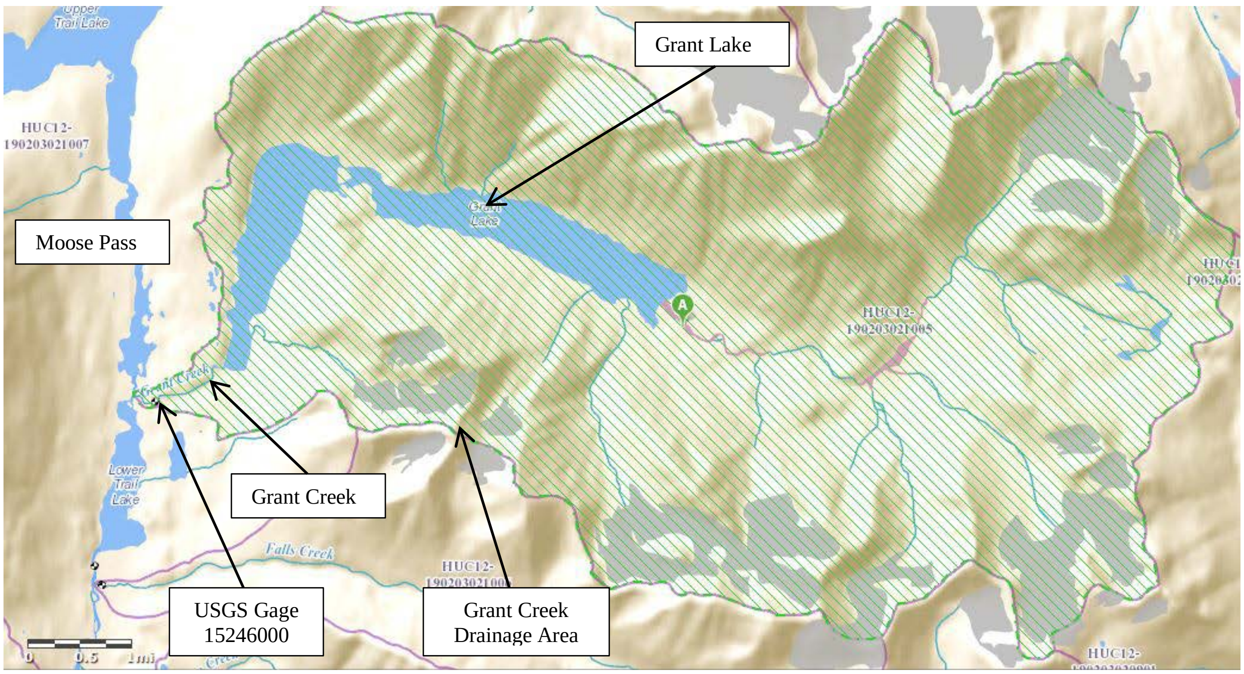

Figure 1. Grant Lake Hydroelectric Project Location Map

Grant Creek is the only natural outlet from Grant Lake and is located at the south end of the lake. Grant Creek is approximately 1 mile long and flows west from Grant Lake and discharges into the Trail Lake Narrows that connects the Upper Trail Lake to Lower Trail Lake. The total drop in elevation from Grant Lake to the Trail Lake Narrows is approximately 230 feet. The U.S. Geological Survey (USGS) had previously operated a stream flow gage (Station 15246000) on Grant Creek, but this gage is no longer operated. Additional basin statistics for Grant Creek are provided in Table 1.

Table 1. Grant Creek Basin Characteristics[1]

USGS Station No.	Station Name	Drainage Area (mi^2)	Mean Basin Elevation (ft)	Areas of Lakes and Ponds (storage) (percent)	Area of Forest (percent)	Mean Annual Precipitation (inches)	Mean Min. January Temperature (°F)
15246000	Grant Creek near Moose Pass, AK	44.2	2,900	10	20	90	10

[1] Curran, Meyer, and Tasker, 2003

2.0 HYDROLOGIC DATA SUMMARY

The USGS operated streamflow gage 1524600 on Grant Creek between 1947 and 1958. Daily and annual peak flows were recorded for this period. This 11-year record is the most complete hydrologic data that exists for Grant Creek. The most recent statewide analysis of Alaska peak streamflow frequency was completed in 2003 (Curran, Meyer, and Tasker, 2003). The basin characteristics for Grant Creek in Table 1 are cited from this source.

2.1 Previous Hydrologic Studies

As discussed previously, Grant Lake has been studied several times since the 1950’s as a potential hydroelectric project location. The most recent studies, which included hydrologic data, are briefly described below. In 1981, the Alaska Power Authority (APA) authorized Ebasco Services Inc. (Ebasco) to conduct a detailed feasibility analysis for Grant Lake and some additional nearby basins. Intermittent streamflow data for Grant Creek was collected between 1981 and 1983; and was conducted by R&M Consultants (Ebasco, 1984). A HEC-4 Monthly Streamflow Model was developed to extend the Grant Creek streamflow record and was used to estimate power generation potential. The Ebasco study included a peak streamflow statistical analysis and a Probable Maximum Flood (PMF) estimate (Table 2). In 2009, as part of the Grant Creek Baseline Environmental Studies, HDR collected streamflow data between June and October 2009 (HDR, 2010).

Table 2. Approximate Grant Creek Peak Streamflow Statistics from Ebasco Study1

Peak streamflow, in cubic feet per second (cfs), for a given recurrence interval in years							
Q_2	Q_5	Q_{10}	Q_{25}	Q_{50}	Q_{100}		PMF
1,000	1,300	1,500	2,000	2,200	2,600	--	27,700

[1] Ebasco, 1984

2.2 Current Hydrologic Study

In 2013, under contract with HEA, McMillen reestablished streamflow measurements at the former USGS gage location as part of an instream flow study. The streamflow measurement location is referred to as GC200, consistent with the 2009 HDR report. McMillen established continuous stage monitoring for Grant Creek at the beginning of April 2013 and stage monitoring is presently ongoing. The most recent streamflow data which has been retrieved and gone through the QA/QC process is through December 2013. During spring and summer 2013, five discharge measurements were taken for flows ranging between 17 and 706 cfs. These measurements were used to develop a stage-discharge rating for the GC200 location.

3.0 HYDROLOGIC ANALYSIS

The ongoing hydrologic analysis of Grant Creek will be used as a foundation for determining the anticipated power output from the powerhouse, determining the appropriate tailrace channel elevation, and developing a tailwater rating curve for Grant Creek at the tailrace channel exit. Flood protection requirements at the powerhouse site will be developed utilizing the peak streamflow information. Detailed discussion of the analysis is presented in the following paragraphs.

3.1 Peak Streamflow Magnitude and Frequency

3.1.1 Estimating Peak Streamflow Statistics Using Station Data

As stated previously, the 11-year USGS gage record for station 15246000 is the most complete gage record for Grant Creek. This station data is the most suitable for a peak streamflow magnitude and frequency analysis. The standard procedure for evaluating peak streamflow is to utilize the log-Pearson Type III frequency distribution. This procedure is described in Bulletin 17B issued by the Interagency Advisory Committee on Water Data (IACWD, 1982). The recommended minimum gage record length for such an analysis is 10 years. Additional miscellaneous streamflow data was collected in the 1980's, 2009, and 2013 by various consulting firms. The 2013 and 1980's data was excluded from the peak flow analysis since only the partial year data were available at the time of this analysis. The 2009 data was excluded since the stage-discharge information could not be verified. The peak streamflow estimates for Grant Creek using station data are provided in Table 3.

3.1.2 Estimating Peak Streamflow Statistics Using Regional Regression Equations

Regional regression equations are often developed to estimate flow statistics for streams with no gage record. Regional regression equations use basin characteristics (see Table 1 for basin data) to estimate peak flow statistics. The most recent regional regression equations for basins in Alaska were developed by the USGS in 2003 (Curran, Meyer, and Tasker, 2003). In the 2003 USGS study, Alaska was divided into 7 regions. Grant Creek is located in Region 4, which includes the northern part of the Kenai and Alaska Peninsulas. Geographically, Grant Creek is near the border of Region 3, which includes land along the Pacific Coast north of Juneau, along the south side of the Kenai Peninsula, and the south side of the Aleutian Range. The peak streamflow estimates for Grant Creek using the regional regression equation are provided in Table 3.

3.1.3 Grant Creek Peak Streamflow Magnitude and Frequency

Station and regression peak flow estimates may be combined to form a weighted value. This type of estimate is especially useful for stations with a short record length, such as Grant Creek (Curran, Meyer, and Tasker, 2003). Since Grant Creek had a suitable station record, it was included in a table of station information and peak flow estimates in the 2003 USGS report. The station, regression, and weighted peak flow estimates for Grant Creek from the 2003 report are provided in Table 3. Flow magnitudes are provided for the 2-year through the 500-year recurrence interval.

Table 3. Grant Creek Peak Streamflow Statistics at the USGS 15246000 Gage Location

Analysis Type	Peak streamflow, in cubic feet per second (cfs), for a given recurrence interval in years							
	Q_2	Q_5	Q_{10}	Q_{25}	Q_{50}	Q_{100}	Q_{200}	Q_{500}
Station	936	1,330	1,660	2,170	2,620	3,140	3,760	4,730
Regression	1,260	1,810	2,220	2,760	3,170	3,590	4,020	4,620
Weighted	961	1,410	1,790	2,350	2,810	3,310	3,860	4,690

A weighted average adds in temporal variability from the longer gage records used to form the regional regression. Most of the weighting goes to the local gage due to the uncertainty introduced by the regional regression equations based on basin characteristics. The weighted peak streamflow estimates for Grant Creek are considered to be the most appropriate and suitable for use in the evaluation and design of the Grant Lake Hydroelectric Project moving forward.

3.2 Grant Creek Daily Streamflow Record Extension

In order to give a better long-term representation of the Grant Creek streamflows, a record extension was conducted. A correlation between the Grant Creek USGS gage (station 15246000) and the Kenai River at Cooper Landing USGS gage (station 15258000) provided a means to extend the streamflow record at the Grant Creek gage location.

3.2.1 Record Extension Procedure

The procedure applied to Grant Creek was the "maintenance of variance extension" (MOVE), specifically the MOVE1 procedure (Hirsch, 1982; Robison, 1991). The MOVE1 procedure involves correlating short-term or incomplete gage data with one or more nearby gages that have more complete records (long-term gage). These long-term values and the relationship between the two gages are used to generate data to extend or fill in data at the short-term gage. Several studies have compared the different procedures with varying results. Alley and Burns (1983) illustrated several deficiencies of using simple linear regression including the loss of variance. Hirsch (1982) and Robison (1991) both showed that MOVE1 was superior to regression or regression plus noise when extending daily values.

The MOVE1 record extension, as mentioned earlier, involves using a correlation relationship between a “short-term” (incomplete or limited gage record) to a “long-term” (reference or source gage). As record extension is done, the long-term and short-term gage data should come from situations as similar as possible. Characteristics such as basin size, elevation, location, and other basin characteristics should be as similar as possible. Ideally, both gages should be unregulated or adjusted to unregulated conditions. In this study, extension occurs between mostly unregulated gages. When extension occurs there is a concurrent record where the short-term gage record and long-term record overlap. This concurrent record is used to create the relationship to fill in missing data on the short-term gage to the period of record of the long-term gage. The length of suitable concurrent record may be as small as 15–30 data points when the points are independent and represent variable conditions. Generally, the longer the concurrent record, the more confidence there is in the relationship.

By choosing gages with similar basin characteristics, there is a greater chance for a strong linear predictive relationship between the short- and long-term gages. MOVE1 assumes a linear relationship between the short- and long-term gages after they have been transformed into logarithms (LOGS) of the flow values.

Synthetic discharge values for missing values from the short-term site are calculated by entering known LOGs of the discharge at the long-term site into the equation (below) and then taking the inverse (exponential) of the LOGS to get the short-term gage flows back into original units. The equation for converting short-term gage flows in MOVE1 is show in Equation 1.

Equation 1 $Y_i = Y_{ave} + Y_{StndDev} / X_{StndDev} (X_i - X_{ave})$

Where:

Y_i	= Short-term gage extended flow, at the i^{th} step
Y_{ave}	= Average (mean) of concurrent short-term gage data
$Y_{StndDev}$	= Standard Deviation of concurrent short-term gage data
X_i	= Long-term flow data at concurrent short-term data point, i^{th} step
$X_{StndDev}$	= Standard Deviation of concurrent long-term gage data
X_{ave}	= Average of concurrent long-term gage data

3.2.2 Record Extension Application

The long-term gage selected for the Grant Creek record extension was the Kenai River at Cooper Landing USGS gage (station 15258000). The Kenai River gage is located approximately 16 miles due west of the Grant Creek location and has a drainage area of 634 square miles. Grant Creek is a tributary to the Kenai River. The period of record at the Kenai gage extends from 1947 to present and is concurrent with the entire 11-year period of record for the USGS Grant Creek gage (1947-1958).

Figure 2 provides a graph of the log transformations of the concurrent streamflow data for Grant Creek and Kenai River. The coefficient of determination (r^2) of 0.92 represents an excellent correlation between the two gages.

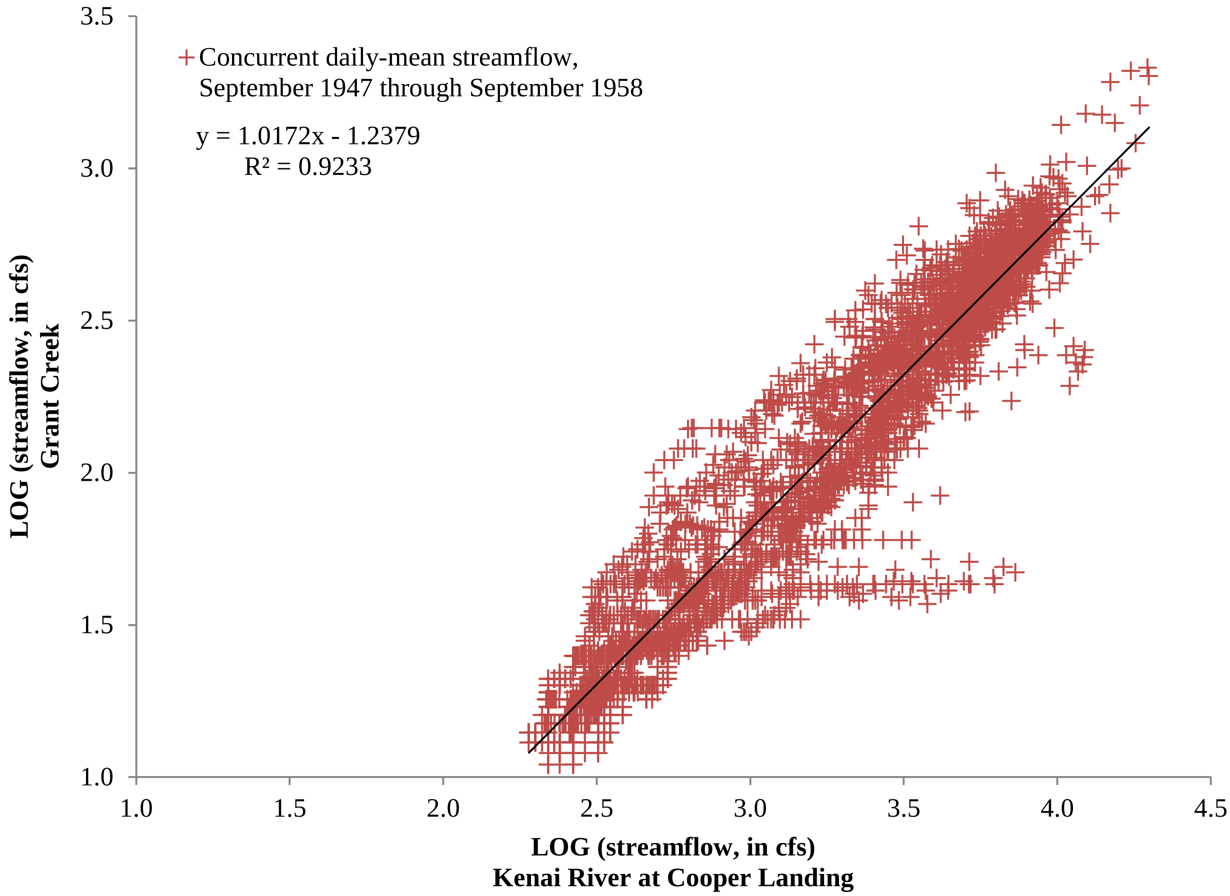

Figure 2. Correlation of daily mean streamflow between Grant Creek and Kenai River

The concurrent period of record for the Grant Creek and Kenai River gages was used to develop the MOVE1 equation. The MOVE1 equation was used to compute estimated Grant Creek streamflow records, based on the Kenai River record, for the period May 1947 through December 2013. The MOVE1 estimated streamflow record was combined with the observed Grant Creek streamflows (from USGS, EBASCO, and McMillen records) to create a composite record. The composite record (Composite) resulted in 66 complete years (Calendar Years 1948 through 2013) of streamflow for Grant Creek.

3.2.3 Cooper Lake Power Plant

The Kenai River flow at gage 15258000 is unregulated with the exception of the Cooper Lake hydroelectric power plant. Chugach Electric Associations commissioned the Cooper Lake power plant in 1960, which diverts flow from Cooper Lake into Kenai Lake, upstream of the 15258000 gage. Operations data from 1966-70 indicate that the average discharge from the Cooper Lake power plant was 89 cfs (USGS 1976). During the same period, the average flow at the Kenai gage was 2981 cfs, thus the additional inflow from Cooper Lake only represented about 3% of the total flow. Absent of detailed operations records for the Cooper Lake power plant, no adjustments to the Kenai gage record were made to account for this additional inflow. Thus, the extended record streamflows for Grant Creek, after 1960, may be approximately 3% high.

3.3 Streamflow Statistics

Streamflow statistics have been computed for Grant Creek to help characterize the daily streamflow. A flow duration analysis and mean daily flow analysis was performed for both the 11-year USGS gage record, and the 66-year composite streamflow record for Grant Creek.

3.3.1 Flow Duration Analysis

A flow duration analysis evaluates the percentage of time that a given magnitude of flow is exceeded. Flow duration curves were developed for the Grant Creek USGS record and Composite record. Table 4 and Figure 3 display the daily flow duration results for Grant Creek. With the exception of very high flows (<5% Days Exceeded), the USGS record was lower that the composite record. For the median flow and below, the flow values for the USGS record were between 29% and 41% lower than the longer Composite record. This indicates that the USGS record represents a drier period of record.

Table 4. Grant Creek Daily Flow Duration Analysis

Percent of Days Exceeded	Grant Creek Discharge (cfs) [USGS Record, WY 1948-1958]	Grant Creek Discharge (cfs) [Composite Record, CY 1948-2013]	11-year USGS Record relative to 66-year Composite Record
5%	580	575	1%
10%	496	499	-1%
20%	390	402	-3%
30%	279	302	-8%
40%	170	186	-9%
50%	91	110	-17%
60%	47	71	-34%
70%	33	49	-33%
80%	22	37	-41%
90%	18	27	-33%
95%	15	21	-29%

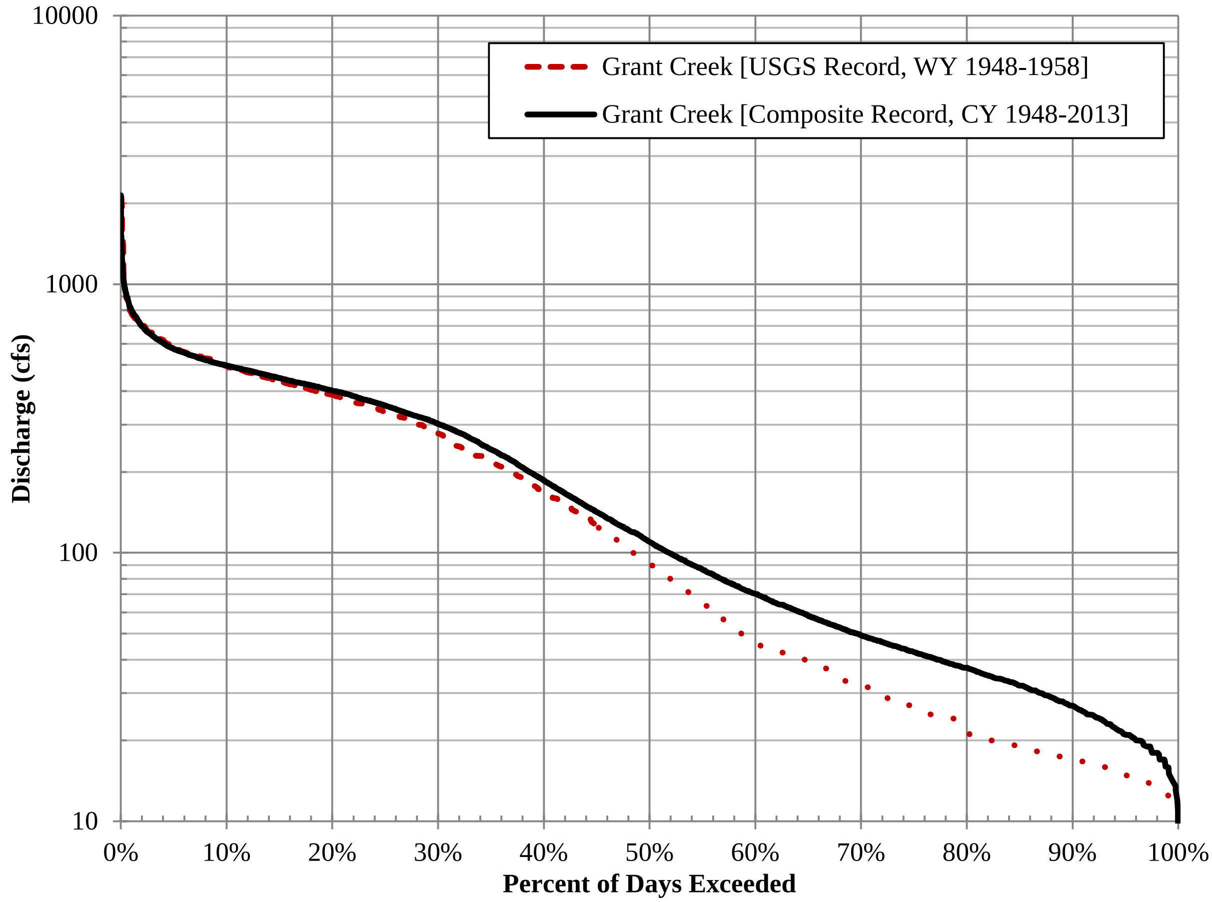

Figure 3. Grant Creek Daily Flow Duration Analysis

3.3.2 Mean Daily Flow Analysis

A mean daily flow analysis evaluates the mean flow on a given day over multiple years of recorded data. Averaging the daily flow values results in a composite, average annual hydrograph where specific events are smoothed out but seasonal trends can be identified. Figure 4 compares the mean daily flow for the Grant Creek USGS Record and the Grant Creek Composite record. The most recent annual hydrograph, from 2013, is also provided in Figure 4 for comparison. The figure presents the annual hydrograph with respect to the calendar year, as opposed to a water year, due to the shape of the annual hydrograph.

The shape of the Grant Creek average annual hydrographs (USGS - dashed red line and Composite - solid line) illustrate that annual runoff begins to increase in mid-April and peaks in late June. The runoff declines from July through mid-November as the snowpack is diminished. There is a slight bump between Mid-November and early December which is likely indicative of late Fall rain-runoff events before the basin precipitation transitions to snow. There is also a pronounced rise in the average annual hydrograph for the Composite record in the latter part of September. This spike is a relic of the Kenai River gage data that was used to extend the Grant Creek record. Almost a quarter of all Kenai River annual peak flows occurred in September and a third of the September annual peaks were the result of glacial-outburst floods. Glacial-outburst floods are events unique to a specific basin, in this case the Kenai basin, and thus, corresponding glacial outbursts in the Grant Creek basin would not be expected. The MOVE1 record extension method, described previously, is used to correlate the same types of runoff events between basins, in this case, typically rainfall-runoff and snowmelt events.

The 2013 data (dashed blue line) shows that there were two peak runoff events, one in Mid-June and one in Mid-September. The Mid-June event was a spring freshet with warming temperatures resulting in increased snowmelt. The Mid-September event was a rainfall-runoff event resulting from heavy precipitation. These two peaks do not imply that the most recent year contained more intense run-off events. The average annual hydrographs are smoother due to averaging. The shape and timing of the 2013 hydrograph is consistent average Grant Creek hydrographs.

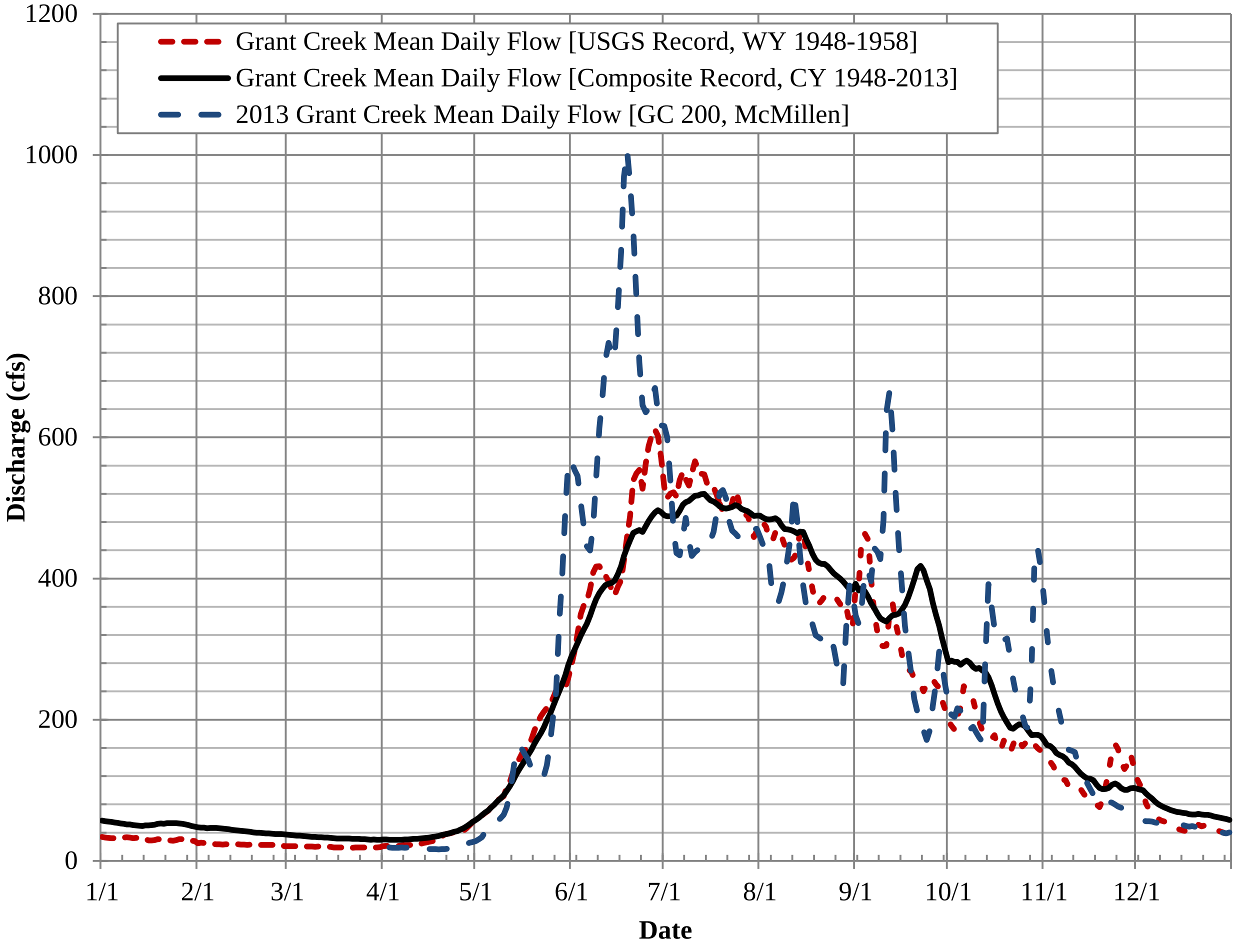

Figure 4. Grant Creek Annual Hydrographs

4.0 CONCLUSIONS AND RECOMENDATIONS

4.1 Conclusions

The Grant Lake site has been studied on numerous occasions since 1954 when R.W. Beck completed their original study. Within these studies, analyses of the hydrologic conditions within the basin were completed to develop an understanding of the potential water availability and associated power production. The most comprehensive study was completed by Ebasco (Ebasco, 1984) which primarily utilized the 11-year gage record for USGS station 15246000 for their analyses. The current study reviewed the more recent data collected in 2009 by HDR and 2013 data by McMillen. The USGS gage record for Grant Creek still represents the longest term and most reliable streamflow data for Grant Creek.

Regional regression equations were used to improve the peak flow estimates. The estimated 100-year discharge for Grant Creek was 3,310 cfs; the 25-year event was 2,350 cfs; and the 10-year event was 1,790 cfs. In comparing these current flood magnitude estimates to the Ebasco estimates, the smaller magnitude events are similar for both. The Ebasco 100-year estimate was 2,600 cfs, 700 cfs smaller than the present weighted estimate that included the regional regression equations.

A daily streamflow record extension for Grant Creek was performed based on the Kenai River at Cooper Landing USGS streamflow record. This record extension was used to create a Composite, 66-year streamflow record for Grant Creek to be used for the Project. A flow durational analysis of the Composite record indicated that the 95% exceedance flow was 21 cfs and the 5% exceedance was 575 cfs. The 20% exceedance flow, which is often selected to size powerhouse turbines, was estimated at 402 cfs. Additional streamflow data tables are provided in Appendix A.

4.2 Recommendations

Based on the analysis presented in this TM, the estimated 100-year flood flow of 3,310 cfs is recommended to be used to determine the flood protection requirements at the proposed powerhouse. The Composite streamflow record for Grant Creek is recommended to be used as the basis for developing energy production estimates from the generation model.

5.0 REFERENCES

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Appendix A: Gage Data

Grant Creek - USGS Station 15246000

Average of Daily Mean Discharges (cfs)
Data from Water Years 1948-1958

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	34	25	21	21	59	278	529	480	386	198	153	117
2	33	26	21	21	62	298	515	480	393	192	145	108
3	33	25	21	21	64	322	520	473	459	186	141	98
4	32	25	21	21	68	349	522	456	463	205	134	81
5	32	24	21	21	71	363	516	452	455	218	124	73
6	33	24	20	21	76	368	540	465	401	248	117	69
7	32	24	20	22	81	385	551	471	351	242	115	63
8	33	23	20	22	86	409	541	460	324	235	114	59
9	33	23	20	22	88	417	532	447	305	228	105	57
10	33	23	20	23	92	417	549	436	304	212	106	56
11	32	23	20	23	103	410	566	426	305	198	107	51
12	32	24	20	24	111	405	554	429	351	184	104	49
13	32	23	20	24	125	396	548	439	363	177	101	47
14	32	23	20	25	135	384	548	466	337	174	94	46
15	31	23	20	26	144	377	533	470	317	173	90	44
16	29	23	19	27	153	389	530	434	292	178	85	43
17	29	23	19	28	157	397	530	410	278	160	83	42
18	29	23	19	29	165	426	518	385	271	158	80	42
19	31	23	19	32	172	460	506	364	268	170	76	42
20	30	23	19	35	185	488	496	364	259	165	86	44
21	30	23	19	38	196	539	492	369	254	154	107	51
22	29	23	19	38	205	549	497	375	250	165	127	49
23	29	23	19	39	211	554	507	378	240	176	154	50
24	29	23	19	41	217	527	526	378	250	170	165	51
25	30	23	19	40	222	562	513	376	258	162	158	48
26	31	23	19	41	230	587	490	370	257	167	140	46
27	31	22	19	42	241	604	490	363	250	164	130	44
28	30	22	19	46	245	611	490	370	245	157	136	42
29	29	21	19	51	244	602	475	358	228	164	152	40
30	28	---	19	55	246	571	459	336	214	160	134	39
31	28	---	19	---	259	---	468	329	---	156	---	37
Mean	31	23	20	31	152	448	518	413	311	184	119	56
Min	28	21	19	21	59	278	459	329	214	154	76	37
Max	34	26	21	55	259	611	566	480	463	248	165	117

Grant Creek - Composite Record
(USGS Station 15246000 Location)

Average of Daily Mean Discharges (cfs)
Data from Calendar Years 1948-2013

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	57	47	37	30	58	290	489	489	392	281	170	102
2	56	47	37	30	61	300	488	487	383	284	164	101
3	56	47	36	30	65	309	488	484	386	282	163	100
4	55	46	36	30	68	319	488	484	382	282	158	96
5	54	47	36	30	72	328	489	484	374	278	153	92
6	54	47	35	30	76	336	496	485	365	282	150	88
7	53	47	35	30	80	347	505	482	358	284	148	84
8	53	46	34	30	84	360	508	476	350	281	145	80
9	52	46	34	30	88	371	510	470	344	275	139	78
10	52	45	34	31	93	379	514	469	341	272	137	76
11	51	45	34	31	99	386	517	469	339	273	133	74
12	50	44	33	31	105	391	518	467	344	270	128	72
13	50	44	33	32	113	393	519	464	348	267	123	71
14	50	43	33	32	121	394	520	466	349	260	120	69
15	50	42	33	33	129	397	515	466	350	249	117	69
16	50	42	32	33	137	406	511	455	356	236	117	68
17	51	41	32	34	143	417	509	447	362	223	114	67
18	51	41	32	34	150	432	506	435	373	212	108	66
19	53	40	32	35	158	444	502	427	386	204	103	65
20	53	40	32	36	166	454	500	423	399	196	101	65
21	53	40	32	38	173	464	499	420	413	188	102	66
22	53	39	31	39	181	467	500	420	418	187	103	66
23	53	39	31	40	189	469	501	417	412	191	108	65
24	53	39	31	41	199	466	504	412	398	194	110	65
25	53	39	31	42	208	474	503	407	385	193	107	64
26	53	38	31	44	218	481	498	403	366	190	103	63
27	53	38	30	46	230	488	497	400	348	184	100	62
28	52	38	30	49	241	494	495	396	333	178	101	61
29	51	37	30	52	251	497	492	390	315	179	103	60
30	49	---	30	55	263	494	489	384	298	178	103	59
31	49	---	30	---	277	---	489	385	---	177	---	58
Mean	52	43	33	36	145	408	502	444	366	233	124	73
Min	49	37	30	30	58	290	488	384	298	177	100	58
Max	57	47	37	55	277	497	520	489	418	284	170	102

Grant Creek - USGS Station 15246000

Daily Mean Discharge (cfs)
Calendar Year
1947

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	---	---	---	---	---	---	---	---	---	418	152	500
2	---	---	---	---	---	---	---	---	---	467	131	480
3	---	---	---	---	---	---	---	---	---	404	117	400
4	---	---	---	---	---	---	---	---	---	362	104	250
5	---	---	---	---	---	---	---	---	---	327	91	180
6	---	---	---	---	---	---	---	---	---	313	78	160
7	---	---	---	---	---	---	---	---	---	306	86	130
8	---	---	---	---	---	---	---	---	---	278	86	110
9	---	---	---	---	---	---	---	---	---	250	84	100
10	---	---	---	---	---	---	---	---	---	222	82	94
11	---	---	---	---	---	---	---	---	---	243	78	86
12	---	---	---	---	---	---	---	---	---	236	72	76
13	---	---	---	---	---	---	---	---	---	229	68	71
14	---	---	---	---	---	---	---	---	---	236	66	65
15	---	---	---	---	---	---	---	---	---	236	64	65
16	---	---	---	---	---	---	---	---	---	222	64	58
17	---	---	---	---	---	---	---	---	---	208	62	52
18	---	---	---	---	---	---	---	---	---	180	62	47
19	---	---	---	---	---	---	---	---	---	159	64	47
20	---	---	---	---	---	---	---	---	---	145	70	71
21	---	---	---	---	---	---	---	---	---	138	80	65
22	---	---	---	---	---	---	---	---	---	215	230	58
23	---	---	---	---	---	---	---	---	---	320	420	71
24	---	---	---	---	---	---	---	---	---	313	500	71
25	---	---	---	---	---	---	---	---	---	278	540	52
26	---	---	---	---	---	---	---	---	---	280	430	52
27	---	---	---	---	---	---	---	---	---	278	350	42
28	---	---	---	---	---	---	---	---	---	243	460	42
29	---	---	---	---	---	---	---	---	---	243	700	38
30	---	---	---	---	---	---	---	---	---	201	600	35
31	---	---	---	---	---	---	---	---	---	187	---	35
Mean	---	---	---	---	---	---	---	---	---	262	200	116
Min	---	---	---	---	---	---	---	---	---	138	62	35
Max	---	---	---	---	---	---	---	---	---	467	700	500

Grant Creek - USGS Station 15246000

Daily Mean Discharge (cfs)
Calendar Year
1948

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	33	30	18	16	32	383	529	467	173	138	128	39
2	30	42	19	15	38	376	561	453	160	138	128	36
3	30	38	18	15	42	348	569	432	152	173	120	33
4	26	32	18	14	52	362	585	418	152	173	120	31
5	25	28	18	14	58	369	585	418	160	152	107	29
6	27	27	17	14	78	362	765	432	166	138	100	28
7	26	26	17	14	84	369	780	418	180	117	128	27
8	24	25	17	15	104	369	705	383	208	320	120	27
9	23	24	17	16	104	383	665	355	222	517	81	28
10	22	25	16	16	104	390	665	334	236	537	100	29
11	23	26	16	19	173	411	625	316	222	478	148	28
12	28	26	16	21	187	425	585	320	210	436	148	28
13	30	24	16	23	208	482	521	348	201	358	142	29
14	30	23	16	28	229	553	529	453	180	324	128	28
15	28	22	16	35	264	585	521	505	194	316	114	27
16	28	22	16	42	313	625	561	545	210	400	107	26
17	30	21	16	42	320	609	545	545	220	372	94	27
18	32	21	16	42	383	665	561	505	208	352	87	27
19	32	20	16	47	369	705	545	467	201	324	74	26
20	30	20	16	42	348	665	529	425	180	324	62	27
21	32	20	15	38	341	600	497	397	145	260	55	24
22	30	20	15	35	313	561	490	418	138	226	50	23
23	28	19	15	35	306	537	497	453	117	212	48	22
24	30	19	15	35	292	505	529	418	104	198	45	21
25	42	20	16	32	320	505	521	348	104	176	43	21
26	58	21	17	30	390	529	505	299	91	162	46	20
27	58	20	18	30	446	545	497	257	78	148	45	19
28	52	19	17	28	460	529	475	230	65	156	43	18
29	44	19	16	30	425	505	446	210	71	148	42	18
30	38	---	15	30	404	529	418	194	117	142	40	18
31	35	---	16	---	390	---	432	180	---	128	---	18
Mean	32	24	16	27	244	493	556	385	162	259	90	26
Min	22	19	15	14	32	348	418	180	65	117	40	18
Max	58	42	19	47	460	705	780	545	236	537	148	39

Grant Creek - USGS Station 15246000

Daily Mean Discharge (cfs)
Calendar Year
1949

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	18	13	14	16	25	450	380	390	660	420	215	150
2	19	12	13	16	22	467	380	400	710	370	208	146
3	20	11	14	14	20	467	376	370	770	330	220	140
4	20	12	15	13	20	450	411	370	800	300	180	130
5	19	13	16	14	20	430	470	380	800	270	160	120
6	17	13	15	14	20	380	540	390	740	250	170	115
7	16	12	16	14	19	350	580	411	610	250	145	100
8	16	11	14	13	19	330	590	430	550	210	138	91
9	17	11	14	13	18	320	570	440	470	190	120	82
10	18	11	13	14	19	310	545	430	410	170	110	76
11	17	12	14	14	20	310	530	410	370	150	100	68
12	16	13	16	14	20	320	540	360	320	140	92	60
13	15	14	16	14	21	340	577	320	300	150	95	58
14	15	14	15	14	23	334	560	274	290	140	91	55
15	14	13	14	14	25	320	540	260	320	130	84	53
16	14	12	13	15	27	310	510	230	310	110	77	55
17	13	11	12	16	30	310	490	210	300	98	74	54
18	12	11	12	17	38	330	480	200	285	90	74	54
19	13	11	13	18	58	369	480	200	260	95	81	55
20	13	11	13	20	91	400	460	208	250	110	180	54
21	13	11	14	20	110	450	430	218	230	100	397	53
22	13	12	15	18	222	600	400	280	220	90	500	50
23	13	13	17	16	278	785	400	260	210	80	545	48
24	14	13	17	18	313	600	432	240	250	84	467	46
25	13	14	17	19	320	500	440	230	330	159	334	45
26	12	14	17	19	341	430	460	230	430	264	250	44
27	13	14	16	23	418	397	460	240	520	299	230	43
28	13	14	15	27	430	390	460	300	630	260	215	42
29	12	---	16	30	432	430	430	360	550	243	190	41
30	13	---	16	27	410	390	400	480	470	243	159	41
31	13	---	16	---	430	---	376	560	---	222	---	41
Mean	15	12	15	17	137	409	474	325	446	194	197	71
Min	12	11	12	13	18	310	376	200	210	80	74	41
Max	20	14	17	30	432	785	590	560	800	420	545	150

Grant Creek - USGS Station 15246000

Daily Mean Discharge (cfs)
Calendar Year
1950

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	43	27	20	17	39	200	545	397	327	166	54	21
2	43	27	20	17	39	210	529	390	320	160	50	21
3	43	27	20	17	39	210	545	390	300	170	47	21
4	43	27	20	17	39	220	505	432	290	173	43	21
5	43	27	20	16	42	230	497	460	264	166	42	21
6	40	22	19	16	47	280	490	482	260	150	41	21
7	40	22	19	16	44	292	510	480	250	139	39	21
8	40	22	19	16	55	300	510	467	257	133	36	21
9	40	22	19	16	61	290	545	450	280	120	35	21
10	40	22	19	17	77	250	565	440	370	110	34	21
11	37	20	18	18	100	383	600	450	450	110	33	21
12	37	20	18	19	110	320	585	467	486	110	33	21
13	37	20	18	20	120	240	570	482	440	105	35	21
14	37	20	18	22	139	240	545	480	370	100	28	21
15	37	20	18	23	140	250	505	520	360	95	28	21
16	38	19	18	23	140	310	486	505	350	89	28	21
17	38	19	18	25	140	420	470	490	348	81	28	21
18	38	19	18	29	140	540	440	460	360	77	28	21
19	38	19	18	32	140	650	400	453	390	74	28	21
20	38	19	18	35	139	750	400	467	430	70	28	21
21	33	19	18	37	139	865	450	480	505	67	28	21
22	33	19	18	39	140	820	525	505	470	64	28	21
23	33	19	18	42	152	800	665	540	420	67	28	21
24	33	19	18	39	160	665	849	569	369	77	28	21
25	33	19	18	35	170	665	700	640	320	76	28	21
26	33	19	17	34	170	580	505	650	280	74	28	21
27	33	19	17	34	173	570	480	600	250	70	28	21
28	33	19	17	35	173	570	460	529	220	67	28	21
29	33	---	17	37	180	610	440	490	200	64	28	21
30	33	---	17	39	194	665	420	400	190	62	28	21
31	33	---	17	---	200	---	400	340	---	58	---	21
Mean	37	21	18	26	117	447	521	481	338	101	33	21
Min	33	19	17	16	39	200	400	340	190	58	28	21
Max	43	27	20	42	200	865	849	650	505	173	54	21

Grant Creek - USGS Station 15246000

Daily Mean Discharge (cfs)
Calendar Year
1951

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	21	16	13	17	45	190	467	340	530	120	60	33
2	21	16	13	21	45	220	500	340	530	120	60	33
3	21	16	13	21	45	257	545	340	530	120	60	33
4	21	16	13	21	45	360	545	340	530	120	60	33
5	21	16	13	21	45	360	486	362	530	120	60	33
6	21	16	13	21	48	360	540	390	530	120	60	33
7	21	16	13	21	84	360	620	390	530	120	60	33
8	21	16	13	21	84	360	665	390	530	120	60	33
9	21	16	13	21	84	360	660	390	530	120	60	33
10	21	16	13	21	84	450	660	390	530	120	60	33
11	21	16	13	21	84	330	660	390	530	120	60	33
12	21	16	13	21	84	330	660	414	530	120	60	33
13	21	16	13	21	135	330	660	470	530	120	60	33
14	21	16	13	21	170	330	660	560	530	120	60	33
15	21	16	13	23	170	330	585	545	530	120	60	31
16	17	15	14	25	170	330	540	420	480	120	43	28
17	17	15	14	25	170	257	540	420	480	60	43	28
18	17	15	14	25	170	230	540	420	480	53	43	28
19	17	15	14	25	170	230	540	344	480	53	43	28
20	17	15	14	25	170	230	540	310	480	53	43	28
21	17	15	14	25	170	230	540	310	480	53	43	28
22	17	15	14	25	170	230	467	310	480	53	43	28
23	17	15	14	31	170	230	400	310	480	53	43	28
24	17	15	14	43	170	348	400	310	480	53	43	28
25	17	15	14	43	170	420	400	292	480	53	43	28
26	17	15	14	43	170	420	400	360	480	53	43	28
27	17	15	14	43	140	420	400	360	480	53	43	28
28	17	15	14	43	140	420	400	360	480	53	43	28
29	17	---	14	43	140	420	362	360	480	53	43	28
30	19	---	16	43	152	420	350	360	480	53	43	28
31	19	---	16	---	160	---	340	360	---	53	---	28
Mean	19	16	14	27	124	325	518	376	505	88	52	30
Min	17	15	13	17	45	190	340	292	480	53	43	28
Max	21	16	16	43	170	450	665	560	530	120	60	33

Grant Creek - USGS Station 15246000

Daily Mean Discharge (cfs)
Calendar Year
1952

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	20	16	17	14	17	200	510	555	306	279	300	168
2	20	16	17	14	18	212	452	508	306	251	283	110
3	20	16	17	14	19	212	466	476	292	276	270	110
4	20	16	17	14	20	210	423	472	276	560	254	110
5	20	16	17	14	22	212	435	476	254	702	244	110
6	20	16	17	14	23	200	510	494	222	708	225	110
7	20	16	17	14	25	184	585	570	202	605	247	110
8	20	16	17	14	27	176	533	600	188	512	300	110
9	20	16	17	14	30	176	479	580	175	440	300	110
10	20	16	17	14	33	200	456	555	163	408	328	110
11	20	16	17	14	38	218	470	526	156	376	338	90
12	20	16	15	14	42	282	533	565	152	338	328	90
13	20	16	15	14	44	344	651	570	163	317	303	90
14	20	16	15	14	45	358	675	540	213	324	273	90
15	20	16	15	14	45	358	603	521	244	331	263	90
16	17	17	15	15	47	390	528	472	241	331	241	90
17	17	17	15	15	51	414	479	420	225	300	213	90
18	17	17	15	15	56	450	452	380	208	279	193	90
19	17	17	15	15	60	464	443	338	193	260	175	90
20	17	17	15	15	74	471	484	346	188	244	178	90
21	17	17	15	15	90	521	538	349	222	228	178	186
22	17	17	15	15	90	541	669	349	314	219	165	178
23	17	17	15	15	90	565	733	346	349	208	235	186
24	17	17	15	15	92	537	792	328	400	193	372	202
25	17	17	15	15	95	509	785	328	462	183	372	196
26	17	17	15	15	100	494	720	324	458	202	335	180
27	17	17	15	15	111	545	702	314	420	228	286	161
28	17	17	15	15	130	621	696	292	384	247	260	147
29	17	17	15	15	156	601	702	286	349	306	228	135
30	17	---	15	15	170	581	636	283	306	300	196	122
31	17	---	15	---	190	---	595	289	---	289	---	106
Mean	18	16	16	15	66	375	572	434	268	337	263	124
Min	17	16	15	14	17	176	423	283	152	183	165	90
Max	20	17	17	15	190	621	792	600	462	708	372	202

Grant Creek - USGS Station 15246000

Daily Mean Discharge (cfs)
Calendar Year
1953

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	90	42	33	24	170	524	1210	657	352	115	80	45
2	83	42	33	24	177	575	989	831	320	108	80	44
3	76	42	33	24	182	657	885	933	295	103	80	44
4	72	42	33	24	193	726	810	831	391	126	80	42
5	70	42	33	24	201	768	747	675	549	237	80	41
6	70	42	33	24	204	726	705	585	538	645	80	40
7	64	42	33	24	207	699	693	569	488	740	80	38
8	64	42	33	24	207	705	699	538	443	657	80	39
9	64	42	33	24	201	733	651	538	387	528	80	41
10	64	42	33	24	190	761	609	549	345	423	80	41
11	64	42	33	24	177	719	597	520	305	367	74	41
12	64	42	33	24	198	699	627	484	302	323	74	39
13	64	42	33	24	212	663	657	524	327	363	74	38
14	64	42	33	24	243	597	719	585	338	356	74	38
15	64	42	33	24	262	554	754	549	331	313	74	37
16	47	48	28	26	278	543	761	488	309	281	74	40
17	47	48	28	30	302	543	719	427	288	243	74	41
18	47	48	28	35	323	564	675	391	269	218	74	41
19	47	48	28	66	359	621	663	367	246	204	74	39
20	47	48	28	90	399	663	621	349	230	185	74	39
21	47	48	28	110	411	733	575	341	210	167	59	41
22	47	48	28	120	387	824	559	349	193	165	56	40
23	47	48	28	120	359	925	575	407	195	160	58	40
24	47	48	28	120	345	1050	580	439	201	150	56	42
25	47	48	28	115	338	1510	705	448	193	140	54	41
26	47	46	28	110	331	1920	754	419	177	130	53	39
27	47	45	28	109	338	2090	754	387	165	120	51	39
28	47	44	28	126	356	2140	747	439	154	110	50	37
29	47	---	28	145	356	2010	705	474	139	100	48	36
30	47	---	28	160	367	1610	663	427	126	99	47	35
31	47	---	28	---	439	---	645	387	---	97	---	34
Mean	58	44	30	61	281	928	711	513	294	257	69	40
Min	47	42	28	24	170	524	559	341	126	97	47	34
Max	90	48	33	160	439	2140	1210	933	549	740	80	45

Grant Creek - USGS Station 15246000

Daily Mean Discharge (cfs)
Calendar Year
1954

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	34	32	32	25	55	233	452	627	237	160	338	93
2	33	32	32	25	56	269	452	569	227	158	327	86
3	32	32	32	25	58	313	427	543	233	147	309	79
4	30	32	32	25	63	327	411	520	240	135	285	71
5	30	32	32	25	68	352	395	484	237	124	253	65
6	30	32	32	25	80	387	379	466	224	115	224	60
7	30	32	32	25	89	431	367	456	215	110	198	57
8	33	32	32	25	94	492	379	439	201	98	177	57
9	40	32	32	25	106	510	399	439	193	96	154	58
10	40	32	32	25	117	502	448	427	221	94	137	56
11	38	34	32	25	131	479	502	431	230	91	122	52
12	38	34	32	25	156	484	492	448	221	89	112	51
13	37	34	32	25	180	448	456	403	198	86	106	50
14	36	34	32	25	182	383	423	352	177	96	97	48
15	35	34	32	25	180	367	419	323	167	154	91	45
16	35	34	25	25	185	363	452	305	172	180	89	44
17	34	34	25	25	190	375	474	281	224	170	84	43
18	34	34	25	25	190	403	452	295	249	154	82	44
19	32	34	25	25	201	427	448	320	249	147	78	50
20	32	34	25	25	221	431	443	338	230	143	78	50
21	31	34	25	29	230	452	423	323	207	126	76	46
22	31	34	25	30	224	435	391	298	182	119	76	45
23	30	34	25	31	233	403	363	320	163	239	86	42
24	29	34	25	33	262	387	345	356	185	302	96	39
25	29	34	25	36	275	403	327	363	185	281	124	38
26	28	34	25	39	272	435	331	352	170	295	126	38
27	28	34	25	44	275	452	352	331	154	272	122	37
28	27	34	25	47	265	452	387	298	139	246	115	37
29	27	---	25	50	256	448	411	278	145	237	104	37
30	26	---	25	53	237	439	456	262	151	243	97	37
31	26	---	25	---	224	---	549	249	---	309	---	37
Mean	32	33	28	30	173	409	420	384	201	168	145	51
Min	26	32	25	25	55	233	327	249	139	86	76	37
Max	40	34	32	53	275	510	549	627	249	309	338	93

Grant Creek - USGS Station 15246000

Daily Mean Discharge (cfs)
Calendar Year
1955

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	38	27	18	18	20	112	403	627	768	95	59	25
2	38	27	18	18	21	112	461	621	810	91	56	25
3	38	27	18	18	22	114	559	597	621	89	53	25
4	38	27	18	18	23	117	693	559	488	88	51	25
5	38	27	18	18	24	122	693	675	391	93	48	25
6	38	27	18	18	26	127	651	789	331	96	47	25
7	38	27	18	18	26	135	627	726	285	93	47	25
8	38	27	18	18	28	156	609	633	249	89	45	25
9	38	27	18	18	29	210	657	543	237	85	44	25
10	38	27	18	18	32	240	877	497	265	81	44	25
11	38	27	18	18	38	278	1030	456	302	77	44	25
12	38	27	18	18	44	275	893	411	379	75	43	25
13	38	27	18	18	53	259	733	371	375	71	42	25
14	38	27	18	18	56	240	633	345	334	74	42	25
15	38	27	18	18	61	230	575	313	288	71	43	25
16	45	20	18	18	76	240	559	275	249	71	42	25
17	45	20	18	18	90	262	528	253	210	74	42	25
18	45	20	18	18	98	316	510	237	180	76	41	25
19	45	20	18	18	100	383	520	230	163	74	41	25
20	45	20	18	18	102	415	575	227	143	69	40	25
21	45	20	18	18	103	423	657	227	131	68	39	25
22	45	20	18	18	103	431	712	233	126	85	38	25
23	45	20	18	18	106	443	740	246	117	99	37	25
24	45	20	18	18	119	456	726	295	117	99	36	25
25	45	20	18	18	126	488	687	352	115	94	35	25
26	45	20	18	18	124	488	663	349	112	88	34	25
27	45	20	18	18	119	448	633	338	108	84	33	25
28	45	20	18	18	117	423	591	334	104	78	32	25
29	45	---	18	18	117	395	569	298	98	72	31	25
30	45	---	18	18	117	383	564	259	94	65	30	25
31	45	---	18	---	112	---	609	308	---	63	---	25
Mean	42	24	18	18	72	291	643	407	273	82	42	25
Min	38	20	18	18	20	112	403	227	94	63	30	25
Max	45	27	18	18	126	488	1030	789	810	99	59	25

Grant Creek - USGS Station 15246000

Daily Mean Discharge (cfs)
Calendar Year
1956

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	20	17	15	18	74	141	456	534	312	94	44	119
2	20	17	15	18	78	139	460	477	290	91	45	108
3	20	17	15	18	79	145	460	431	263	88	44	98
4	20	17	15	18	78	154	460	390	245	87	44	89
5	20	17	15	18	81	156	452	358	231	84	43	83
6	20	17	15	18	87	166	447	397	220	79	42	76
7	20	17	15	18	89	178	460	447	212	75	41	71
8	20	17	15	18	91	199	469	443	202	71	41	65
9	20	17	15	18	95	215	439	416	193	69	42	60
10	20	17	15	18	95	228	408	408	193	69	41	58
11	20	17	15	18	94	237	393	424	215	70	41	54
12	20	17	15	18	93	251	397	460	245	69	41	51
13	20	17	15	18	90	263	443	469	284	67	41	49
14	20	17	15	18	89	278	505	456	296	66	41	46
15	20	17	15	18	87	293	576	486	272	64	40	44
16	20	17	15	18	87	318	622	560	248	65	39	41
17	20	17	15	18	88	355	633	560	223	63	38	39
18	20	17	15	18	89	372	610	545	248	62	38	37
19	20	17	15	18	90	368	571	555	281	60	38	36
20	20	17	15	18	105	355	539	645	272	59	38	35
21	20	17	15	21	147	332	500	599	239	57	41	34
22	20	17	15	20	183	305	473	510	210	54	44	34
23	20	17	15	20	196	290	447	452	183	51	43	33
24	20	17	15	21	193	290	435	397	160	49	42	32
25	20	17	15	22	191	287	416	386	141	49	47	32
26	20	17	15	26	199	299	400	375	129	48	70	31
27	20	17	15	29	196	322	404	368	119	52	130	31
28	20	17	15	35	191	332	404	412	112	51	145	30
29	20	17	15	46	183	372	404	397	105	49	151	30
30	20	---	15	58	160	427	424	355	99	47	134	30
31	20	---	15	---	147	---	500	335	---	45	---	29
Mean	20	17	15	22	121	269	471	453	215	65	56	52
Min	20	17	15	18	74	139	393	335	99	45	38	29
Max	20	17	15	58	199	427	633	645	312	94	151	119

Grant Creek - USGS Station 15246000

Daily Mean Discharge (cfs)
Calendar Year
1957

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	26	19	20	19	46	288	423	327	363	175	253	98
2	26	19	20	19	46	327	431	327	435	156	230	104
3	26	19	20	19	49	407	427	327	1390	143	227	100
4	26	19	20	20	52	492	423	327	1500	129	253	94
5	26	19	20	20	55	543	399	305	1410	119	240	94
6	26	19	20	20	60	569	363	288	1000	110	215	89
7	26	19	20	20	66	627	341	291	712	104	193	82
8	26	19	20	20	80	687	334	320	564	100	172	76
9	26	19	20	20	100	687	352	352	502	96	158	70
10	26	19	20	20	115	651	383	371	452	93	147	68
11	26	19	21	20	135	585	403	375	419	91	141	61
12	26	19	21	20	149	549	403	363	853	86	143	60
13	26	19	21	21	172	488	399	331	1020	82	143	55
14	26	19	21	23	167	479	407	320	817	79	135	52
15	26	19	21	25	204	466	423	338	621	76	124	49
16	19	19	21	25	210	448	423	356	488	90	127	47
17	19	19	21	26	195	423	419	367	399	96	163	45
18	19	19	21	27	190	415	403	349	359	196	156	44
19	19	19	21	28	204	403	383	323	345	423	143	42
20	19	19	21	30	237	391	341	305	309	411	160	40
21	19	19	18	36	259	359	316	423	295	427	185	39
22	19	19	18	38	253	352	305	466	298	520	172	37
23	19	19	18	40	240	345	285	427	275	448	154	36
24	19	19	18	43	227	341	272	387	334	356	135	35
25	19	19	18	44	218	345	275	356	371	295	120	34
26	19	19	18	45	212	345	291	349	363	243	120	33
27	19	19	18	45	218	345	295	474	323	201	112	33
28	19	19	18	45	221	349	285	575	281	218	108	32
29	19	---	18	45	230	367	291	520	243	288	104	32
30	19	---	18	45	253	399	305	435	207	302	102	32
31	19	---	18	---	269	---	316	383	---	262	---	32
Mean	22	19	20	29	166	449	359	370	565	207	161	56
Min	19	19	18	19	46	288	272	288	207	76	102	32
Max	26	19	21	45	269	687	431	575	1500	520	253	104

Grant Creek - USGS Station 15246000

Daily Mean Discharge (cfs)
Calendar Year
1958

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	32	32	27	44	125	335	447	361	220	---	---	---
2	32	32	27	48	139	372	447	361	212	---	---	---
3	33	32	27	49	154	408	464	368	199	---	---	---
4	35	31	26	50	162	424	477	361	186	---	---	---
5	40	30	26	50	164	447	520	379	178	---	---	---
6	49	30	25	52	162	491	545	404	176	---	---	---
7	56	30	25	55	158	610	496	424	178	---	---	---
8	62	30	26	59	154	726	456	420	174	---	---	---
9	58	29	25	60	145	705	431	416	169	---	---	---
10	54	29	25	62	141	610	424	393	160	---	---	---
11	51	29	25	65	139	555	416	390	158	---	---	---
12	48	29	24	66	141	515	382	431	160	---	---	---
13	45	28	24	67	143	496	365	539	160	---	---	---
14	43	29	25	69	143	431	368	761	158	---	---	---
15	41	28	25	68	143	390	358	810	156	---	---	---
16	38	28	25	68	145	397	393	616	151	---	---	---
17	36	28	25	67	147	404	529	539	145	---	---	---
18	42	30	25	67	143	404	576	456	139	---	---	---
19	58	30	25	65	141	443	571	408	138	---	---	---
20	56	29	25	66	145	599	520	382	132	---	---	---
21	53	28	25	65	156	965	486	390	125	---	---	---
22	51	28	25	65	169	941	473	404	120	---	---	---
23	49	28	25	64	186	768	469	393	134	---	---	---
24	44	28	25	64	210	622	424	416	147	---	---	---
25	43	27	26	65	215	555	382	397	141	---	---	---
26	40	27	25	69	223	520	361	365	138	---	---	---
27	39	27	25	77	218	505	408	328	134	---	---	---
28	38	28	26	87	212	491	486	296	129	---	---	---
29	35	---	26	101	212	469	469	269	123	---	---	---
30	34	---	27	114	242	443	408	245	115	---	---	---
31	33	---	29	---	290	---	382	231	---	---	---	---
Mean	44	29	26	66	170	535	449	418	155	---	---	---
Min	32	27	24	44	125	335	358	231	115	---	---	---
Max	62	32	29	114	290	965	576	810	220	---	---	---

Grant Creek - EBASCO Gage

Daily Mean Discharge (cfs)
Calendar Year
1981

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	---	---	---	---	---	---	---	---	---	---	---	---
2	---	---	---	---	---	---	---	---	---	---	---	---
3	---	---	---	---	---	---	---	---	---	---	---	---
4	---	---	---	---	---	---	---	---	---	---	---	---
5	---	---	---	---	---	---	---	---	---	---	---	---
6	---	---	---	---	---	---	---	---	---	---	---	---
7	---	---	---	---	---	---	---	---	---	---	---	---
8	---	---	---	---	---	---	---	---	---	---	---	---
9	---	---	---	---	---	---	---	---	---	---	---	---
10	---	---	---	---	---	---	---	---	---	---	---	---
11	---	---	---	---	---	---	---	---	---	---	---	---
12	---	---	---	---	---	---	---	---	---	---	---	---
13	---	---	---	---	---	---	---	---	---	---	---	---
14	---	---	---	---	---	---	---	---	---	---	---	---
15	---	---	---	---	---	---	---	---	---	---	---	---
16	---	---	---	---	---	---	---	---	---	---	---	---
17	---	---	---	---	---	---	---	---	---	---	---	---
18	---	---	---	---	---	---	---	---	---	---	---	---
19	---	---	---	---	---	---	---	---	---	---	---	---
20	---	---	---	---	---	---	---	---	---	---	---	---
21	---	---	---	---	---	---	---	---	---	121	---	---
22	---	---	---	---	---	---	---	---	---	---	---	---
23	---	---	---	---	---	---	---	---	---	---	---	---
24	---	---	---	---	---	---	---	---	---	---	---	---
25	---	---	---	---	---	---	---	---	---	---	---	---
26	---	---	---	---	---	---	---	---	---	---	---	---
27	---	---	---	---	---	---	---	---	---	---	---	---
28	---	---	---	---	---	---	---	---	---	---	---	---
29	---	---	---	---	---	---	---	---	---	---	---	---
30	---	---	---	---	---	---	---	---	---	---	---	---
31	---	---	---	---	---	---	---	---	---	---	---	---
Mean	---	---	---	---	---	---	---	---	---	---	---	---
Min	---	---	---	---	---	---	---	---	---	121	---	---
Max	---	---	---	---	---	---	---	---	---	121	---	---

Grant Creek - EBASCO Gage

Daily Mean Discharge (cfs)
Calendar Year
1982

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	---	---	---	26	---	196	468	490	284	260	103	94
2	---	---	---	---	---	210	446	472	262	---	104	92
3	---	---	---	---	---	223	400	460	232	---	101	94
4	---	---	30	---	---	234	365	449	261	---	105	97
5	---	---	---	---	---	238	365	434	219	---	105	108
6	---	---	---	---	---	244	354	427	412	---	103	120
7	---	---	---	---	---	262	361	427	454	---	101	118
8	---	---	---	---	---	274	408	438	451	---	101	111
9	43	---	---	---	---	298	442	442	446	---	99	108
10	---	---	---	---	---	342	488	434	424	---	97	108
11	---	---	---	---	---	394	486	419	407	---	94	104
12	---	---	---	---	---	375	472	405	385	---	92	101
13	---	---	---	---	---	348	466	393	394	---	92	96
14	---	---	---	---	---	314	472	400	433	---	91	92
15	---	---	---	---	---	290	474	400	457	---	90	90
16	---	---	---	---	---	274	474	398	602	---	89	89
17	---	---	---	---	---	304	472	374	590	---	87	96
18	---	---	---	---	---	304	466	358	552	---	86	104
19	---	---	---	---	---	274	460	338	545	---	84	110
20	---	---	---	---	---	282	464	316	532	---	84	108
21	---	---	---	---	97	282	472	305	514	---	77	106
22	---	---	---	---	---	278	476	289	504	---	77	104
23	---	---	---	---	---	276	474	296	482	---	76	103
24	---	---	---	---	150	288	486	307	454	---	76	101
25	---	---	---	---	155	306	486	316	433	---	80	97
26	---	---	---	---	166	338	474	303	407	---	89	96
27	---	---	---	---	170	388	472	294	383	---	101	95
28	---	---	---	---	166	460	474	274	347	105	101	94
29	---	---	---	---	166	482	490	280	290	104	99	93
30	22	---	---	---	170	468	514	298	260	103	96	92
31	---	---	---	---	180	---	505	292	---	101	---	91
Mean	---	---	---	---	---	308	456	372	414	---	93	100
Min	22	---	30	26	97	196	354	274	219	101	76	89
Max	43	---	30	26	180	482	514	490	602	260	105	120

Grant Creek - EBASCO Gage

Daily Mean Discharge (cfs)
Calendar Year
1983

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	---	---	---	---	96	512	535	422	303	136	110	138
2	---	---	---	---	107	517	533	424	297	135	113	141
3	---	---	---	---	114	496	517	429	282	133	117	140
4	---	---	---	---	119	466	507	449	261	130	114	133
5	---	---	---	---	119	432	509	456	229	127	113	128
6	---	---	---	---	120	412	504	476	203	122	111	122
7	---	---	---	---	117	412	499	476	182	117	111	116
8	---	---	---	---	119	419	494	489	174	114	113	---
9	---	---	---	---	123	422	522	494	167	113	113	---
10	---	---	---	---	128	439	530	481	160	117	124	---
11	---	---	---	---	130	439	517	461	156	131	128	---
12	---	---	---	---	133	429	501	444	149	139	128	---
13	---	---	---	---	138	424	491	427	146	139	124	---
14	---	---	---	---	146	429	489	405	165	136	119	---
15	---	---	---	---	156	436	486	382	148	133	117	---
16	---	---	---	---	166	432	484	368	143	130	113	---
17	---	---	---	---	175	432	486	354	138	127	111	---
18	---	---	---	---	184	434	486	345	133	128	105	---
19	---	---	---	---	184	449	479	336	136	128	102	---
20	---	---	---	---	182	459	469	327	144	123	98	---
21	46	---	---	---	184	456	459	323	154	127	95	---
22	---	---	---	---	193	459	449	327	161	133	94	---
23	---	---	18	---	199	466	434	325	158	135	92	---
24	---	---	---	---	197	476	424	323	153	133	89	---
25	---	---	---	---	195	489	417	318	146	128	88	---
26	---	---	---	65	195	507	407	320	143	123	87	---
27	---	---	---	70	195	519	410	323	138	120	84	---
28	---	---	---	80	195	525	419	323	135	122	88	---
29	---	---	---	87	208	525	432	320	136	119	96	---
30	---	---	---	92	288	530	434	318	138	116	128	---
31	---	---	---	96	424	---	429	310	---	113	---	---
Mean	---	---	---	---	169	461	476	386	173	127	108	---
Min	46	---	18	65	96	412	407	310	133	113	84	116
Max	46	---	18	96	424	530	535	494	303	139	128	141

Grant Creek - McMillen GC200 Gage

Daily Mean Discharge (cfs)
Calendar Year
2013

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	---	---	---	---	28	565	616	459	348	224	370	60
2	---	---	---	---	31	554	600	448	335	207	321	59
3	---	---	---	19	33	545	539	436	362	204	280	57
4	---	---	---	19	41	507	468	420	411	216	250	56
5	---	---	---	19	46	472	436	381	411	212	229	56
6	---	---	---	19	49	446	433	368	396	200	208	56
7	---	---	---	19	52	440	460	367	443	190	188	54
8	---	---	---	19	56	477	486	381	438	186	174	54
9	---	---	---	19	60	542	453	402	427	190	157	53
10	---	---	---	19	65	613	432	432	483	183	156	52
11	---	---	---	19	75	659	438	459	636	175	154	50
12	---	---	---	18	94	710	441	521	665	169	137	49
13	---	---	---	18	125	734	444	484	604	284	125	49
14	---	---	---	18	154	712	452	434	520	392	118	52
15	---	---	---	17	162	718	451	390	445	359	110	53
16	---	---	---	17	158	784	454	359	386	329	102	51
17	---	---	---	16	151	862	466	348	333	317	94	49
18	---	---	---	17	143	970	493	336	298	311	87	49
19	---	---	---	16	130	1005	521	319	264	313	82	49
20	---	---	---	17	130	960	526	317	230	315	77	48
21	---	---	---	17	123	894	514	313	211	288	76	47
22	---	---	---	17	119	797	483	320	200	258	84	47
23	---	---	---	19	119	706	468	319	185	234	82	45
24	---	---	---	21	135	646	464	317	171	216	80	44
25	---	---	---	22	167	636	459	301	185	206	77	43
26	---	---	---	23	203	641	463	276	219	190	75	42
27	---	---	---	24	240	660	459	253	251	188	75	41
28	---	---	---	24	340	670	461	251	296	278	68	41
29	---	---	---	26	404	636	467	335	279	446	65	40
30	---	---	---	27	499	617	470	391	248	442	62	39
31	---	---	---	---	566	---	470	378	---	414	---	40
Mean	---	---	---	19	152	673	477	371	356	263	139	49
Min	---	---	---	16	28	440	432	251	171	169	62	39
Max	---	---	---	27	566	1005	616	521	665	446	370	60

```
#
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# National Water Information System
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# This file contains the annual peak streamflow data.
#
# This information includes the following fields:
#
#  agency_cd     Agency Code
#  site_no       USGS station number
#  peak_dt       Date of peak streamflow (format YYYY-MM-DD)
#  peak_tm       Time of peak streamflow (24 hour format, 00:00 - 23:59)
#  peak_va       Annual peak streamflow value in cfs
#  peak_cd       Peak Discharge-Qualification codes (see explanation below)
#  gage_ht       Gage height for the associated peak streamflow in feet
#  gage_ht_cd    Gage height qualification codes
#  year_last_pk  Peak streamflow reported is the highest since this year
#  ag_dt         Date of maximum gage-height for water year (if not concurrent with peak)
#  ag_tm         Time of maximum gage-height for water year (if not concurrent with peak
#  ag_gage_ht    maximum Gage height for water year in feet (if not concurrent with peak
#  ag_gage_ht_cd maximum Gage height code
#
# Sites in this file include:
#  USGS 15246000 GRANT C NR MOOSE PASS AK
#
# Peak Streamflow-Qualification Codes(peak_cd):
#   1 ... Discharge is a Maximum Daily Average
#   2 ... Discharge is an Estimate
#   3 ... Discharge affected by Dam Failure
#   4 ... Discharge less than indicated value,
#           which is Minimum Recordable Discharge at this site
#   5 ... Discharge affected to unknown degree by
#           Regulation or Diversion
#   6 ... Discharge affected by Regulation or Diversion
#   7 ... Discharge is an Historic Peak
#   8 ... Discharge actually greater than indicated value
#   9 ... Discharge due to Snowmelt, Hurricane,
#           Ice-Jam or Debris Dam breakup
#   A ... Year of occurrence is unknown or not exact
#   B ... Month or Day of occurrence is unknown or not exact
#   C ... All or part of the record affected by Urbanization,
```

Mining, Agricultural changes, Channelization, or other
D ... Base Discharge changed during this year
E ... Only Annual Maximum Peak available for this year
#
Gage height qualification codes(gage_ht_cd,ag_gage_ht_cd):
1 ... Gage height affected by backwater
2 ... Gage height not the maximum for the year
3 ... Gage height at different site and(or) datum
4 ... Gage height below minimum recordable elevation
5 ... Gage height is an estimate
6 ... Gage datum changed during this year
#
#

agency_cd	site_no	peak_dt	peak_tm	peak_va	peak_cd	gage_ht	gage_ht_cd	year_last_pk	ag_dt	ag_tm	ag_gage_ht	ag_gage_ht_cd
5s	15s	10d	6s	8s	27s	8s	13s	4s	10d	6s	8s	11s
USGS	15246000	1948-07-07		780	1							
USGS	15246000	1949-09-04		800	1							
USGS	15246000	1950-06-21		865		4.00						
USGS	15246000	1951-07-08		665	1							
USGS	15246000	1952-07-24		820		3.00	2		1952-06-28		3.36	
USGS	15246000	1953-06-28		2230		4.46						
USGS	15246000	1953-10-07		782		3.11						
USGS	15246000	1955-07-11		1050		3.45						
USGS	15246000	1956-08-20		663		2.93	2		1956-01-10		3.30	1
USGS	15246000	1957-09-03		1700		4.06						
USGS	15246000	1958-06-21		1020		3.42						

Appendix B: Supplemental Information

Table 3. Regression equations for estimating 2-, 5-, 10-, 25-, 50-, 100-, 200-, and 500-year peak streamflows for unregulated streams in Regions 1-7, Alaska and conterminous basins in Canada

[Q_T, *T*-year peak streamflow, in cubic feet per second; *A*, drainage area, in square miles; *ST*, area of lakes and ponds (storage), in percent; *P*, mean annual precipitation, in inches; *J*, mean minimum January temperature, in degrees Fahrenheit; *E*, elevation, in feet; *F*, area of forest, in percent]

Regression equation for specified recurrence interval Q_T	Average standard error of prediction (log units)	Average standard error of prediction (percent)	Average equivalent years of record
Region 1, Region 3 (93 gaging stations)			
Applicable range of variables:			
***A*: 0.720–571; *ST*: 0–26; *P*: 70–300; *J*: 0–32**			
$Q_2 = 0.004119\, A^{0.8361}\, (ST+1)^{-0.3590}\, P^{0.9110}\, (J+32)^{1.635}$	0.158	38	0.88
$Q_5 = 0.009024\, A^{0.8322}\, (ST+1)^{-0.3670}\, P^{0.8128}\, (J+32)^{1.640}$	.156	37	1.3
$Q_{10} = 0.01450\, A^{0.8306}\, (ST+1)^{-0.3691}\, P^{0.7655}\, (J+32)^{1.622}$	.157	37	1.8
$Q_{25} = 0.02522\, A^{0.8292}\, (ST+1)^{-0.3697}\, P^{0.7165}\, (J+32)^{1.588}$	.161	38	2.4
$Q_{50} = 0.03711\, A^{0.8286}\, (ST+1)^{-0.3693}\, P^{0.6847}\, (J+32)^{1.559}$	.166	40	2.8
$Q_{100} = 0.05364\, A^{0.8281}\, (ST+1)^{-0.3683}\, P^{0.6556}\, (J+32)^{1.527}$	.171	41	3.1
$Q_{200} = 0.07658\, A^{0.8276}\, (ST+1)^{-0.3669}\, P^{0.6284}\, (J+32)^{1.495}$	.178	43	3.4
$Q_{500} = 0.1209\, A^{0.8272}\, (ST+1)^{-0.3646}\, P^{0.5948}\, (J+32)^{1.449}$	.188	45	3.6
Region 2 (25 gaging stations)			
Applicable range of variables:			
***A*: 92.7–19,900; *ST*: 0–9; *P*: 12–100**			
$Q_2 = 0.7479\, A^{0.9580}\, (ST+1)^{-0.03292}\, P^{0.9284}$	.121	28	.82
$Q_5 = 1.021\, A^{0.9449}\, (ST+1)^{-0.03603}\, P^{0.9359}$	.116	27	1.5
$Q_{10} = 1.184\, A^{0.9368}\, (ST+1)^{-0.03813}\, P^{0.9500}$	.119	28	2.0
$Q_{25} = 1.374\, A^{0.9274}\, (ST+1)^{-0.04074}\, P^{0.9713}$	.129	30	2.5
$Q_{50} = 1.506\, A^{0.9209}\, (ST+1)^{-0.04263}\, P^{0.9887}$	.141	33	2.7
$Q_{100} = 1.628\, A^{0.9147}\, (ST+1)^{-0.04448}\, P^{1.007}$	.154	37	2.7
$Q_{200} = 1.742\, A^{0.9086}\, (ST+1)^{-0.04629}\, P^{1.027}$	.168	40	2.7
$Q_{500} = 1.880\, A^{0.9008}\, (ST+1)^{-0.04864}\, P^{1.056}$	.189	46	2.6
Region 4 (71 gaging stations)			
Applicable range of variables:			
***A*: 1.07–19,400; *ST*: 0–28; *P*: 20–158**			
$Q_2 = 0.2535\, A^{0.9462}\, (ST+1)^{-0.1981}\, P^{1.201}$	.177	42	.98
$Q_5 = 0.5171\, A^{0.9084}\, (ST+1)^{-0.2128}\, P^{1.162}$	.162	39	2.2
$Q_{10} = 0.7445\, A^{0.8887}\, (ST+1)^{-0.2204}\, P^{1.147}$	.159	38	3.5
$Q_{25} = 1.091\, A^{0.8686}\, (ST+1)^{-0.2273}\, P^{1.131}$	.164	39	5.0
$Q_{50} = 1.395\, A^{0.8563}\, (ST+1)^{-0.2313}\, P^{1.120}$	.172	41	5.9
$Q_{100} = 1.738\, A^{0.8457}\, (ST+1)^{-0.2347}\, P^{1.109}$	.183	44	6.6
$Q_{200} = 2.124\, A^{0.8363}\, (ST+1)^{-0.2377}\, P^{1.099}$	.194	47	7.1
$Q_{500} = 2.704\, A^{0.8253}\, (ST+1)^{-0.2413}\, P^{1.088}$	.212	52	7.4

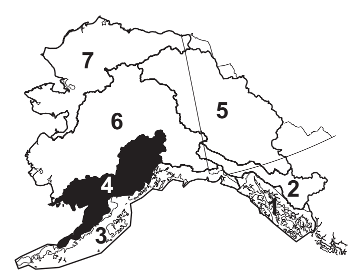


Table 4. Station information and peak-streamflow statistics for streamflow-gaging and partial-record stations in Alaska and conterminous basins in Canada—*Continued*

[Rounding differences may cause values in this table to vary by less than 1 percent from those computed using equations in table 3 or by the computer program available at http://pubs.water.usgs.gov/wri034188. **Station No.:** R, presently regulated. **Station name:** AK, Alaska; BC, British Columbia; YT, Yukon. **Region**: See figure 1 for location of regions. **Latitude and Longitude** are given in degrees, minutes, and seconds. **Mean basin elevation**: Elevations are given in feet above NGVD of 1929. **Skew coefficient used for analysis**: weighted skew except where noted in footnote. **Peak streamflow analysis type:** Sta, value of Q_T from analysis of observed station data using weighted skew coefficient; Reg, value of Q_T estimated from regression equation (table 3); Wtd, value of Q_T estimated by weighting Sta and Reg based on the years of record for station data and equivalent years of record for the equation. **Peak streamflow:** Q_T, peak streamflow having a recurrence interval of T years. –, not available; ft, foot; mi^2, square mile; in., inch; °F, degree Fahrenheit]

Station No.	Station name	Region	Latitude	Longitude	Drainage area (mi^2)	Mean basin elevation (ft)	Area of lakes and ponds (storage) (percent)	Area of forest (percent)	Mean annual precipitation (in.)	Mean minimum January temperature (°F)
15242000	Kasilof River near Kasilof, AK	4	60 19 05	151 15 35	738	1,810	15	39	50	10
15243950	Porcupine Creek near Primrose, AK	4	60 20 24	149 22 30	16.8	2,300	0	34	80	10
15244000	Ptarmigan Creek at Lawing, AK	4	60 24 20	149 21 45	32.6	2,800	6	46	90	10
15246000	Grant Creek near Moose Pass, AK	4	60 27 25	149 21 15	44.2	2,900	10	20	90	10
15248000	Trail River near Lawing, AK	4	60 26 01	149 22 19	181	2,470	2	9	90	10
15250000	Falls Creek near Lawing, AK	4	60 25 50	149 22 10	11.8	3,480	0	19	80	10
15251800	Quartz Creek at Gilpatricks, AK	4	60 35 45	49 32 35	9.41	3,260	0	11	60	10
15254000	Crescent Creek near Cooper Landing, AK	4	60 29 49	149 40 38	31.7	2,700	13	38	50	8
15258000[1,R]	Kenai River at Cooper Landing, AK	4	60 29 34	149 48 28	634	2,650	5	13	70	10
15258000[1,2,R]	Kenai River at Cooper Landing, AK, regulated years	4	61 29 34	150 48 28	634	2,650	5	13	70	10
15260000	Cooper Creek near Cooper Landing, AK	4	60 26 00	149 49 15	31.8	2,400	16	44	60	8
15266300	Kenai River at Soldotna, AK	4	60 28 39	151 04 46	1,950	1,750	5	29	50	8
15266500	Beaver Creek near Kenai, AK	4	60 33 50	151 07 03	51.0	140	15	67	20	6

[1] Record includes glacial outbursts. Station not included in regression analysis. Station skew coefficient used to calculate Q_T.
[2] Record includes regulated years. Station not included in regression analysis. Station skew coefficient used to calculate Q_T.
[3] Drainage area is indeterminate. Station not included in regression analysis. Station skew coefficient used to calculate Q_T.

Table 4. Station information and peak-streamflow statistics for streamflow-gaging and partial-record stations in Alaska and conterminous basins in Canada—*Continued*

[Rounding differences may cause values in this table to vary by less than 1 percent from those computed using equations in table 3 or by the computer program available at http://pubs.water.usgs.gov/wri034188. **Station No.:** R, presently regulated. **Station name:** AK, Alaska; BC, British Columbia; YT, Yukon. **Region**: See figure 1 for location of regions. **Latitude and Longitude** are given in degrees, minutes, and seconds. **Mean basin elevation**: Elevations are given in feet above NGVD of 1929. **Skew coefficient used for analysis**: weighted skew except where noted in footnote. **Peak streamflow analysis type:** Sta, value of Q_T from analysis of observed station data using weighted skew coefficient; Reg, value of Q_T estimated from regression equation (table 3); Wtd, value of Q_T estimated by weighting Sta and Reg based on the years of record for station data and equivalent years of record for the equation. **Peak streamflow:** Q_T, peak streamflow having a recurrence interval of *T* years. –, not available; ft, foot; mi^2, square mile; in., inch; °F, degree Fahrenheit]

Station No.	Number of systematic peaks	Skew coefficient used for analysis	Peak streamflow analysis type	Peak streamflow, in cubic feet per second, for given recurrence interval, in years							
				Q_2	Q_5	Q_{10}	Q_{25}	Q_{50}	Q_{100}	Q_{200}	Q_{500}
15242000	25	0.158	Sta	8,080	9,890	11,000	12,400	13,400	14,400	15,400	16,700
			Reg	8,300	10,900	12,700	15,000	16,800	18,500	20,300	22,700
			Wtd	8,080	9,930	11,100	12,700	13,800	14,900	16,000	17,500
15243950	27	.939	Sta	772	1,290	1,790	2,640	3,490	4,550	5,900	8,250
			Reg	706	1,090	1,390	1,800	2,110	2,440	2,780	3,270
			Wtd	769	1,270	1,730	2,460	3,140	3,960	4,940	6,580
15244000	10	.380	Sta	523	703	832	1,000	1,140	1,280	1,430	1,650
			Reg	1,040	1,510	1,870	2,350	2,710	3,080	3,470	4,010
			Wtd	558	815	1,040	1,350	1,590	1,830	2,080	2,430
15246000	10	.962	Sta	936	1,330	1,660	2,170	2,620	3,140	3,760	4,730
			Reg	1,260	1,810	2,220	2,760	3,170	3,590	4,020	4,620
			Wtd	961	1,410	1,790	2,350	2,810	3,310	3,860	4,690
15248000	29	.609	Sta	3,670	4,840	5,700	6,890	7,860	8,890	10,000	11,600
			Reg	6,200	8,600	10,400	12,600	14,300	16,000	17,800	20,300
			Wtd	3,720	4,990	5,980	7,370	8,490	9,660	10,900	12,700
15250000	8	.349	Sta	242	452	642	951	1,240	1,580	1,990	2,650
			Reg	505	793	1,020	1,320	1,560	1,810	2,070	2,440
			Wtd	266	519	749	1,090	1,380	1,690	2,030	2,540
15251800	8	.867	Sta	166	319	478	773	1,090	1,510	2,060	3,100
			Reg	289	462	599	785	932	1,090	1,250	1,480
			Wtd	176	343	508	777	1,020	1,310	1,660	2,240
15254000	34	.750	Sta	331	519	682	939	1,180	1,460	1,790	2,330
			Reg	434	643	799	1,010	1,170	1,330	1,510	1,750
			Wtd	334	526	692	948	1,170	1,430	1,730	2,210
15258000[1,R]	13	1.42	Sta	9,960	12,900	15,400	19,200	22,600	26,500	31,000	38,000
15258000[1,2,R]	39	.372	Sta	11,100	14,800	17,400	20,800	23,500	26,400	29,300	33,500
15260000	10	.952	Sta	294	413	512	662	796	950	1,130	1,410
			Reg	521	764	947	1,190	1,370	1,560	1,760	2,040
			Wtd	310	465	605	812	982	1,170	1,360	1,660
15266300	35	.788	Sta	18,900	24,000	27,700	32,800	37,000	41,400	46,300	53,200
			Reg	25,300	32,500	37,500	43,700	48,400	53,000	57,800	64,300
			Wtd	19,000	24,200	28,100	33,400	37,700	42,300	47,200	54,200
15266500	25	.0559	Sta	188	357	501	721	914	1,130	1,380	1,750
			Reg	221	332	414	524	610	699	793	925
			Wtd	189	355	490	685	849	1,030	1,230	1,530

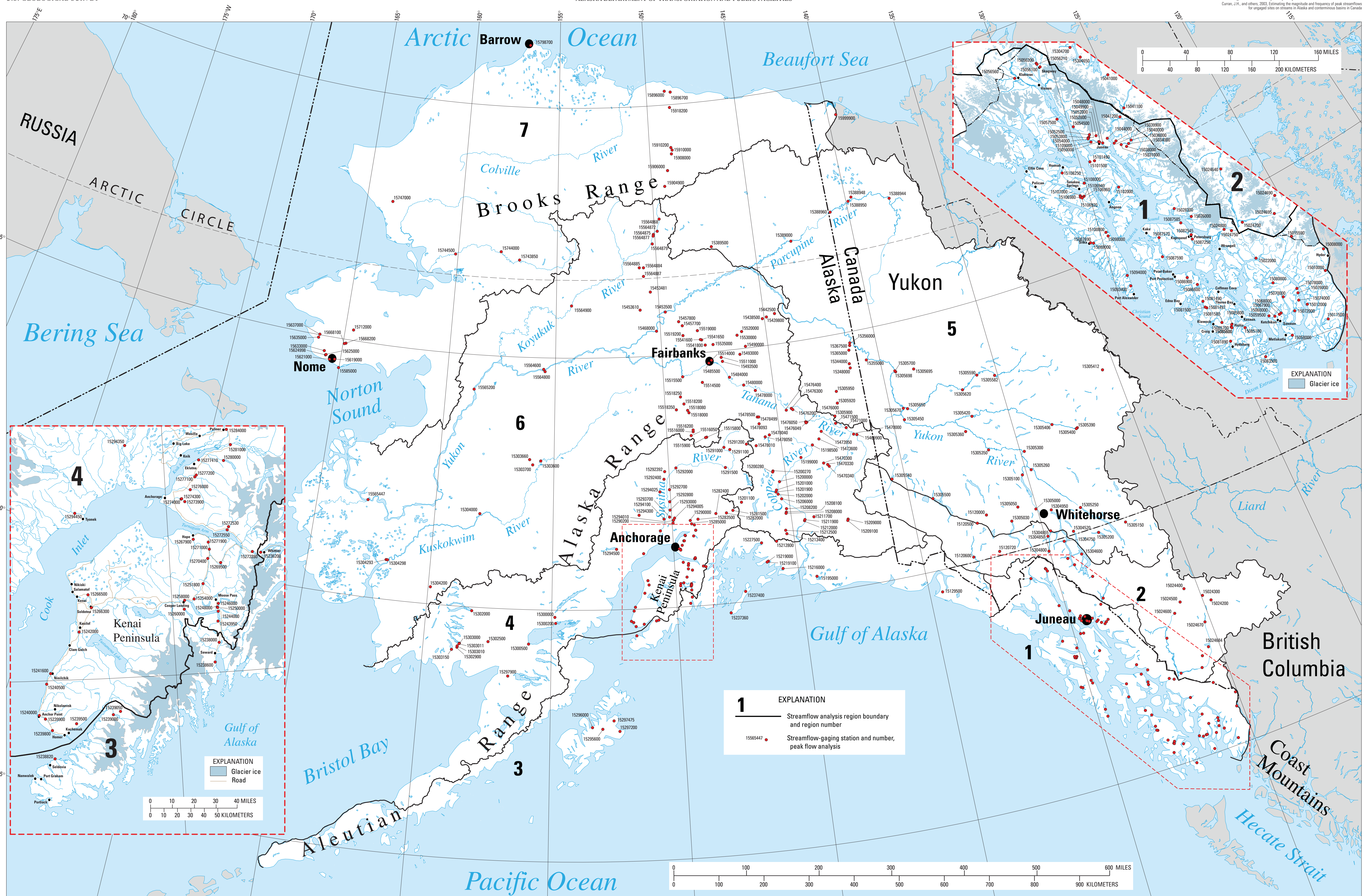
Appendix A. Years of record for annual peak streamflows used in this report—*Continued*
[Refer to table 4 for number of systematic peaks used; AK, Alaska; BC, British Columbia; YT, Yukon]

Station No.	Station name	Water years for peak streamflows (systematic and historic) used in this report	Water years for historic peaks used in this report	Length of historic period (years)
15216000	Power Creek near Cordova, AK	1948-95	–	–
15219000	West Fork Olsen Bay Creek near Cordova, AK	1965-80	–	–
15219100	Control Creek near Cordova, AK	1964-74	–	–
15227500	Mineral Creek near Valdez, AK	1976-81, 1990-99	–	–
15236200	Shakespeare Creek at Whittier, AK	1970-80, 1984-99	–	–
15237360	San Juan River near Seward, AK	1987-96	–	–
15237400	Chalmers River near Cordova, AK	1967-73, 1975-80	–	–
15238000	Lost Creek near Seward, AK	1949, 1963-72, 1976, 1987	1976, 1987	51
15238600	Spruce Creek near Seward, AK	1966-86, 1988-99	–	–
15238820	Barabara Creek near Seldovia, AK	1973-92	–	–
15239000	Bradley River near Homer, AK	1958-88	–	–
15239050	Middle Fork Bradley River tributary near Homer, AK	1980-99	–	–
15239500	Fritz Creek near Homer, AK	1963-99	–	–
15239800	Diamond Creek near Homer, AK	1963-81	–	–
15239900	Anchor River near Anchor Point, AK	1966-74, 1979-87, 1992	–	48
15240000	Anchor River at Anchor Point, AK	1954-66, 1984-92	–	48
15240500	Cook Inlet tributary near Ninilchik, AK	1966-81	–	–
15241600	Ninilchik River at Ninilchik, AK	1963-85, 1999	–	–
15242000	Kasilof River near Kasilof, AK	1950-74, 1977	1977	28
15243950	Porcupine Creek near Primrose, AK	1963-89	–	–
15244000	Ptarmigan Creek at Lawing, AK	1948-50, 1952-58	–	–
15246000	Grant Creek near Moose Pass, AK	1948-50, 1952-58	–	–
15248000	Trail River near Lawing, AK	1948-50, 1952-77	–	–
15250000	Falls Creek near Lawing, AK	1963-70	–	–
15251800	Quartz Creek at Gilpatricks, AK	1963-70, 1987	1987	25
15254000	Crescent Creek near Cooper Landing, AK	1950-83	–	–
15258000	Kenai River at Cooper Landing, AK	1948-60	–	–
15258000	Kenai River at Cooper Landing, AK, regulated years	1961-99	–	–
15260000	Cooper Creek near Cooper Landing, AK	1950-59	–	–
15266300	Kenai River at Soldotna, AK	1965-99	–	47
15266500	Beaver Creek near Kenai, AK	1968-78, 1980-83, 1985-94	–	–
15267900	Resurrection Creek near Hope, AK	1968-85	–	–
15269500	Granite Creek near Portage, AK	1967-80	–	–
15270400	Donaldson Creek near Wibel, AK	1963-72	–	–
15271000	Sixmile Creek near Hope, AK	1980-90, 1998-99	–	–
15271900	Cub Creek near Hope, AK	1965-79	–	–
15272280	Portage Creek at Portage Lake outlet near Whittier, AK	1989-99	–	–
15272530	California Creek at Girdwood, AK	1967-84, 1986-93, 1995	1995	28
15272550	Glacier Creek at Girdwood, AK	1966-78	–	–
15273900	South Fork Campbell Creek at canyon mouth near Anchorage, AK	1967-79, 1981	–	–
15274000	South Fork Campbell Creek near Anchorage, AK	1948-72, 1999	–	–
15274300	North Fork Campbell Creek near Anchorage, AK	1967-84	–	–

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
ALASKA DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES

WATER-RESOURCES INVESTIGATIONS REPORT 03Ð4188
Magnitude and frequency of peak streamflowsÑPLATE 1
Curran, J.H., and others, 2003, Estimating the magnitude and frequency of peak streamflows
for ungaged sites on streams in Alaska and conterminous basins in Canada



Base map modified from U.S. Geological Survey Digital Line Graphs published at 1:2,000,000
Canadian Land Inventory Level I Digital Data published at 1:2,000,000
Publication projection is Albers Equal Area
Standard Parallels are 55° and 65°, central meridian -154°, latitude of projection origin 50°
Russian coastline from U.S. Geological Survey, Geologic Investigations Series I-2679, published at 1:7,500,000.
Projection is Albers Equal Area, Standard Parallels are 55° and 65°, central meridian 160° west

MAP SHOWING STREAMFLOW ANALYSIS REGIONS AND LOCATIONS OF STREAMFLOW-GAGING AND PARTIAL-RECORD STATIONS FOR WHICH PEAK-STREAMFLOW STATISTICS WERE COMPUTED, ALASKA AND CONTERMINOUS BASINS IN CANADA

By
Janet H. Curran, David F. Meyer, and Gary D. Tasker

2003