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Funding for WRDS and the creation of this electronic document was provided by the Wyoming Water Development Commission (http://wwdc.state.wy.us)

FINAL REPORT ON THE FEASIBILITY OF PROVIDING INSTREAM FLOWS IN THE DOUGLAS CREEK DRAINAGE

Lidstone & Anderson, Inc.
Water Resources and Environmental Consultants

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Prepared For:

Wyoming Water Development Commission
Herschler Building, 4th Floor
Cheyenne, WY 82002

Prepared By:

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June 11, 1993

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I. SUMMARY

The Wyoming Water Development Commission (WWDC) is required by W.S. 41-3-1004(a) to evaluate the capability of a given basin to provide the unappropriated direct flows necessary to meet the Wyoming Game and Fish Department (WGFD) instream flow request at a particular instream flow segment. Lidstone & Anderson, Inc. was contracted by the WWDC to investigate the following streams identified by the WGFD:

Instream Flow Segment	Temporary Filing No.	Stream Length	Instream Flow Request (cfs)
Douglas Creek	27 5/213	22.3 miles	5.5
Horse Creek	27 1/213	0.1 miles	0.2
Nugget Gulch Branch	27 2/213	0.1 miles	0.2
Beaver Creek	27 3/213	1.9 miles	0.35
Camp Creek	27 4/213	1.2 miles	0.2
Lake Creek	27 2/211	5.8 miles	0.5

For all streams identified above, the instream flow request applies to the entire year. A vicinity map illustrating the general location of the instream flow segments is provided on Figure 1.

In previous instream flow studies, the point of measurement for the instream flow filings was identified at the downstream end of the instream flow segments. For the streams within the Douglas Creek Basin, the point of measurement was changed to the upstream end of each segment. The Wyoming Game and Fish Department (WGFD) specifically requested this change to coincide with the diversions associated with the Douglas Creek Diversion Pipeline which is part of the City of Cheyenne Stage II Water Project.

In addition to the evaluation of available flow at the upstream end of each instream flow segment, the WGFD requested a determination of the flow available at two additional locations within Douglas Creek. Consequently, the analysis was also conducted for Douglas Creek near the Foxpark gaging station and at the confluence of Douglas Creek with the North Platte River.

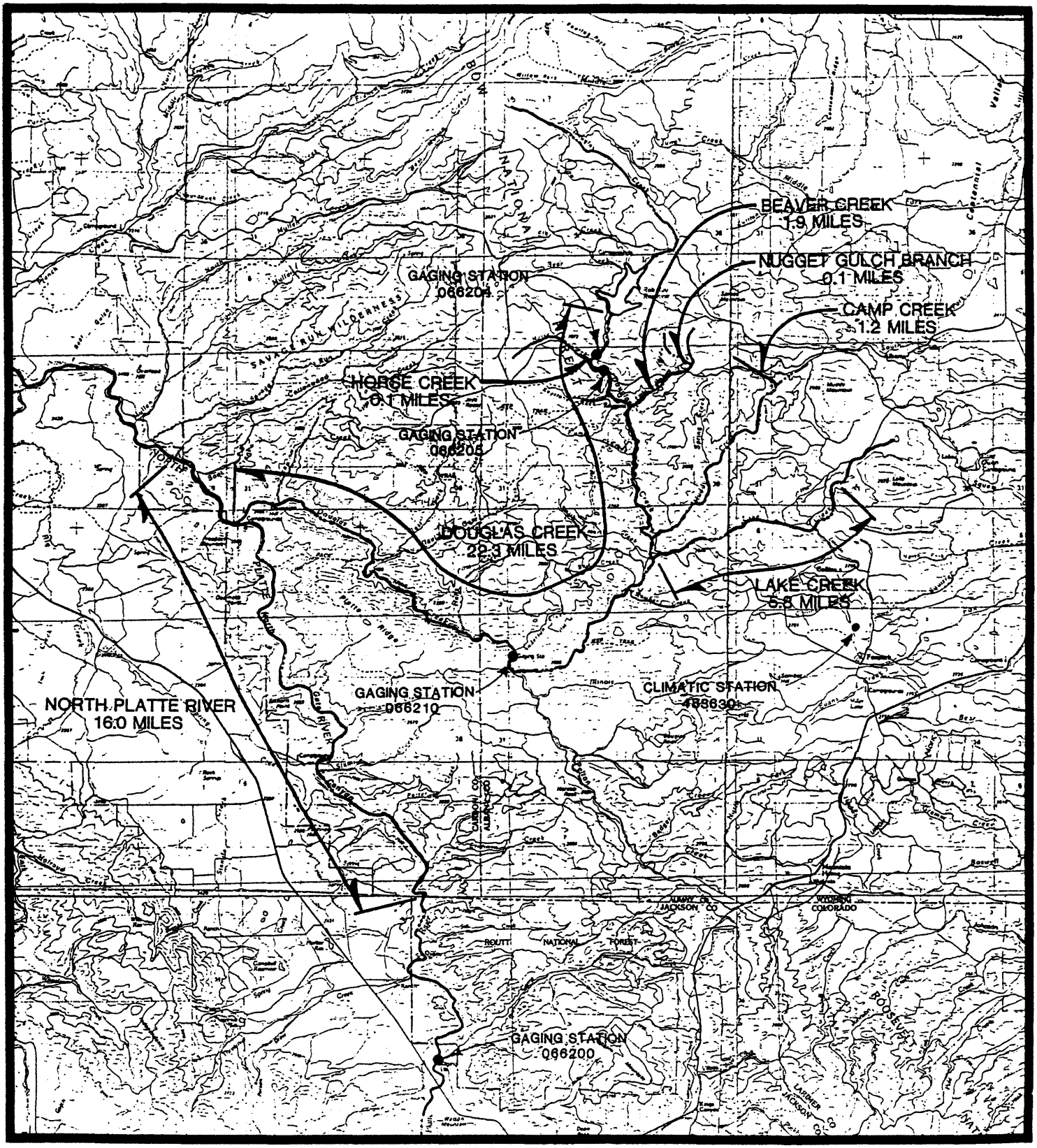

Figure 1. Project Location Map.

The investigation of the instream flow requests included an analysis of mean monthly flows, dry year flows and a daily flow exceedance analysis. The results of the investigation can be summarized as follows:

Mean Monthly Flow Analysis

The results of the monthly flow analysis indicated that the requested flow of 5.5 cfs for the *Douglas Creek* instream flow segment is available from March through October at the confluence of the North Platte River and at the Foxpark gaging station. At the upstream end of the segment, a shortage occurs during the winter months of November through March and the month of September.

At the upstream end of the *Horse Creek* instream flow segment, the requested flow of 0.2 cfs is available during the entire year.

The requested flow of 0.35 cfs at the upstream end of the *Beaver Creek* instream flow segment is available during the months of April through July.

The requested flow of 0.5 cfs is available every month of the year at the upstream end of the *Lake Creek* instream flow segment.

At the upstream end of the *Nugget Gulch Branch* instream flow segment, the requested flow of 0.2 cfs is available during the months of May and June.

The requested flow of 0.2 cfs at the upstream end of the *Camp Creek* instream flow segment is available from April through July. Shortfalls occur during the remaining months.

Dry Year Flow Analysis

For the *Douglas Creek* instream flow segment, shortages predominantly occur in the months of August through March during the driest year, 1977. The annual shortfall for the dry year analysis is approximately 1,565 acre-feet, 1,262 acre-feet, and 1,262 acre-feet respectively for the upstream end of the instream flow segment, at the Foxpark gaging station and at the confluence with the North Platte River.

No annual shortfall occurs for the *Horse Creek* instream flow segment.

For the *Beaver Creek* instream flow segment, shortages occur during the months from August through March and total approximately 117 acre-feet.

Shortages occur from November through March within the *Lake Creek* instream flow segment. The total annual shortfall is approximately 36 acre-feet.

Shortages occur in every month except May and June for the *Nugget Gulch Branch* instream flow segment. Approximately 106 acre-feet is the annual shortfall.

For the *Camp Creek* instream flow segment, shortages are experienced during the months from August through April. The total annual shortfall is approximately 75 acre-feet.

Shortages experienced during the dry years may be alleviated with storage upstream of the Beaver Creek, Lake Creek and Camp Creek instream flow segments. The amount of storage is minimal and several potential storage locations may be feasible.

Daily Flow Exceedance Analysis

The available flows exceed the criteria adopted by the WGFD for feasible instream flows in Douglas Creek, Horse Creek and Lake Creek. The WGFD considers that the instream flow requests are feasible if the requested flow is available 40% of the time during the time period from July 1st to September 30th.

The available flows in Beaver Creek, Camp Creek and Nugget Gulch Branch fall short of the criteria adopted by the WGFD.

II. WATER RIGHTS

To facilitate the generation of virgin streamflow data for each instream flow segment, a data base of water right information was compiled. This data base included all water rights and permits located *upstream of the downstream end* of each instream flow segment. The staff of the Wyoming State Engineer's Office (Mr. Jade Henderson) provided the information necessary to develop the data base.

Table 1 presents the tabulation of water right information for the instream flow segments within the Douglas Creek Basin. The data are listed sequentially by priority date and include both direct flow and storage rights. The tabulation is restricted to those water rights with the following status: (a) adjudicated, (b) unadjudicated, (c) temporary filing, and (d) permits in good standing but not constructed. Water right permits that are either expired or canceled have not been included in Table 1. Table 2 presents a tabulation of water right information for Horse Creek, Nugget Gulch Branch, Beaver Creek, Camp Creek and Lake Creek.

Table 1. Wyoming Water Rights: Douglas Creek Drainage.

Permit #	Facility	Source	Priority Date			Amount (cfs)	Use* Code	Status	Diversion Location		
			M	D	Y				Sec.	Twn.	Rng
DIRECT FLOW: 18909D	Holmes Campground Pipe Line	Holmes Spring	2	28	1938	.030	2	Adj.	4	14	79
18926D	Keystone Ranger Station Pipe Line	Keystone Creek	5	21	1938	0.45	2	Adj.	21	14	79
19072D	WY Timber Co. Camp Pipe Line	Camp Spring	10	13	1938	0.18	2	Adj.	21	14	79
19599D	Keystone Cabin Group Pipe Line	Keystone Spring #1	7	3	1941	.020	2,3	Adj.	21	14	79
19649D	Ropers Resort Ditch	Smith N. Creek	7	3	1941	.160	1,2,3	Adj.	10	13	79
19800D	Keystone Cabin Group Pipe Line	Keystone Spring #2	7	18	1941	.020	2,3	Adj.	21	14	79
22094D	Douglas Creek Diversion Pipe Line	Douglas Creek	3	12	1954	227.93	8,10,1	Unadj.	9	14	79
22095	Douglas Creek Diversion Pipe Line	West Branch Muddy Creek	3	12	1954	1.00	1,10,8	Adj.	22	14	78
22097D	Douglas Creek Diversion Pipe Line	Podunk Creek	3	12	1954	1.70	1,10,8	Adj.	22	14	79
22101D	Douglas Creek Diversion Pipe Line	Spring Creek	3	12	1954	4.60	1,10,8	Adj.	13	14	79
21561D	Bluejay #1 Pipe Line	Bluejay Spring #1	2	14	1955	.01	2	Unadj.	22	14	79
21562D	Bluejay #2 Pipe Line	Bluejay Spring #2	2	14	1955	.01	2	Adj.	22	14	79
21563D	Bluejay #3 Pipe Line	Bluejay Spring #3	2	14	1955	.01	2	Unadj.	22	14	79
21564D	Bluejay #4 Pipe Line	Bluejay Spring #1	2	14	1955	.01	2	Unadj.	22	14	79
21565D	Bluejay #5 Pipe Line	Bluejay Spring #2	2	14	1955	.01	2	Unadj.	22	14	79
21566D	Bluejay #6 Pipe Line	Bluejay Spring #3	2	14	1955	.01	2	Unadj.	22	14	79

Table 1. Wyoming Water Rights: Douglas Creek Drainage (Con't.)

Permit #	Facility	Source	Priority Date			Amount (cfs)	Use* Code	Status	Diversion Location		
			M	D	Y				Sec.	Twn.	Rng
DIRECT FLOW: 21655D	Nevada Springs Pipe Line #1	Nevada Spring #1	8	23	1955	.02	2	Unadj.	34	14	79
21656D	Nevada Springs Pipe Line #2	Nevada Spring #2	8	23	1955	.01	2	Unadj.	34	14	79
21671D	Nevada Springs Pipe Line #17	Nevada Spring #17	8	23	1955	.05	2	Adj.	22	14	79
21672D	Nevada Springs Pipe Line #18	Nevada Spring #18	8	23	1955	.015	2	Adj.	22	14	79
21673D	Nevad Springs Pipe Line #19	Nevada Spring #19	8	23	1955	.02	2	Adj.	22	14	79
21799D	Freeman Pipe Line	Freeman Spring	9	20	1956	.02	2	Adj.	22	14	79
25241D	Konold Pipe Line	Konold Spring	6	3	1976	.026	2	Adj.	22	14	79
25242D	Konold Pipe Line	Konold Spring	6	3	1976	.007	2	Adj.	22	14	79
STORAGE: 6536R	Rob Roy	Douglas Creek	6	2	1955	5489.2 AF	8,10,1	Adj.	9	14	79
6537R	Berg (Lake Owen)	Douglas Creek	5	8	1956	.00 AF	8,10,1	Unadj./ Gst.	25	14	78
6888R	Enl. Rob Roy	Douglas Creek	1	4	1967	3405.21A F	8,10,1	Adj.	9	14	79
8444R	Enl. Rob Roy	Douglas Creek	4	16	1979	26539.51 AF	8,10,1	Adj.	9	14	79
8779S	Horatio Rock #3	Cecilia Dr.	6	10	1981	.16 AF	3	Adj.	5	12	79
8780S	Horatio Rock #4	Drainage Of.	6	10	1981	.16 AF	3	Adj.	32	13	79
8781S	Horatio Rock #5	Little Steve Dr.	6	10	1981	.16 AF	3	Adj.	33	13	79
8782S	Horatio Rock #6	Ida Dr.	6	10	1981	.16 AF	3	Adj.	34	13	79
8783S	Horatio Rock #7	Drainage Of.	6	10	1982	.16 AF	3	Adj.	34	13	79
10715S	Horatio Rock #8	Saddle Dr.	5	18	1989	.16 AF	3	Unadj.	4	12	79

*Use Description: 1= Irrigation 2= Domestic 3= Stock 4= Highway Department 5=Mining 6= Power 7= BLM Water Use 8= Municipal Use 9= Miscellaneous Use 10=Industrial 11=Instream Flow 12=Supplemental Supply

Table 2. Wyoming Water Rights: Horse Creek, Beaver Creek, Nugget Gulch Branch, Camp Creek, and Lake Creek.

Permit #	Facility	Source	Priority Date			Amount (cfs)	Use* Code	Status	Diversion Location		
			M	D	Y				Sec.	Twn.	Rng
HORSE CREEK											
DIRECT FLOW: 22115D	Keystone Creek, Ext. Douglas Creek	Horse Creek	3	3	1961	22.96	10,8,1	Unadj/G st	16	14	79
BEAVER CREEK											
DIRECT FLOW: 19592D	Keystone Ranger Station Pipe Line	Keystone Ranger Station Spring	7	3	1941	.090	3,9,2	Adj.	22	14	79
22100D	Douglas Creek Diversion Pipe Line	Beaver Creek	3	12	1954	1.400	10,8,1	Adj.	14	14	79
22098D	Douglas Creek Diversion Pipe Line	Gold Crater Creek	3	12	1954	1.600	10,8,1	Adj.	15	14	79
22099D	Douglas Creek Diversion Pipe Line	Spring Branch	3	12	1954	12.300	10,8,1	Adj.	14	14	79
NUGGET GULCH BRANCH											
DIRECT FLOW: 22096D	Douglas Creek Diversion Pipe Line	Nugget Gulch Branch	3	12	1954	1.900	10,8,1	Adj.	14	14	79
CAMP CREEK											
DIRECT FLOW: 22103D	Douglas Creek Diversion Pipe Line	Middle branch Camp Creek	3	12	1954	1.200	10,8,1	Adj.	18	14	78
22102D	Douglas Creek Diversion Pipe Line	Camp Creek	3	12	1954	2.000	10,8,1	Adj.	13	14	79
22104D	Douglas Creek Diversion Pipe Line	East Branch Camp Creek	3	12	1954	1.0	10,8,1	Adj.	18	14	78
LAKE CREEK											
No adjudicated or unadjudicated water rights filed.											

*Use Description

1= Irrigation 3= Stock 5= Mining 7= BLM Water Use 9= Miscellaneous Use 11=Instream Flow
2= Domestic 4= Highway Department 6= Power 8= Municipal Use 10=Industrial 12=Supplemental Supply

III. STREAMFLOW RECORDS

Within the Douglas Creek Basin, limited data records were available to document the historic streamflow in the vicinity of the instream flow segments. During the hydrologic analysis, data from two United States Geological Survey (USGS) gaging stations located on Douglas Creek were utilized. The approximate location of these two gaging stations is presented on Figure 1. Data from a third USGS gaging station, located above Hog Park Creek on the Encampment River, was utilized to extend the period of records from the two gages on Douglas Creek. Pertinent information related to all three gages is provided below.

Table 3. Pertinent USGS Gaging Data.

Stream	USGS Gage #	Location	Period of Record
Douglas Creek	066204 066210	Above Keystone Near Foxpark	1955-65 1946-72
Encampment River	066238	Above Hog Park Creek	1965-91

The historic flow records for these gaging stations are presented in tabular form in Appendix B.

IV. HYDROLOGY

4.1 General

The objective of the hydrologic analysis is to develop virgin streamflow data to promote the determination of the flow available to satisfy the instream flow request. In previous instream flow studies, the point of measurement for the instream flow filings was identified at the downstream end of the instream flow segments. For the streams within the Douglas Creek Basin, the point of measurement was changed to the upstream end of each segment. The Wyoming Game and Fish Department (WGFD) specifically requested this change to coincide with the diversions associated with the Douglas Creek Diversion Pipeline which is part of the City of Cheyenne Stage II Water Project.

In addition to the evaluation of available flow at the upstream end of each instream flow segment, the WGFD requested a determination of the flow available at two additional locations within Douglas Creek. Consequently, the hydrologic analysis was also conducted for Douglas Creek near the Foxpark gaging station and at the confluence of Douglas Creek with the North Platte River. A schematic diagram illustrating the relative locations of gaging stations, tributaries, major diversions and the proposed instream flow segments is provided in Figure 2. Exhibit 1 presents a detailed map of the study area associated with the instream flow requests.

There are several existing water rights within the Douglas Creek Basin. Few of these rights directly impact the flow available within the instream flow segments with the most notable exceptions being the water rights associated with the Douglas Creek Diversion Pipeline. Prior to the construction of these facilities, the USFS issued a Special Use Permit which identified a bypass requirement to sustain minimum flows downstream of each diversion. In accordance with the Special Use Permit, the requirement to satisfy the bypass flows must be fulfilled prior to the diversion of water to the Stage II Water Project. The bypass requirement directly coincides with the water right filed by the WGFD for the purpose of providing an instream flow for fisheries within each segment. Consequently, the diversions associated with the Douglas Creek Diversion Pipeline will not impact the available flow at the upstream end of the instream flow segment. It is important to note that the diversions to the Douglas Creek Diversion Pipeline will impact the available flows at the Foxpark gage along Douglas Creek and the downstream end of the instream flow segment along Douglas Creek. This will be discussed in more detail in Section 4.2. The conditions of the Special Use Permit associated with the Stage II Water Project are presented for information purposes in Appendix C.

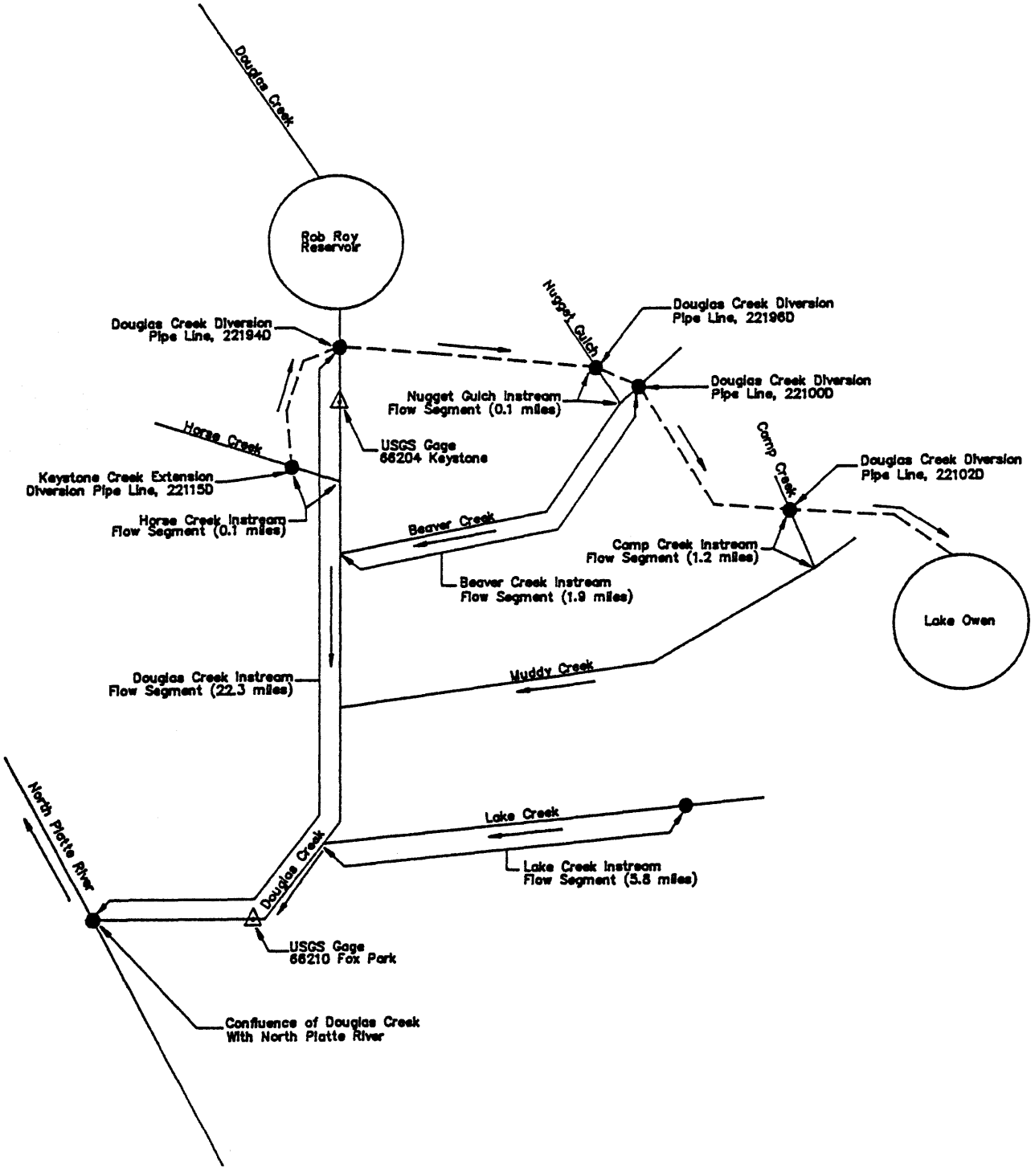

FIGURE 2. SCHEMATIC DIAGRAM DOUGLAS CREEK

The remaining water rights within the Douglas Creek Basin are very small with 8.39 cfs and 0.96 acre-feet of direct flow and storage rights, respectively. No storage rights presently exist in the vicinity of the instream flow segments for Horse Creek, Beaver Creek, Nugget Gulch Branch, Camp Creek or Lake Creek. The only direct flow right (other than those associated with the Douglas Creek Diversion Pipeline) is for 0.09 cfs located within the Beaver Creek Basin.

4.2 Determination of Available Flow

The first step in the hydrologic analysis is the generation of monthly streamflow data at the locations requested by the WGFD. These data may be generated through various techniques depending on the data available in the vicinity of the instream flow segments. The best approach involves the utilization of gaging data and the development of correlations to synthesize the long-term flow records.

Where gaging information is limited, other techniques must be applied to generate the monthly streamflow data. These techniques commonly involve regression equations that relate streamflow characteristics to features of the drainage basin. These regional equations were based on gaged streams and may be applied to ungaged streams where streamflow determinations are required. A good method for this type of approach is described by Lowham ("Streamflows in Wyoming", USGS, Water Resources Investigation Report 88-4045, 1988). This publication documents regional relationships which involve regression equations based on area-elevation data or altitude-runoff data.

Both techniques were investigated during the completion of this study. Given the gaging information along Douglas Creek, the determination of available flow for this instream flow segment was based on an evaluation and correlation of annual and monthly streamflow data. For the ungaged basins (Horse Creek, Nugget Gulch Branch, Beaver Creek, Camp Creek and Lake Creek), the determination of available flow was based on an evaluation and comparison of Lowham's procedures with unit runoff values derived from the gaged watershed of Douglas Creek. A more detailed discussion of the procedures utilized during the determination of available streamflow for both the gaged and ungaged watersheds is provided in the following paragraphs.

4.2.1 Douglas Creek

For Douglas Creek, the evaluation of available streamflow was based on the correlation of the gaging records near Keystone (Gage #066204) with the gaging records near Foxpark (Gage #066210) and the records of the Encampment River above Hog Park Creek (Gage #066238). As indicated in Exhibit 1, the upstream end of the instream flow segment is located less than one mile above the Keystone gage.

Prior to the manipulation of gaging data, a determination regarding the correlation of monthly versus annual flow data was made. Based on a report prepared by the Water Resources Research Institute ("Cheyenne Water Project Feasibility Study", 1979), the results of regression analyses conducted with annual flows will be more reliable than those using monthly values. For example, although some monthly correlations may be excellent, a poor correlation during a month with high runoff may incorrectly reflect the annual values for a given station. Given the information in the WRRI Report, the correlation of gaging data was evaluated with annual flow values. Once the annual flows were determined, the historic records of virgin streamflow were utilized to evaluate the monthly flow distribution and generate the monthly flow values. Appendix D presents the documentation related to the procedures utilized to determine the distribution of monthly flow values.

Adjustments to the annual flow values at both the Keystone and Foxpark gages were made to: (a) reflect the upstream diversions to Lake Owen and the storage allocation in Rob Roy Reservoir, and (b) generate the virgin streamflow data. Appendix D documents the approach taken to develop the virgin flow data at the Keystone and Foxpark gages. In general, the gage data for the Foxpark gage were adjusted to reflect the diversions to Lake Owen and the changes in storage in Rob Roy Reservoir. For the ten years of gage data at the Keystone gage (1955 to 1965), the records were only adjusted to reflect the diversions to Lake Owen since storage changes in Rob Roy Reservoir did not occur until 1966. With the virgin streamflow data, a regression analysis was conducted to develop a correlation between the Keystone and Foxpark gaging data. The results of the regression analysis are indicated below.

Period of Correlation	1955 to 1965
Number of Observations	10
Equation	Keystone = 7195 + 0.293 x Foxpark
Correlation Coefficient	0.95
Coefficient of Determination	0.91

This information was utilized to extend the Keystone gage to coincide with the period of record of the Foxpark gage (1947 to 1971). An additional regression analysis was conducted to further extend the period of record to 1990. For this analysis, a correlation of gaging data from the Foxpark gage with data from the gaging station on the Encampment River above Hog Park Creek (#066238) was conducted. The results of this second regression analysis are presented below.

Period of Correlation	1965 to 1971
Number of Observations	7
Equation	Foxpark = -27,550 + 1.157xHog Park
Correlation Coefficient	0.93
Coefficient of Determination	0.86

With the record at the Foxpark gage extended to 1990, the regression equation between Foxpark and Keystone was utilized to generate the long-term record for the Keystone gage. Appendix D also presents graphical results of the regression analysis.

To adjust the long-term record at the Keystone gage to the upstream end of the instream flow segment for Douglas Creek, an area-weighting procedure was utilized whereby the annual flow values were reduced by 5% to compensate for a corresponding decrease in drainage area. Table 4 presents the average monthly flows for the upstream end of the instream flow segment. The average monthly flows within Douglas Creek near the Foxpark gaging station are provided in Table 5.

To determine the average monthly flows at the downstream end of the instream flow segment (confluence of Douglas Creek and the North Platte River), an estimation of the runoff volume for the drainage basin below the Foxpark gage was developed. This estimate was based on the flow contribution for the area between the Keystone and Foxpark gages. For the drainage basin located between the gages (approximately 98 square miles), an estimate of 0.6 acre-feet/acre was generated for the annual flow volume of 37,040 acre-feet. The contributing area below the Foxpark gage is approximately 61 square miles and is hydrologically very similar to the area between the Foxpark and Keystone gages. Consequently, a unit runoff of 0.6 acre-feet/acre was utilized to generate the annual and monthly flows at the downstream end of the instream flow segment. Table 6 presents the results of this analysis.

Table 4. Average Monthly Flow (cfs): Douglas Creek @ Beginning of Instream Flow Segment

YEAR	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	ANNUAL (AF)
1947	6.9	5.1	3.9	3.5	3.3	3.3	13.4	171.0	186.0	23.1	7.4	5.7	26,162
1948	5.6	4.2	3.2	2.9	2.6	2.7	11.0	139.7	152.0	18.9	6.0	4.6	21,373
1949	7.1	5.3	4.1	3.7	3.4	3.5	14.0	178.0	193.6	24.0	7.7	5.9	27,229
1950	6.2	4.6	3.6	3.2	3.0	3.0	12.3	155.8	169.4	21.1	6.7	5.1	23,829
1951	7.0	5.2	4.0	3.6	3.4	3.4	13.8	175.5	191.0	23.7	7.6	5.8	26,848
1952	7.0	5.2	4.0	3.6	3.4	3.4	13.8	175.5	191.0	23.7	7.6	5.8	26,859
1953	4.6	3.4	2.6	2.4	2.2	2.3	9.1	114.9	125.1	15.5	4.9	3.8	17,591
1954	3.8	2.8	2.2	2.0	1.8	1.8	7.4	94.2	102.5	12.8	4.1	3.1	14,411
1955	5.2	4.0	2.9	2.6	2.4	2.5	10.6	116.5	63.2	12.9	7.9	3.3	14,202
1956	3.5	3.3	3.3	3.8	3.4	3.8	9.3	211.5	95.6	10.7	5.2	2.9	21,663
1957	3.6	3.0	2.6	2.1	1.9	1.7	2.1	39.5	349.0	63.1	10.1	4.6	28,990
1958	6.3	3.3	2.8	2.4	1.7	1.2	18.9	262.0	156.1	10.0	4.5	4.0	28,730
1959	2.7	2.5	2.0	1.7	1.6	1.5	3.0	95.5	227.4	17.0	5.8	4.7	21,978
1960	11.1	5.7	3.3	2.8	2.5	2.4	21.1	148.3	99.6	11.0	4.0	3.1	19,089
1961	3.0	3.4	2.8	2.4	1.9	2.2	7.7	128.4	109.1	10.9	6.0	12.5	17,567
1962	16.2	11.5	6.7	5.1	5.1	5.6	37.1	190.0	140.7	21.1	5.6	3.7	27,148
1963	4.3	2.6	1.9	1.6	1.9	2.4	4.1	164.3	70.7	9.5	5.7	9.2	16,909
1964	7.1	7.4	6.8	6.9	6.9	6.1	9.3	115.3	191.0	30.7	11.9	6.5	24,486
1965	6.1	6.9	7.7	6.1	7.1	6.5	7.6	114.7	229.1	32.4	11.2	6.7	27,001
1966	4.6	3.5	2.6	2.4	2.3	2.3	9.2	116.1	126.3	15.7	5.0	3.9	17,762
1967	5.3	4.0	3.0	2.7	2.6	2.6	10.4	131.9	143.4	17.8	5.7	4.3	20,173
1968	7.0	5.2	4.0	3.6	3.4	3.4	13.7	174.6	189.9	23.5	7.6	5.8	26,709
1969	6.0	4.4	3.4	3.1	2.9	2.9	11.8	149.6	162.8	20.2	6.4	4.9	22,893
1970	8.1	6.0	4.6	4.2	3.9	4.0	16.0	203.1	220.8	27.4	8.7	6.7	31,062
1971	9.3	6.9	5.3	4.8	4.4	4.4	18.2	231.6	252.0	31.3	10.0	7.7	35,437
1972	5.3	3.9	3.0	2.7	2.6	2.6	10.3	131.2	142.7	17.7	5.7	4.3	20,073
1973	5.9	4.3	3.4	3.0	2.8	2.8	11.5	146.9	159.8	19.9	6.3	4.8	22,471
1974	7.6	5.7	4.3	3.9	3.7	3.7	14.8	188.6	205.2	25.5	8.1	6.2	28,857
1975	7.3	5.4	4.2	3.8	3.5	3.5	14.2	180.7	196.6	24.4	7.8	6.0	27,647
1976	6.0	4.4	3.4	3.1	2.9	2.9	11.8	149.8	163.1	20.2	6.4	4.9	22,927
1977	3.1	2.4	1.8	1.6	1.5	1.5	6.2	79.1	86.0	10.7	3.4	2.6	12,102
1978	8.2	6.1	4.7	4.3	4.0	4.0	16.3	206.5	224.7	27.9	8.9	6.8	31,600
1979	8.2	6.1	4.7	4.3	4.0	4.0	16.2	205.4	223.5	27.7	8.8	6.8	31,425
1980	7.5	5.5	4.3	3.8	3.6	3.6	14.6	185.4	201.7	25.1	7.9	6.1	28,365
1981	3.9	2.8	2.2	2.0	1.9	1.9	7.6	96.0	104.5	13.0	4.2	3.1	14,690
1982	8.9	6.6	5.1	4.6	4.3	4.3	17.6	223.1	242.8	30.2	9.6	7.4	34,134
1983	8.3	6.2	4.8	4.3	4.1	4.1	16.4	208.5	226.9	28.2	9.0	6.9	31,904
1984	8.6	6.4	4.9	4.4	4.2	4.2	16.9	215.2	234.2	29.0	9.3	7.1	32,929
1985	6.9	5.2	4.0	3.6	3.3	3.4	13.6	173.4	188.6	23.4	7.5	5.7	26,523
1986	8.5	6.3	4.8	4.3	4.1	4.2	16.7	212.2	230.8	28.6	9.2	7.0	32,472
1987	4.1	3.0	2.4	2.1	2.0	2.0	7.9	101.3	110.2	13.7	4.3	3.3	15,508
1988	5.8	4.3	3.3	2.9	2.7	2.7	11.3	143.7	156.3	19.4	6.1	4.7	21,978
1989	4.3	3.2	2.5	2.2	2.1	2.1	8.4	107.0	116.5	14.5	4.6	3.5	16,374
1990	4.9	3.6	2.8	2.6	2.4	2.4	9.6	122.2	132.9	16.5	5.3	4.1	18,694
MEAN	6.4	4.8	3.7	3.3	3.1	3.1	12.4	156.2	170.1	21.4	6.9	5.4	24,018

Table 5. Average Monthly Flows (cfs): Douglas Creek @ Fox Park Gage

YEAR	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	ANNUAL (AF)
1947	19.4	13.4	10.0	5.0	5.0	7.0	25.0	550.0	394.4	78.3	26.3	16.3	69,799
1948	19.0	14.0	11.0	9.5	9.3	9.5	62.0	507.8	166.1	35.5	11.6	9.3	52,610
1949	18.1	13.2	11.0	10.0	11.0	17.0	85.0	491.2	471.9	58.0	16.9	16.2	73,755
1950	19.1	12.6	10.0	9.0	9.4	10.0	35.0	389.3	437.2	52.4	12.7	20.4	61,478
1951	14.6	13.8	13.0	12.0	11.0	11.0	26.5	599.4	412.5	51.1	18.4	9.8	72,380
1952	26.0	15.0	13.0	11.0	10.4	13.0	75.0	648.2	331.9	29.8	12.4	6.9	72,417
1953	8.1	8.4	8.0	10.0	10.0	12.0	24.7	207.7	290.9	38.3	20.0	7.3	38,955
1954	9.1	12.8	11.0	10.0	9.0	11.0	63.6	246.3	55.7	11.7	5.9	6.2	27,476
1955	9.4	8.0	8.0	7.0	6.5	7.0	32.2	180.0	100.8	18.6	12.2	5.0	23,941
1956	7.3	7.5	7.5	8.0	7.8	12.0	66.3	454.0	135.8	18.1	10.9	5.4	45,069
1957	7.1	9.0	8.5	8.0	7.5	9.0	17.0	361.7	757.6	124.0	22.9	12.5	81,059
1958	21.0	15.1	15.0	14.0	13.0	12.0	47.2	616.9	254.8	23.3	9.5	8.7	63,874
1959	8.3	11.0	9.5	9.0	9.5	12.0	43.2	434.8	367.0	35.9	13.2	11.4	58,408
1960	30.9	25.5	14.0	12.0	11.4	25.6	130.8	334.2	162.6	22.5	6.3	6.1	47,364
1961	9.5	9.2	7.7	7.2	7.0	9.4	32.3	345.9	208.9	22.7	14.9	32.9	42,908
1962	41.2	32.5	16.7	11.0	11.2	12.2	172.1	617.4	267.4	43.1	12.6	9.8	75,652
1963	14.9	9.3	6.3	3.9	5.2	11.1	61.0	345.2	121.3	17.5	12.6	13.5	37,789
1964	9.1	11.8	8.6	6.8	6.7	6.2	13.5	286.0	316.2	39.8	12.4	9.7	43,952
1965	8.6	8.8	7.5	5.8	7.0	6.6	16.7	450.1	472.2	55.5	21.5	28.2	65,845
1966	44.6	28.1	23.4	18.1	11.4	24.4	86.5	289.9	93.6	17.9	7.1	6.6	39,574
1967	9.8	8.7	9.2	8.6	5.7	13.8	43.3	262.4	367.9	52.6	7.0	11.0	48,278
1968	24.9	11.2	12.5	11.5	10.5	10.0	34.6	282.2	692.3	75.0	21.4	16.9	71,878
1969	16.8	11.0	10.2	11.4	11.9	13.1	91.4	501.8	219.4	46.4	14.3	8.9	58,100
1970	14.6	13.3	10.6	7.8	7.8	7.0	40.0	549.5	658.0	89.0	24.6	26.9	87,591
1971	39.0	25.7	16.7	15.4	14.2	13.7	111.5	605.1	736.7	88.3	25.3	22.2	103,388
1972	14.0	11.3	8.6	7.0	6.9	9.3	48.3	349.9	276.3	36.6	11.7	13.0	47,919
1973	16.9	13.6	10.3	8.4	8.3	11.3	58.2	421.4	332.8	44.1	14.1	12.6	57,716
1974	24.5	19.7	15.0	12.3	12.1	16.4	84.5	611.8	483.2	64.0	20.4	18.3	83,800
1975	23.1	18.6	14.1	11.5	11.4	15.4	79.5	575.7	454.7	60.3	19.2	17.2	78,859
1976	17.4	14.0	10.7	8.7	8.6	11.6	60.1	435.0	343.5	45.5	14.5	13.0	59,579
1977	4.5	3.6	2.7	2.2	2.2	3.0	15.5	112.2	88.6	11.7	3.7	3.4	15,364
1978	27.8	22.4	17.0	13.9	13.7	18.5	95.8	693.6	547.8	72.6	23.2	20.8	95,005
1979	27.8	22.3	17.0	13.9	13.7	18.5	95.6	692.3	546.7	72.5	23.1	20.7	94,825
1980	23.9	19.2	14.6	12.0	11.8	16.0	82.5	597.1	471.6	62.5	20.0	17.9	81,787
1981	7.6	6.1	4.6	3.8	3.7	5.1	26.2	189.3	149.5	19.8	6.3	5.7	25,935
1982	30.8	24.8	18.8	15.4	15.2	20.6	106.3	769.1	607.4	80.5	25.7	23.0	105,351
1983	28.2	22.6	17.2	14.1	13.9	18.8	97.1	702.7	554.9	73.5	23.5	21.0	96,244
1984	29.4	23.6	18.0	14.7	14.5	19.6	101.3	733.2	579.1	76.7	24.5	22.0	100,430
1985	21.7	17.5	13.3	10.9	10.7	14.5	74.9	542.2	428.2	56.7	18.1	16.2	74,265
1986	28.8	23.2	17.6	14.4	14.2	19.2	99.4	719.6	568.3	75.3	24.0	21.5	98,565
1987	8.6	6.9	5.2	4.3	4.2	5.7	29.5	213.7	168.8	22.4	7.1	6.4	29,274
1988	16.3	13.1	10.0	8.1	8.0	10.9	56.2	406.7	321.2	42.6	13.6	12.2	55,701
1989	9.6	7.7	5.9	4.8	4.7	6.4	33.1	239.6	189.2	25.1	8.0	7.2	32,816
1990	12.5	9.7	7.8	6.7	6.4	8.2	39.9	294.0	228.0	32.9	10.4	8.8	42,288
MEAN	18.7	14.7	11.5	9.8	9.4	12.4	61.8	451.3	359.8	48.2	15.5	13.8	62,256

Table 6. Average Monthly Flow (cfs): Douglas Creek @ Confluence With North Platte River

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANNUAL (AF)
1947	26.8	18.6	13.7	6.7	6.9	9.7	34.8	765	547	108.2	36.7	22.4	96,113
1948	26.2	19.4	15.1	12.8	12.8	13.1	86.3	706	230	49.1	16.2	12.8	72,444
1949	25	18.3	15.1	13.5	15.1	23.4	118.3	683	655	80.2	23.6	22.3	101,561
1950	26.4	17.5	13.7	12.1	12.9	13.8	48.7	541	606	72.4	17.7	28.1	84,655
1951	20.1	19.2	17.9	16.2	15.1	15.2	36.9	833	572	70.6	25.6	13.5	99,667
1952	35.9	20.8	17.9	14.8	14.3	17.9	104.4	901	460	41.2	17.3	9.5	99,718
1953	11.2	11.7	11	13.5	13.7	16.5	34.4	289	404	52.9	27.9	10.1	53,641
1954	12.6	17.8	15.1	13.5	12.3	15.2	88.5	342.4	77.3	16.2	8.2	8.5	37,834
1955	13	11.1	11	9.4	8.9	9.7	44.8	250	140	25.7	17	6.9	32,967
1956	10.1	10.4	10.3	10.8	10.7	16.5	92.3	631	188	25	15.2	7.4	62,060
1957	9.8	12.5	11.7	10.8	10.3	12.4	23.7	502.8	1050.8	171.4	31.9	17.2	111,618
1958	29	21	20.6	18.9	17.8	16.5	65.7	858	353	32.2	13.2	12	87,954
1959	11.5	15.3	13.1	12.1	13	16.5	60.1	604	509	49.6	18.4	15.7	80,428
1960	42.6	35.4	19.2	16.2	15.6	35.3	182.1	465	226	31.1	8.8	8.4	65,220
1961	13.1	12.8	10.6	9.7	9.6	13	45	481	290	31.4	20.8	45.3	59,084
1962	56.9	45.1	22.9	14.8	15.4	16.8	239.6	858	371	59.6	17.6	13.5	104,173
1963	20.6	12.9	8.7	5.3	7.1	15.3	84.9	480	168	24.2	17.6	18.6	52,035
1964	12.6	16.4	11.8	9.2	9.2	8.5	18.8	398	439	55	17.3	13.4	60,522
1965	11.9	12.2	10.3	7.8	9.6	9.1	23.2	626	655	76.7	30	38.8	90,669
1966	61.5	39	32.2	24.4	15.6	33.6	120.4	403	130	24.7	9.9	9.1	54,493
1967	13.5	12.1	12.6	11.6	7.8	19	60.3	365	510	72.7	9.8	15.1	66,479
1968	34.4	15.5	17.2	15.5	14.4	13.8	48.2	392	960	103.6	29.8	23.3	98,976
1969	23.2	15.3	14	15.4	16.3	18.1	127.2	698	304	64.1	19.9	12.3	80,004
1970	20.1	18.5	14.6	10.5	10.7	9.7	55.7	764	913	123	34.3	37	120,613
1971	53.8	35.7	22.9	20.7	19.5	18.9	155.2	841.1	122	122	35.3	30.6	142,365
1972	19.3	15.7	11.8	9.4	9.5	12.8	67.2	486	383	50.6	16.3	17.9	65,984
1973	23.3	18.9	14.2	11.3	11.4	15.6	81	586	462	60.9	19.7	17.4	79,475
1974	33.8	27.3	20.6	16.6	16.6	22.6	117.6	850	670	88.4	28.4	25.2	115,393
1975	31.9	25.8	19.4	15.5	15.6	21.2	110.7	800	631	83.3	26.8	23.7	108,589
1976	24	19.4	14.7	11.7	11.8	16	83.7	605	4766	2.9	20.2	17.9	82,040
1977	6.2	5	3.7	3	3	4.1	21.6	156	1231	6.6	5.2	4.7	21,156
1978	38.4	31.1	23.4	18.7	18.8	25.5	133.4	964	760	100.3	32.3	28.6	130,822
1979	38.4	31	23.4	18.7	18.8	25.5	133.1	962	758	100.2	32.2	28.5	130,574
1980	33	26.6	20.1	16.2	16.2	22.1	114.8	830	654	86.4	27.9	24.6	112,621
1981	10.5	8.5	6.3	5.1	5.1	7	36.5	263	207	27.4	8.8	7.8	35,712
1982	42.5	34.4	25.8	20.7	20.9	28.4	148	1069	843	111.3	35.8	31.7	145,068
1983	38.9	31.4	23.6	19	19.1	25.9	135.2	977	770	101.6	32.8	28.9	132,528
1984	40.6	32.8	24.7	19.8	19.9	27	141	1019	803	106	34.2	30.3	138,292
1985	29.9	24.3	18.3	14.7	14.7	20	104.3	754	594	78.4	25.2	22.3	102,263
1986	39.7	32.2	24.2	19.4	19.5	26.5	138.4	1000	788	104.1	33.5	29.6	135,724
1987	11.9	9.6	7.1	5.8	5.8	7.9	41.1	297	234	31	9.9	8.8	40,310
1988	22.5	18.2	13.7	10.9	11	15	78.2	565	446	58.9	19	16.8	76,700
1989	13.2	10.7	8.1	6.5	6.4	8.8	46.1	333	262	34.7	11.2	9.9	45,188
1990	17.3	13.5	10.7	9	8.8	11.3	55.5	409	316	45.5	14.5	12.1	58,231
MEAN	25.8	20.4	15.8	13.2	12.9	17.1	86	627	499	66.6	21.6	19	85,726

4.2.2 Horse Creek, Nugget Gulch Branch, Beaver Creek, Camp Creek and Lake Creek

For the ungaged watersheds of Horse Creek, Nugget Gulch Branch, Beaver Creek, Camp Creek and Lake Creek, several techniques were employed to generate the virgin streamflow data. These techniques included: (a) utilization of a regression equation based on unit runoff values obtained from existing gaging data on Douglas Creek, (b) Lowham's regression equation based on regional area-elevation data, and (c) Lowham's regression equation based on regional area-precipitation data. Comparative analysis of the unit runoff values obtained from the three techniques revealed the following:

- Lowham's area-precipitation equation resulted in the highest unit runoff values for the ungaged watersheds;
- Lowham's area-elevation equation appears to underestimate the unit runoff; and
- the unit runoff values obtained from the existing gaging data more closely resembled the results of the regional area-precipitation equation.

Based on the results of the comparative analysis, the unit runoff values obtained from the existing gaging data were selected. Furthermore, the unit runoff values obtained from this technique should better reflect the local climatic effects of the Douglas Creek Basin. The equation developed to estimate the annual flow volume is presented below.

$$\text{Annual Runoff Volume(AF/AC)} = 1.938 - [0.0094 \times \text{Basin Area}(mi^2)]$$

Given the unit runoff equation, annual flow values were developed for each instream flow segment. The average of the monthly flow distribution values from the Keystone and Foxpark gages were utilized to generate the mean monthly flows at the upstream end of the instream flow segments. Tables 7 through 11 present the results of the hydrologic analysis for the ungaged watersheds.

Table 7. Average Monthly Flows (cfs): Horse Creek

YEAR	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	ANNUAL (AF)
1946	1.13	0.87	0.68	0.60	0.57	0.66	2.96	27.08	25.41	3.30	1.08	0.88	3,947
1947	0.92	0.71	0.56	0.49	0.46	0.54	2.42	22.12	20.76	2.70	0.88	0.72	3,224
1948	1.18	0.90	0.71	0.63	0.59	0.69	3.08	28.19	26.45	3.44	1.12	0.92	4,108
1949	1.03	0.79	0.62	0.55	0.52	0.60	2.70	24.67	23.14	3.01	0.98	0.80	3,595
1950	1.16	0.89	0.70	0.62	0.58	0.68	3.04	27.79	26.08	3.39	1.11	0.91	4,050
1951	1.16	0.89	0.70	0.62	0.58	0.68	3.04	27.80	26.09	3.39	1.11	0.91	4,052
1952	0.76	0.58	0.46	0.40	0.38	0.44	1.99	18.21	17.08	2.22	0.72	0.59	2,654
1953	0.62	0.48	0.37	0.33	0.31	0.36	1.63	14.92	14.00	1.82	0.59	0.49	2,174
1955	0.61	0.47	0.37	0.33	0.31	0.36	1.61	14.70	13.79	1.79	0.59	0.48	2,142
1956	0.94	0.72	0.56	0.50	0.47	0.55	2.45	22.42	21.04	2.74	0.89	0.73	3,268
1957	1.25	0.96	0.75	0.67	0.63	0.73	3.28	30.01	28.16	3.66	1.19	0.98	4,373
1958	1.24	0.95	0.75	0.66	0.62	0.73	3.25	29.74	27.90	3.63	1.18	0.97	4,334
1959	0.95	0.73	0.57	0.50	0.48	0.56	2.49	22.75	21.35	2.78	0.91	0.74	3,315
1960	0.82	0.63	0.50	0.44	0.41	0.48	2.16	19.76	18.54	2.41	0.79	0.64	2,880
1961	0.76	0.58	0.46	0.40	0.38	0.44	1.99	18.18	17.06	2.22	0.72	0.59	2,650
1962	1.17	0.90	0.71	0.62	0.59	0.69	3.07	28.10	26.37	3.43	1.12	0.92	4,095
1963	0.73	0.56	0.44	0.39	0.37	0.43	1.91	17.50	16.42	2.14	0.70	0.57	2,551
1964	1.06	0.81	0.64	0.56	0.53	0.62	2.77	25.35	23.78	3.09	1.01	0.83	3,694
1965	1.17	0.90	0.70	0.62	0.59	0.68	3.05	27.95	26.22	3.41	1.11	0.91	4,073
1966	0.77	0.59	0.46	0.41	0.39	0.45	2.01	18.39	17.25	2.24	0.73	0.60	2,679
1967	0.87	0.67	0.52	0.46	0.44	0.51	2.28	20.88	19.59	2.55	0.83	0.68	3,043
1968	1.15	0.89	0.69	0.61	0.58	0.67	3.02	27.65	25.94	3.37	1.10	0.90	4,029
1969	0.99	0.76	0.60	0.53	0.50	0.58	2.59	23.70	22.23	2.89	0.94	0.77	3,453
1970	1.34	1.03	0.81	0.71	0.68	0.78	3.51	32.15	30.17	3.92	1.28	1.05	4,686
1971	1.53	1.18	0.92	0.81	0.77	0.90	4.01	36.68	34.42	4.48	1.46	1.20	5,346
1972	0.87	0.67	0.52	0.46	0.44	0.51	2.27	20.78	19.49	2.54	0.83	0.68	3,028
1973	0.97	0.75	0.58	0.52	0.49	0.57	2.54	23.26	21.82	2.84	0.93	0.76	3,390
1974	1.25	0.96	0.75	0.66	0.63	0.73	3.26	29.87	28.03	3.65	1.19	0.97	4,353
1975	1.19	0.92	0.72	0.63	0.60	0.70	3.13	28.62	26.85	3.49	1.14	0.93	4,171
1976	0.99	0.76	0.60	0.53	0.50	0.58	2.59	23.73	22.27	2.90	0.94	0.77	3,459
1977	0.52	0.40	0.31	0.28	0.26	0.31	1.37	12.53	11.75	1.53	0.50	0.41	1,826
1978	1.36	1.05	0.82	0.73	0.69	0.80	3.57	32.71	30.69	3.99	1.30	1.07	4,767
1979	1.36	1.04	0.82	0.72	0.68	0.79	3.55	32.53	30.52	3.97	1.29	1.06	4,740
1980	1.22	0.94	0.74	0.65	0.62	0.72	3.21	29.36	27.55	3.58	1.17	0.96	4,279
1981	0.63	0.49	0.38	0.34	0.32	0.37	1.66	15.21	14.27	1.86	0.61	0.50	2,216
1982	1.47	1.13	0.89	0.78	0.74	0.86	3.86	35.33	33.15	4.31	1.41	1.15	5,149
1983	1.38	1.06	0.83	0.73	0.69	0.81	3.61	33.02	30.99	4.03	1.31	1.08	4,813
1984	1.42	1.09	0.86	0.76	0.72	0.83	3.72	34.08	31.98	4.16	1.36	1.11	4,967
1985	1.15	0.88	0.69	0.61	0.58	0.67	3.00	27.45	25.76	3.35	1.09	0.89	4,001
1986	1.40	1.08	0.84	0.75	0.71	0.82	3.67	33.61	31.54	4.10	1.34	1.10	4,898
1987	0.67	0.52	0.40	0.36	0.34	0.39	1.75	16.05	15.06	1.96	0.64	0.52	2,339
1988	0.95	0.73	0.57	0.50	0.48	0.56	2.49	22.75	21.35	2.78	0.91	0.74	3,315
1989	0.71	0.54	0.43	0.38	0.36	0.41	1.85	16.95	15.90	2.07	0.67	0.55	2,470
1990	0.81	0.62	0.49	0.43	0.41	0.47	2.11	19.35	18.16	2.36	0.77	0.63	2,820
MEAN	1.04	0.80	0.62	0.55	0.52	0.61	2.72	24.86	23.33	3.03	0.99	0.81	3,623

Table 8. Average Monthly Flows (cfs): Beaver Creek

YEAR	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	ANNUAL (AF)
1946	0.32	0.25	0.19	0.17	0.16	0.19	0.84	7.69	7.22	0.94	0.31	0.25	1,121
1947	0.26	0.2	0.16	0.14	0.13	0.15	0.69	6.28	5.9	0.77	0.25	0.2	916
1948	0.33	0.26	0.2	0.18	0.17	0.2	0.87	8	7.51	0.98	0.32	0.26	1,167
1949	0.29	0.22	0.18	0.16	0.15	0.17	0.77	7.01	6.57	0.85	0.28	0.23	1,021
1950	0.33	0.25	0.2	0.18	0.17	0.19	0.86	7.89	7.41	0.96	0.31	0.26	1,150
1951	0.33	0.25	0.2	0.18	0.17	0.19	0.86	7.9	7.41	0.96	0.31	0.26	1,151
1952	0.22	0.17	0.13	0.11	0.11	0.13	0.57	5.17	4.85	0.63	0.21	0.17	754
1953	0.18	0.14	0.11	0.09	0.09	0.1	0.46	4.24	3.98	0.52	0.17	0.14	617
1955	0.17	0.13	0.1	0.09	0.09	0.1	0.46	4.18	3.92	0.51	0.17	0.14	608
1956	0.27	0.2	0.16	0.14	0.13	0.16	0.7	6.37	5.98	0.78	0.25	0.21	928
1957	0.36	0.27	0.21	0.19	0.18	0.21	0.93	8.52	8	1.04	0.34	0.28	1,242
1958	0.35	0.27	0.21	0.19	0.18	0.21	0.92	8.45	7.92	1.03	0.34	0.28	1,231
1959	0.27	0.21	0.16	0.14	0.14	0.16	0.71	6.46	6.06	0.79	0.26	0.21	942
1960	0.23	0.18	0.14	0.12	0.12	0.14	0.61	5.61	5.27	0.68	0.22	0.18	818
1961	0.22	0.17	0.13	0.11	0.11	0.13	0.56	5.16	4.85	0.63	0.21	0.17	753
1962	0.33	0.26	0.2	0.18	0.17	0.19	0.87	7.98	7.49	0.97	0.32	0.26	1,163
1963	0.21	0.16	0.12	0.11	0.1	0.12	0.54	4.97	4.66	0.61	0.2	0.16	724
1964	0.3	0.23	0.18	0.16	0.15	0.18	0.79	7.2	6.75	0.88	0.29	0.23	1,049
1965	0.33	0.25	0.2	0.18	0.17	0.19	0.87	7.94	7.45	0.97	0.32	0.26	1,157
1966	0.22	0.17	0.13	0.12	0.11	0.13	0.57	5.22	4.9	0.64	0.21	0.17	761
1967	0.25	0.19	0.15	0.13	0.12	0.14	0.65	5.93	5.56	0.72	0.24	0.19	864
1968	0.33	0.25	0.2	0.17	0.16	0.19	0.86	7.85	7.37	0.96	0.31	0.26	1,144
1969	0.28	0.22	0.17	0.15	0.14	0.16	0.74	6.73	6.31	0.82	0.27	0.22	981
1970	0.38	0.29	0.23	0.2	0.19	0.22	1	9.13	8.57	1.11	0.36	0.3	1,331
1971	0.43	0.33	0.26	0.23	0.22	0.25	1.14	10.42	9.77	1.27	0.41	0.34	1,518
1972	0.25	0.19	0.15	0.13	0.12	0.14	0.64	5.9	5.54	0.72	0.23	0.19	860
1973	0.28	0.21	0.17	0.15	0.14	0.16	0.72	6.61	6.2	0.81	0.26	0.22	963
1974	0.35	0.27	0.21	0.19	0.18	0.21	0.93	8.48	7.96	1.04	0.34	0.28	1,236
1975	0.34	0.26	0.2	0.18	0.17	0.2	0.89	8.13	7.63	0.99	0.32	0.26	1,185
1976	0.28	0.22	0.17	0.15	0.14	0.16	0.74	6.74	6.32	0.82	0.27	0.22	982
1977	0.15	0.11	0.09	0.08	0.07	0.09	0.39	3.56	3.34	0.43	0.14	0.12	518
1978	0.39	0.3	0.23	0.21	0.2	0.23	1.02	9.29	8.72	1.13	0.37	0.3	1,354
1979	0.39	0.3	0.23	0.2	0.19	0.23	1.01	9.24	8.67	1.13	0.37	0.3	1,346
1980	0.35	0.27	0.21	0.18	0.18	0.2	0.91	8.34	7.82	1.02	0.33	0.27	1,215
1981	0.18	0.14	0.11	0.1	0.09	0.11	0.47	4.32	4.05	0.53	0.17	0.14	629
1982	0.42	0.32	0.25	0.22	0.21	0.24	1.1	10.03	9.42	1.22	0.4	0.33	1,462
1983	0.39	0.3	0.24	0.21	0.2	0.23	1.02	9.38	8.8	1.14	0.37	0.31	1,367
1984	0.4	0.31	0.24	0.21	0.2	0.24	1.06	9.68	9.08	1.18	0.39	0.32	1,411
1985	0.33	0.25	0.2	0.17	0.16	0.19	0.85	7.8	7.32	0.95	0.31	0.25	1,136
1986	0.4	0.31	0.24	0.21	0.2	0.23	1.04	9.55	8.96	1.16	0.38	0.31	1,391
1987	0.19	0.15	0.11	0.1	0.1	0.11	0.5	4.56	4.28	0.56	0.18	0.15	664
1988	0.27	0.21	0.16	0.14	0.14	0.16	0.71	6.46	6.06	0.79	0.26	0.21	942
1989	0.2	0.15	0.12	0.11	0.1	0.12	0.53	4.81	4.52	0.59	0.19	0.16	702
1990	0.23	0.18	0.14	0.12	0.12	0.13	0.6	5.5	5.16	0.67	0.22	0.18	801
MEAN	0.30	0.23	0.18	0.16	0.15	0.17	0.77	7.06	6.63	0.86	0.28	0.23	1,028

Table 9. Average Monthly Flows (cfs): Lake Creek

YEAR	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	ANNUAL (AF)
1946	1.38	1.06	0.83	0.73	0.7	0.81	3.63	33.25	31.2	4.07	1.32	1.08	4846
1947	1.14	0.87	0.68	0.6	0.58	0.67	2.98	27.17	25.48	3.32	1.09	0.89	3959
1948	1.45	1.11	0.86	0.76	0.72	0.85	3.78	34.6	32.48	4.23	1.38	1.13	5044
1949	1.27	0.97	0.76	0.67	0.63	0.73	3.31	30.29	28.43	3.69	1.2	0.99	4414
1950	1.43	1.09	0.86	0.76	0.72	0.83	3.73	34.13	32.02	4.16	1.37	1.11	4973
1951	1.43	1.09	0.86	0.76	0.72	0.83	3.73	34.13	32.02	4.16	1.37	1.11	4975
1952	0.93	0.72	0.57	0.49	0.47	0.55	2.44	22.36	20.98	2.73	0.89	0.72	3258
1953	0.76	0.59	0.46	0.41	0.38	0.44	2	18.31	17.18	2.23	0.73	0.61	2669
1955	0.75	0.57	0.46	0.41	0.38	0.44	1.97	18.05	16.94	2.2	0.72	0.59	2631
1956	1.15	0.89	0.7	0.62	0.58	0.67	3.01	27.53	25.84	3.37	1.09	0.89	4013
1957	1.54	1.18	0.93	0.81	0.77	0.89	4.03	36.85	34.58	4.5	1.46	1.19	5370
1958	1.53	1.18	0.91	0.81	0.77	0.89	3.98	36.52	34.26	4.46	1.45	1.19	5322
1959	1.17	0.89	0.7	0.62	0.59	0.68	3.06	27.93	26.21	3.41	1.11	0.91	4071
1960	1.01	0.77	0.6	0.54	0.5	0.59	2.66	24.26	22.76	2.96	0.96	0.79	3536
1961	0.93	0.72	0.55	0.49	0.47	0.55	2.44	22.32	20.95	2.73	0.89	0.72	3254
1962	1.45	1.11	0.86	0.76	0.72	0.85	3.77	34.5	32.38	4.21	1.37	1.13	5029
1963	0.89	0.69	0.54	0.47	0.45	0.52	2.35	21.5	20.17	2.62	0.86	0.71	3132
1964	1.3	0.99	0.78	0.68	0.65	0.76	3.4	31.12	29.2	3.8	1.24	1.01	4536
1965	1.43	1.11	0.86	0.76	0.72	0.85	3.75	34.32	32.21	4.2	1.37	1.13	5001
1966	0.94	0.72	0.57	0.5	0.47	0.55	2.47	22.57	21.18	2.75	0.89	0.74	3290
1967	1.07	0.82	0.65	0.57	0.54	0.62	2.81	25.64	24.06	3.12	1.02	0.84	3737
1968	1.41	1.09	0.85	0.75	0.72	0.83	3.72	33.95	31.85	4.15	1.35	1.11	4947
1969	1.22	0.94	0.73	0.65	0.61	0.72	3.18	29.11	27.3	3.54	1.15	0.94	4241
1970	1.64	1.26	0.99	0.88	0.83	0.96	4.32	39.48	37.05	4.81	1.58	1.29	5754
1971	1.89	1.45	1.14	0.99	0.95	1.11	4.93	45.04	42.26	5.5	1.79	1.46	6564
1972	1.06	0.82	0.63	0.57	0.54	0.62	2.79	25.51	23.94	3.11	1.01	0.82	3718
1973	1.19	0.92	0.72	0.63	0.59	0.7	3.13	28.55	26.8	3.48	1.14	0.92	4162
1974	1.53	1.18	0.93	0.81	0.77	0.89	4	36.68	34.41	4.47	1.46	1.19	5345
1975	1.46	1.13	0.88	0.78	0.74	0.86	3.83	35.14	32.96	4.29	1.4	1.14	5121
1976	1.22	0.94	0.73	0.65	0.61	0.72	3.18	29.14	27.35	3.56	1.15	0.94	4247
1977	0.63	0.49	0.39	0.34	0.32	0.37	1.68	15.38	14.44	1.87	0.62	0.5	2242
1978	1.67	1.29	1.01	0.89	0.85	0.98	4.39	40.16	37.69	4.89	1.59	1.31	5853
1979	1.66	1.28	1.01	0.88	0.85	0.98	4.37	39.93	37.47	4.88	1.59	1.29	5821
1980	1.5	1.16	0.91	0.8	0.76	0.88	3.93	36.05	33.82	4.41	1.43	1.18	5254
1981	0.78	0.61	0.47	0.41	0.4	0.46	2.03	18.67	17.52	2.28	0.75	0.61	2721
1982	1.8	1.4	1.09	0.96	0.92	1.06	4.74	43.38	40.71	5.3	1.72	1.41	6323
1983	1.69	1.29	1.02	0.89	0.85	0.99	4.44	40.55	38.04	4.94	1.61	1.33	5910
1984	1.74	1.34	1.06	0.93	0.88	1.02	4.57	41.85	39.27	5.11	1.66	1.36	6099
1985	1.4	1.08	0.85	0.75	0.7	0.83	3.68	33.71	31.64	4.11	1.35	1.09	4913
1986	1.72	1.33	1.04	0.91	0.86	1.01	4.51	41.27	38.73	5.04	1.64	1.34	6015
1987	0.83	0.64	0.49	0.44	0.41	0.49	2.15	19.71	18.49	2.41	0.78	0.64	2873
1988	1.17	0.89	0.7	0.62	0.59	0.68	3.06	27.93	26.21	3.41	1.11	0.91	4071
1989	0.86	0.67	0.52	0.46	0.43	0.5	2.27	20.81	19.53	2.54	0.83	0.67	3033
1990	0.99	0.76	0.6	0.52	0.5	0.59	2.59	23.76	22.29	2.89	0.94	0.77	3463
MEAN	1.27	0.98	0.77	0.68	0.64	0.75	3.34	30.53	28.64	3.73	1.21	0.99	4449

Table 10. Average Monthly Flows (cfs): Nugget Gulch Branch

YEAR	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	ANNUAL (AF)
1946	0.06	0.04	0.03	0.03	0.03	0.03	0.14	1.32	1.24	0.16	0.05	0.04	193
1947	0.05	0.03	0.03	0.02	0.02	0.03	0.12	1.08	1.01	0.13	0.04	0.04	158
1948	0.06	0.04	0.03	0.03	0.03	0.03	0.15	1.38	1.29	0.17	0.05	0.04	201
1949	0.05	0.04	0.03	0.03	0.03	0.03	0.13	1.21	1.13	0.15	0.05	0.04	176
1950	0.06	0.04	0.03	0.03	0.03	0.03	0.15	1.36	1.27	0.17	0.05	0.04	198
1951	0.06	0.04	0.03	0.03	0.03	0.03	0.15	1.36	1.28	0.17	0.05	0.04	198
1952	0.04	0.03	0.02	0.02	0.02	0.02	0.1	0.89	0.84	0.11	0.04	0.03	130
1953	0.03	0.02	0.02	0.02	0.02	0.02	0.08	0.73	0.68	0.09	0.03	0.02	106
1955	0.03	0.02	0.02	0.02	0.02	0.02	0.08	0.72	0.67	0.09	0.03	0.02	105
1956	0.05	0.04	0.03	0.02	0.02	0.03	0.12	1.1	1.03	0.13	0.04	0.04	160
1957	0.06	0.05	0.04	0.03	0.03	0.04	0.16	1.47	1.38	0.18	0.06	0.05	214
1958	0.06	0.05	0.04	0.03	0.03	0.04	0.16	1.45	1.36	0.18	0.06	0.05	212
1959	0.05	0.04	0.03	0.02	0.02	0.03	0.12	1.11	1.04	0.14	0.04	0.04	162
1960	0.04	0.03	0.02	0.02	0.02	0.02	0.11	0.97	0.91	0.12	0.04	0.03	141
1961	0.04	0.03	0.02	0.02	0.02	0.02	0.1	0.89	0.83	0.11	0.04	0.03	130
1962	0.06	0.04	0.03	0.03	0.03	0.03	0.15	1.37	1.29	0.17	0.05	0.04	200
1963	0.04	0.03	0.02	0.02	0.02	0.02	0.09	0.86	0.8	0.1	0.03	0.03	125
1964	0.05	0.04	0.03	0.03	0.03	0.03	0.14	1.24	1.16	0.15	0.05	0.04	181
1965	0.06	0.04	0.03	0.03	0.03	0.03	0.15	1.37	1.28	0.17	0.05	0.04	199
1966	0.04	0.03	0.02	0.02	0.02	0.02	0.1	0.9	0.84	0.11	0.04	0.03	131
1967	0.04	0.03	0.03	0.02	0.02	0.02	0.11	1.02	0.96	0.12	0.04	0.03	149
1968	0.06	0.04	0.03	0.03	0.03	0.03	0.15	1.35	1.27	0.16	0.05	0.04	197
1969	0.05	0.04	0.03	0.03	0.02	0.03	0.13	1.16	1.09	0.14	0.05	0.04	169
1970	0.07	0.05	0.04	0.03	0.03	0.04	0.17	1.57	1.47	0.19	0.06	0.05	229
1971	0.07	0.06	0.05	0.04	0.04	0.04	0.2	1.79	1.68	0.22	0.07	0.06	261
1972	0.04	0.03	0.03	0.02	0.02	0.02	0.11	1.02	0.95	0.12	0.04	0.03	148
1973	0.05	0.04	0.03	0.03	0.02	0.03	0.12	1.14	1.07	0.14	0.05	0.04	166
1974	0.06	0.05	0.04	0.03	0.03	0.04	0.16	1.46	1.37	0.18	0.06	0.05	213
1975	0.06	0.04	0.04	0.03	0.03	0.03	0.15	1.4	1.31	0.17	0.06	0.05	204
1976	0.05	0.04	0.03	0.03	0.02	0.03	0.13	1.16	1.09	0.14	0.05	0.04	169
1977	0.03	0.02	0.02	0.01	0.01	0.01	0.07	0.61	0.57	0.07	0.02	0.02	89
1978	0.07	0.05	0.04	0.04	0.03	0.04	0.17	1.6	1.5	0.2	0.06	0.05	233
1979	0.07	0.05	0.04	0.04	0.03	0.04	0.17	1.59	1.49	0.19	0.06	0.05	232
1980	0.06	0.05	0.04	0.03	0.03	0.04	0.16	1.44	1.35	0.18	0.06	0.05	209
1981	0.03	0.02	0.02	0.02	0.02	0.02	0.08	0.74	0.7	0.09	0.03	0.02	108
1982	0.07	0.06	0.04	0.04	0.04	0.04	0.19	1.73	1.62	0.21	0.07	0.06	252
1983	0.07	0.05	0.04	0.04	0.03	0.04	0.18	1.61	1.51	0.2	0.06	0.05	235
1984	0.07	0.05	0.04	0.04	0.03	0.04	0.18	1.67	1.56	0.2	0.07	0.05	243
1985	0.06	0.04	0.03	0.03	0.03	0.03	0.15	1.34	1.26	0.16	0.05	0.04	196
1986	0.07	0.05	0.04	0.04	0.03	0.04	0.18	1.64	1.54	0.2	0.07	0.05	239
1987	0.03	0.03	0.02	0.02	0.02	0.02	0.09	0.78	0.74	0.1	0.03	0.03	114
1988	0.05	0.04	0.03	0.02	0.02	0.03	0.12	1.11	1.04	0.14	0.04	0.04	162
1989	0.03	0.03	0.02	0.02	0.02	0.02	0.09	0.83	0.78	0.1	0.03	0.03	121
1990	0.04	0.03	0.02	0.02	0.02	0.02	0.1	0.95	0.89	0.12	0.04	0.03	138
MEAN	0.05	0.04	0.03	0.03	0.03	0.03	0.13	1.22	1.14	0.15	0.05	0.04	177

Table 11. Average Monthly Flows (cfs): Camp Creek

YEAR	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	ANNUAL (AF)
1946	0.15	0.11	0.09	0.08	0.07	0.09	0.38	3.49	3.28	0.43	0.14	0.11	509
1947	0.12	0.09	0.07	0.06	0.06	0.07	0.31	2.85	2.68	0.35	0.11	0.09	416
1948	0.15	0.12	0.09	0.08	0.08	0.09	0.4	3.63	3.41	0.44	0.14	0.12	529
1949	0.13	0.1	0.08	0.07	0.07	0.08	0.35	3.18	2.98	0.39	0.13	0.1	463
1950	0.15	0.11	0.09	0.08	0.08	0.09	0.39	3.58	3.36	0.44	0.14	0.12	522
1951	0.15	0.12	0.09	0.08	0.08	0.09	0.39	3.58	3.36	0.44	0.14	0.12	522
1952	0.1	0.08	0.06	0.05	0.05	0.06	0.26	2.35	2.2	0.29	0.09	0.08	342
1953	0.08	0.06	0.05	0.04	0.04	0.05	0.21	1.92	1.8	0.23	0.08	0.06	280
1955	0.08	0.06	0.05	0.04	0.04	0.05	0.21	1.89	1.78	0.23	0.08	0.06	276
1956	0.12	0.09	0.07	0.06	0.06	0.07	0.32	2.89	2.71	0.35	0.12	0.09	421
1957	0.16	0.12	0.1	0.09	0.08	0.09	0.42	3.87	3.63	0.47	0.15	0.13	564
1958	0.16	0.12	0.1	0.09	0.08	0.09	0.42	3.83	3.6	0.47	0.15	0.12	559
1959	0.12	0.09	0.07	0.07	0.06	0.07	0.32	2.93	2.75	0.36	0.12	0.1	427
1960	0.11	0.08	0.06	0.06	0.05	0.06	0.28	2.55	2.39	0.31	0.1	0.08	371
1961	0.1	0.08	0.06	0.05	0.05	0.06	0.26	2.34	2.2	0.29	0.09	0.08	342
1962	0.15	0.12	0.09	0.08	0.08	0.09	0.4	3.62	3.4	0.44	0.14	0.12	528
1963	0.09	0.07	0.06	0.05	0.05	0.06	0.25	2.26	2.12	0.28	0.09	0.07	329
1964	0.14	0.1	0.08	0.07	0.07	0.08	0.36	3.27	3.07	0.4	0.13	0.11	476
1965	0.15	0.12	0.09	0.08	0.08	0.09	0.39	3.6	3.38	0.44	0.14	0.12	525
1966	0.1	0.08	0.06	0.05	0.05	0.06	0.26	2.37	2.22	0.29	0.09	0.08	345
1967	0.11	0.09	0.07	0.06	0.06	0.07	0.29	2.69	2.53	0.33	0.11	0.09	392
1968	0.15	0.11	0.09	0.08	0.07	0.09	0.39	3.56	3.34	0.43	0.14	0.12	519
1969	0.13	0.1	0.08	0.07	0.06	0.07	0.33	3.05	2.87	0.37	0.12	0.1	445
1970	0.17	0.13	0.1	0.09	0.09	0.1	0.45	4.14	3.89	0.51	0.16	0.14	604
1971	0.2	0.15	0.12	0.1	0.1	0.12	0.52	4.73	4.44	0.58	0.19	0.15	689
1972	0.11	0.09	0.07	0.06	0.06	0.07	0.29	2.68	2.51	0.33	0.11	0.09	390
1973	0.13	0.1	0.08	0.07	0.06	0.07	0.33	3	2.81	0.37	0.12	0.1	437
1974	0.16	0.12	0.1	0.09	0.08	0.09	0.42	3.85	3.61	0.47	0.15	0.13	561
1975	0.15	0.12	0.09	0.08	0.08	0.09	0.4	3.69	3.46	0.45	0.15	0.12	538
1976	0.13	0.1	0.08	0.07	0.06	0.07	0.33	3.06	2.87	0.37	0.12	0.1	446
1977	0.07	0.05	0.04	0.04	0.03	0.04	0.18	1.61	1.51	0.2	0.06	0.05	235
1978	0.18	0.14	0.11	0.09	0.09	0.1	0.46	4.22	3.96	0.51	0.17	0.14	614
1979	0.17	0.13	0.11	0.09	0.09	0.1	0.46	4.19	3.93	0.51	0.17	0.14	611
1980	0.16	0.12	0.1	0.08	0.08	0.09	0.41	3.78	3.55	0.46	0.15	0.12	552
1981	0.08	0.06	0.05	0.04	0.04	0.05	0.21	1.96	1.84	0.24	0.08	0.06	286
1982	0.19	0.15	0.11	0.1	0.1	0.11	0.5	4.55	4.27	0.56	0.18	0.15	664
1983	0.18	0.14	0.11	0.09	0.09	0.1	0.47	4.26	3.99	0.52	0.17	0.14	620
1984	0.18	0.14	0.11	0.1	0.09	0.11	0.48	4.39	4.12	0.54	0.17	0.14	640
1985	0.15	0.11	0.09	0.08	0.07	0.09	0.39	3.54	3.32	0.43	0.14	0.12	516
1986	0.18	0.14	0.11	0.1	0.09	0.11	0.47	4.33	4.06	0.53	0.17	0.14	631
1987	0.09	0.07	0.05	0.05	0.04	0.05	0.23	2.07	1.94	0.25	0.08	0.07	302
1988	0.12	0.09	0.07	0.07	0.06	0.07	0.32	2.93	2.75	0.36	0.12	0.1	427
1989	0.09	0.07	0.05	0.05	0.05	0.05	0.24	2.18	2.05	0.27	0.09	0.07	318
1990	0.1	0.08	0.06	0.06	0.05	0.06	0.27	2.49	2.34	0.3	0.1	0.08	363
MEAN	0.13	0.10	0.08	0.07	0.07	0.08	0.35	3.20	3.01	0.39	0.13	0.11	467

V. MEAN MONTHLY FLOW ANALYSIS

In partial fulfillment of the objectives for this study, estimated mean monthly flow values were determined and compared with the flows requested by the WGFD. The mean monthly flow data were obtained from Tables 4 through 10 in Chapter IV. To obtain the flow available to meet the instream flow requests, the monthly flow values were adjusted to reflect upstream diversions and the bypass requirements associated with the Special Use Permit. The approach taken to determine the available flow is described in the following paragraphs.

5.1 Description of Approach

For the Douglas Creek Basin, the procedure developed for the mean monthly flow analysis is presented below.

1. The mean monthly flow volumes for each location along Douglas Creek, Horse Creek, Beaver Creek, Lake Creek, Nugget Gulch Branch and Camp Creek were obtained from Tables 4 through 11 in Chapter IV.

2. At each location, upstream flow diversions were tabulated and subtracted from the mean monthly flow volumes to determine the flow available to meet the instream flow request. In some cases, diversion volumes were limited by the mean monthly flow volumes. Diversions for the Douglas Creek Pipeline included the bypass flow requirement which was initially subtracted from the diversion to satisfy the minimum instream flows mandated by the Special Use Permit. Where diversions exceeded mean monthly flow values, the available flow was equivalent to the by-pass flows.

3. The available flows at each location were compared to the instream flow request to determine whether a shortage existed on a month-by-month basis.

The documentation for the technical approach to the mean monthly flow analysis is provided in Appendix D.

5.2 Results

The results of the mean monthly flow analysis are presented in Table 12 and graphically illustrated in Figures 3 through 8. The results are summarized below.

- The requested flow of 5.5 cfs for the *Douglas Creek* instream flow segment is available during the months of March through October at the confluence of the North Platte River and the Foxpark gaging station. At the upstream end of the segment, a shortage occurs during the winter months of November through March and the month of September. The average monthly shortfall at the upstream end of the segment ranges from less than 0.1 cfs in September to 2.4 cfs in February and March.

- At the upstream end of the *Horse Creek* instream flow segment, the requested flow of 0.2 cfs is available during the entire year.

- The requested flow of 0.35 cfs at the upstream end of the *Beaver Creek* instream flow segment is available during the months of April through July. Shortfalls occur the remaining months of the year and range from a minimum of 0.05 cfs in October to a maximum of 0.2 cfs in February.

- The requested flow of 0.5 cfs is available every month of the year at the upstream end of the *Lake Creek* instream flow segment.

- At the upstream end of the *Nugget Gulch Branch* instream flow segment, the requested flow of 0.2 cfs is available during the months of May and June. Shortfalls occur during the remaining months and range from a minimum of 0.05 cfs in July to a maximum of 0.17 cfs in the months from December through March.

- The requested flow of 0.2 cfs at the upstream end of the *Camp Creek* instream flow segment is available from April through July. Shortfalls occur during the remaining months and range from a minimum of 0.07 cfs in August and October to a maximum of 0.13 cfs in January and February.

Table 12. Results of Mean Monthly Flow Analysis.

(Flows Values in CFS)

Stream	Category	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.
Douglas Creek @ Upstream End of Segment	Mean Monthly Flow	6.4	4.8	3.7	3.3	3.1	3.1	12.4	156	170	21.4	6.9	5.4
	Max Diversion	227.96	227.96	227.96	227.96	227.96	227.96	227.96	227.96	227.96	227.96	227.96	227.96
	Available*	5.5	4.8	3.7	3.3	3.1	3.1	5.5	5.5	5.5	5.5	5.5	5.4
	By-Pass	5.5	4.8	3.7	3.3	3.1	3.1	5.5	5.5	5.5	5.5	5.5	5.4
	ISF Request	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
	Shortfall	0.0	0.7	1.8	2.2	2.4	2.4	0.0	0.0	0.0	0.0	0.0	0.1
Douglas Creek @ Foxpark	Mean Monthly Flow	18.7	14.7	11.5	9.8	9.4	12.4	61.8	451	360	48.2	15.5	13.8
	Max Diversion	280.8	280.8	280.8	280.8	280.8	280.8	280.8	280.8	280.8	280.8	280.8	280.8
	Available*	6.18	5.37	4.19	3.76	3.55	5.98	6.88	170.2	79.2	6.90	6.16	6.09
	By-Pass	6.18	5.37	4.19	3.76	3.55	5.98	6.88	6.95	6.95	6.90	6.16	6.09
	ISF Request	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
	Shortfall	0.0	0.13	1.31	1.74	1.95	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Douglas Creek @ Confluence with North Platte	Mean Monthly Flow	25.8	20.4	15.8	13.2	12.9	17.1	86.0	627	499	66.6	21.6	19.0
	Max Diversion	280.8	280.8	280.8	280.8	280.8	280.8	280.8	280.8	280.8	280.8	280.8	280.8
	Available*	6.18	5.37	4.19	3.76	3.55	5.98	6.88	346.2	218.2	6.90	6.16	6.09
	By-Pass	6.18	5.37	4.19	3.76	3.55	5.98	6.88	6.95	6.95	6.90	6.16	6.09
	ISF Request	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
	Shortfall	0.0	0.13	1.31	1.74	1.95	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 12. Results of Mean Monthly Flow Analysis. (Continued)

(Flows Values in CFS)

Stream	Category	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.
Lake Creek	Mean Monthly Flow	1.27	0.98	0.77	0.68	0.64	0.75	3.3	30.5	28.6	3.7	1.2	0.99
	Max Diversion	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Available*	1.27	0.98	0.77	0.68	0.64	0.75	3.3	30.5	28.6	3.7	1.2	0.99
	By-Pass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	ISF Request	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	Shortfall	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Camp Creek	Mean Monthly Flow	0.13	0.10	0.08	0.07	0.07	0.08	0.35	3.2	3.0	0.39	0.13	0.11
	Max Diversion	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
	Available*	0.13	0.10	0.08	0.07	0.07	0.08	0.2	1.2	1.0	0.2	0.13	0.11
	By-Pass	0.13	0.10	0.08	0.07	0.07	0.08	0.2	0.2	0.2	0.2	0.13	0.11
	ISF Request	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	Shortfall	0.07	0.10	0.12	0.13	0.13	0.12	0.0	0.0	0.0	0.0	0.07	0.09
Beaver Creek	Mean Monthly Flow	0.30	0.23	0.18	0.16	0.15	0.17	0.77	7.1	6.6	0.56	0.28	0.23
	Max Diversion	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
	Available*	0.30	0.23	0.18	0.16	0.15	0.17	0.35	5.7	5.2	0.35	0.28	0.23
	By-Pass	0.30	0.23	0.18	0.16	0.15	0.17	0.35	0.35	0.35	0.35	0.28	0.23
	ISF Request	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
	Shortfall	0.05	0.12	0.17	0.19	0.20	0.18	0.0	0.0	0.0	0.0	0.07	0.12
Nugget Gulch Branch	Mean Monthly Flow	0.05	0.04	0.03	0.03	0.03	0.03	0.13	1.2	1.1	0.15	0.05	0.04
	Max Diversion	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
	Available*	0.05	0.04	0.03	0.03	0.03	0.03	0.13	0.2	0.2	0.15	0.05	0.05
	By-Pass	0.05	0.04	0.03	0.03	0.03	0.03	0.13	0.2	0.2	0.15	0.05	0.05
	ISF Request	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	Shortfall	0.15	0.16	0.17	0.17	0.17	0.17	0.07	0.0	0.0	0.05	0.15	0.16
Horse Creek	Mean Monthly Flow	1.0	0.80	0.62	0.55	0.52	0.61	3.72	24.9	23.9	3.0	0.99	0.81
	Max Diversion	22.96	22.96	22.96	22.96	22.96	22.96	22.96	22.96	22.96	22.96	22.96	22.96
	Available*	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.9	0.9	0.2	0.2	0.2
	By-Pass	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	ISF Request	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	Shortfall	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

* equal to by-pass flows mandated by special use permit U.S. Forest Service or natural flows if less than the by-pass flows.

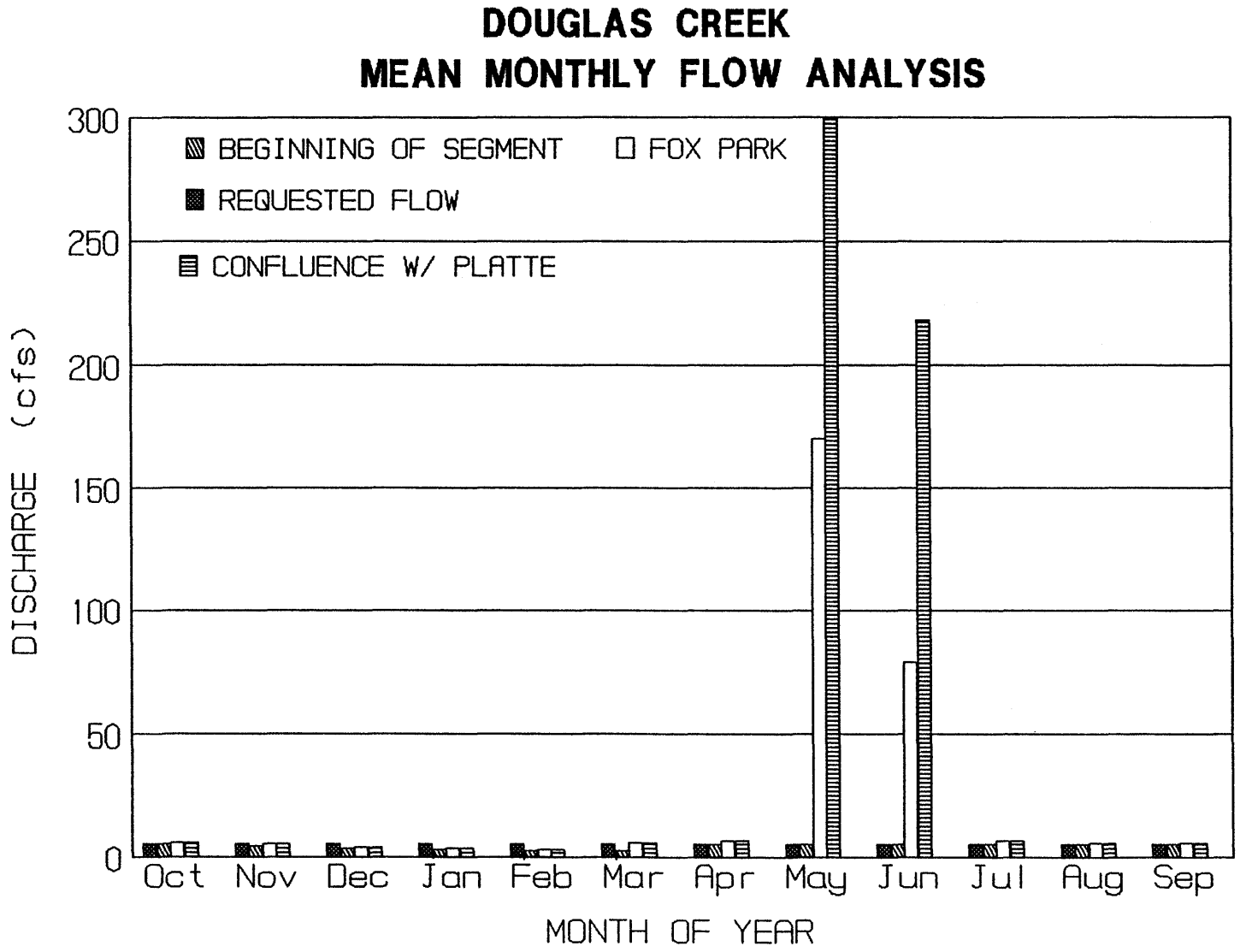

FIGURE 3. COMPARISON OF MEAN MONTHLY FLOWS: DOUGLAS CREEK

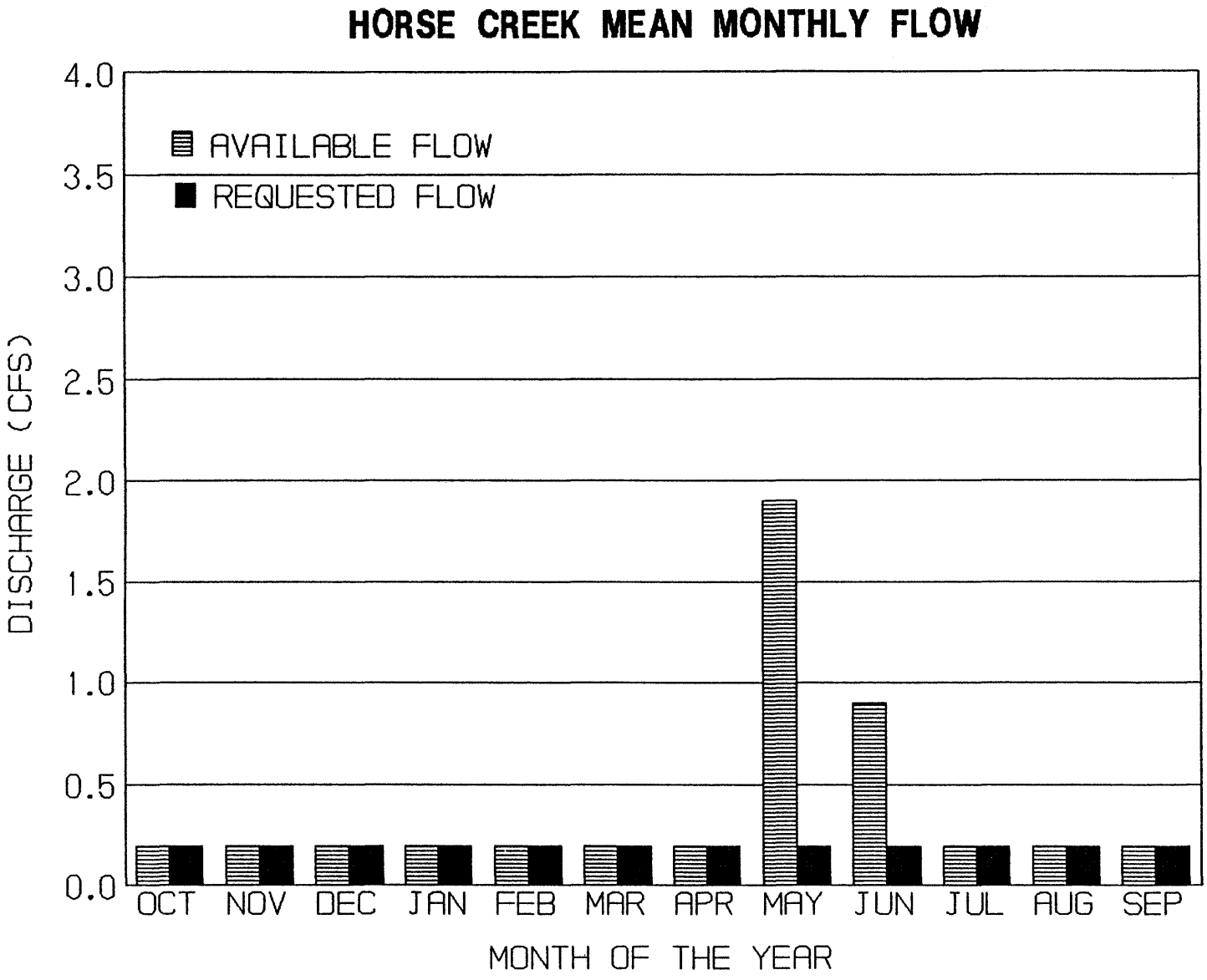

FIGURE 4. COMPARISON OF MEAN MONTHLY FLOWS: HORSE CREEK

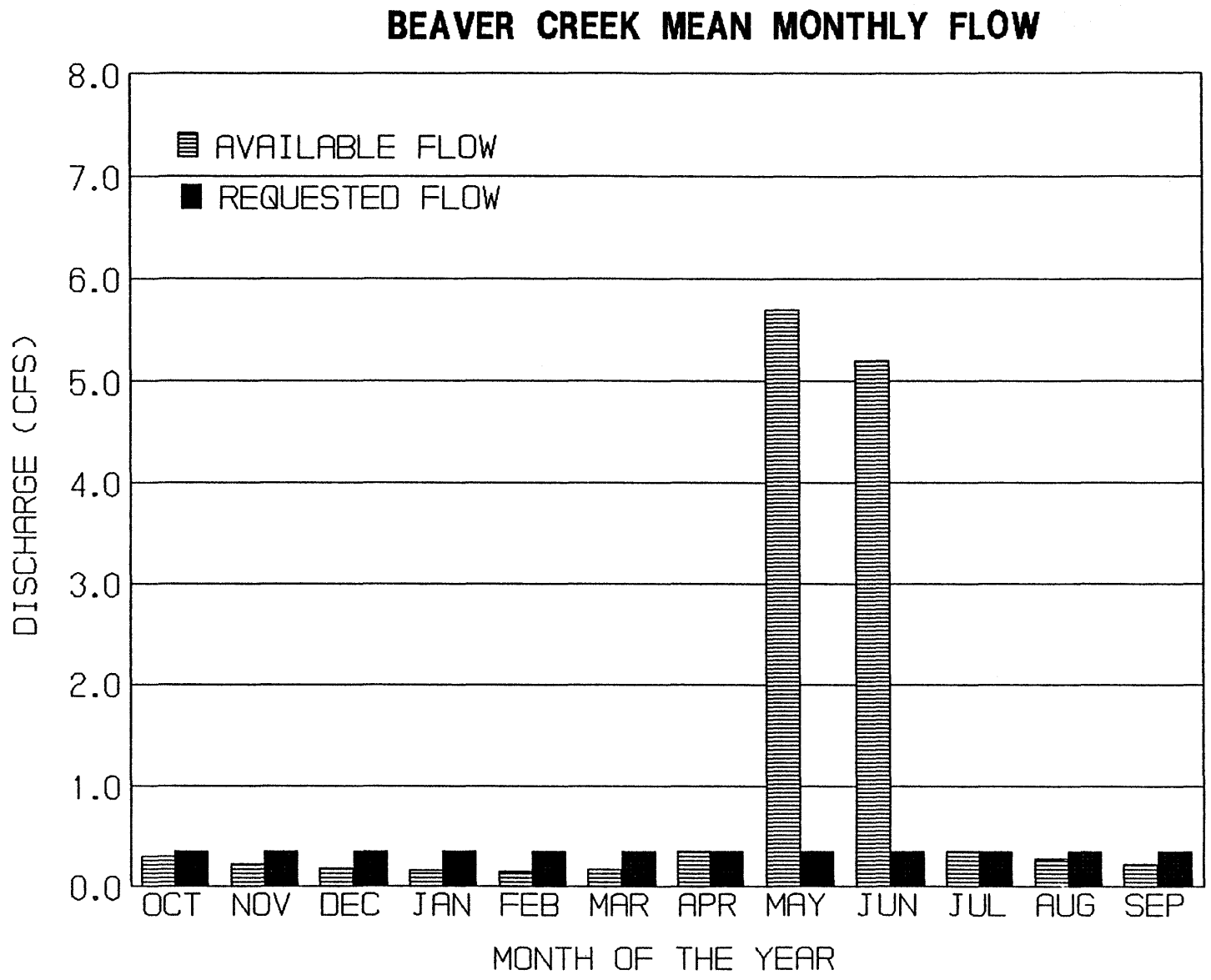

FIGURE 5. COMPARISON OF MEAN MONTHLY FLOWS: BEAVER CREEK

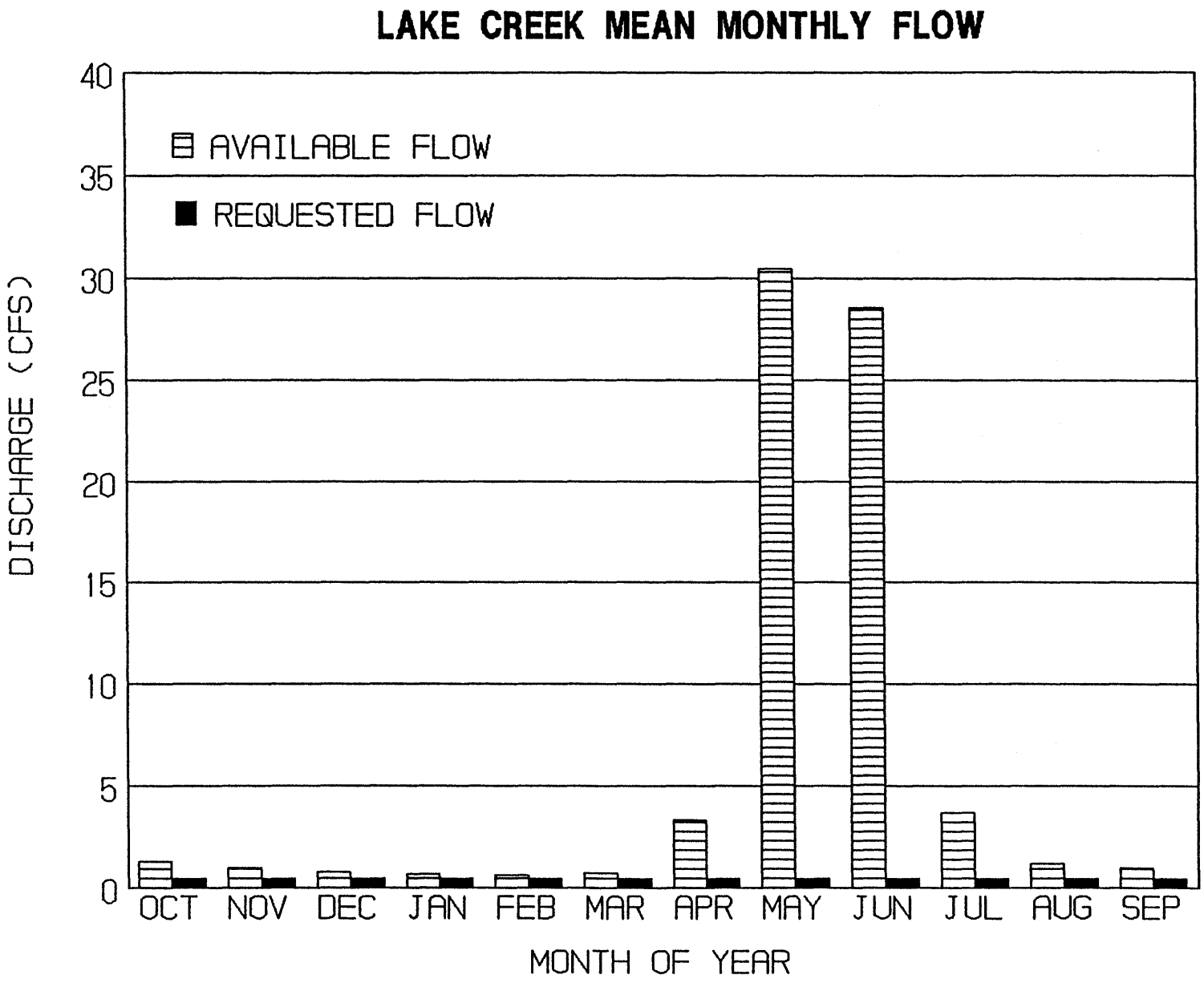

FIGURE 6. COMPARISON OF MEAN MONTHLY FLOWS: LAKE CREEK

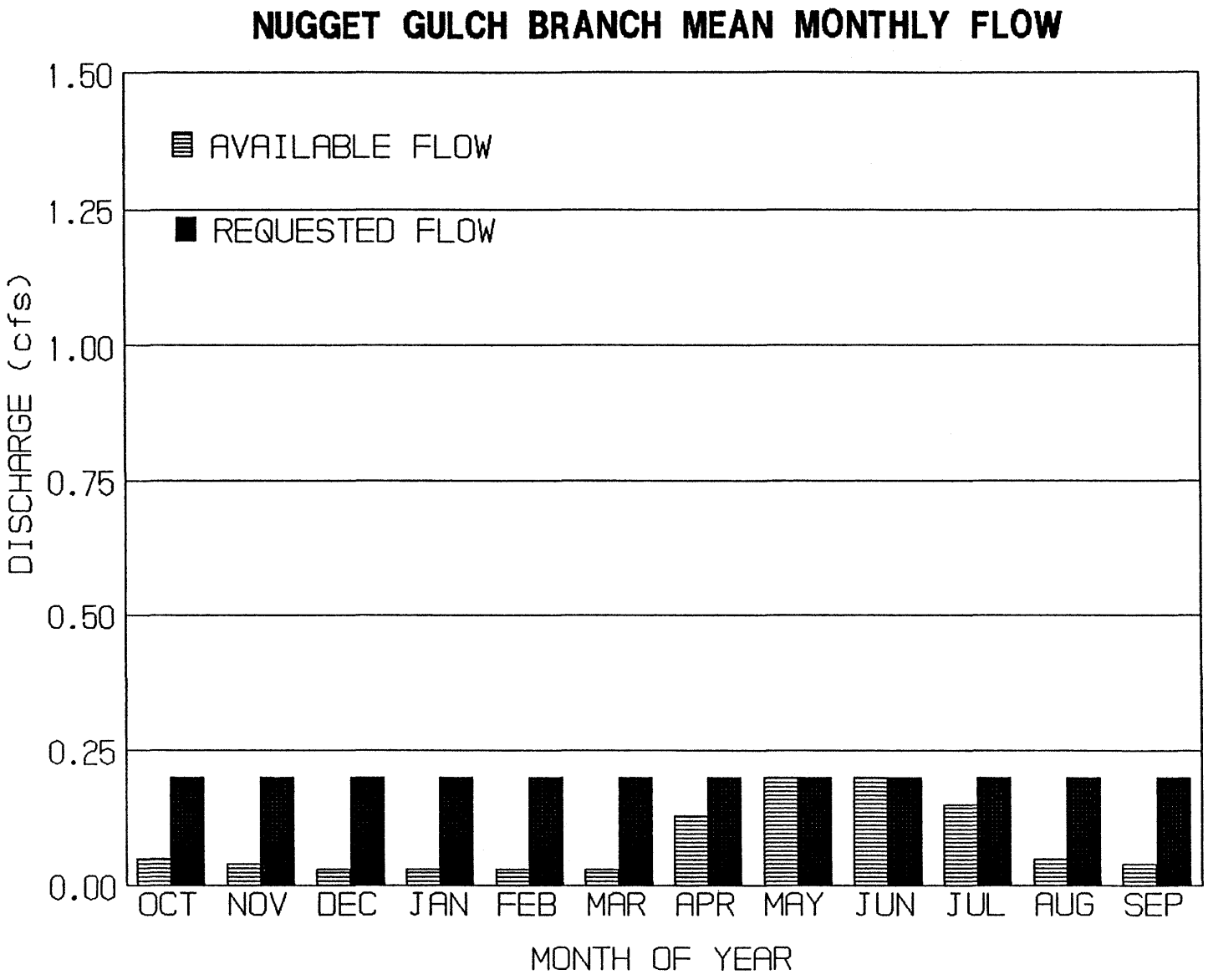

FIGURE 7. COMPARISON OF MEAN MONTHLY FLOWS: NUGGET GULCH BRANCH

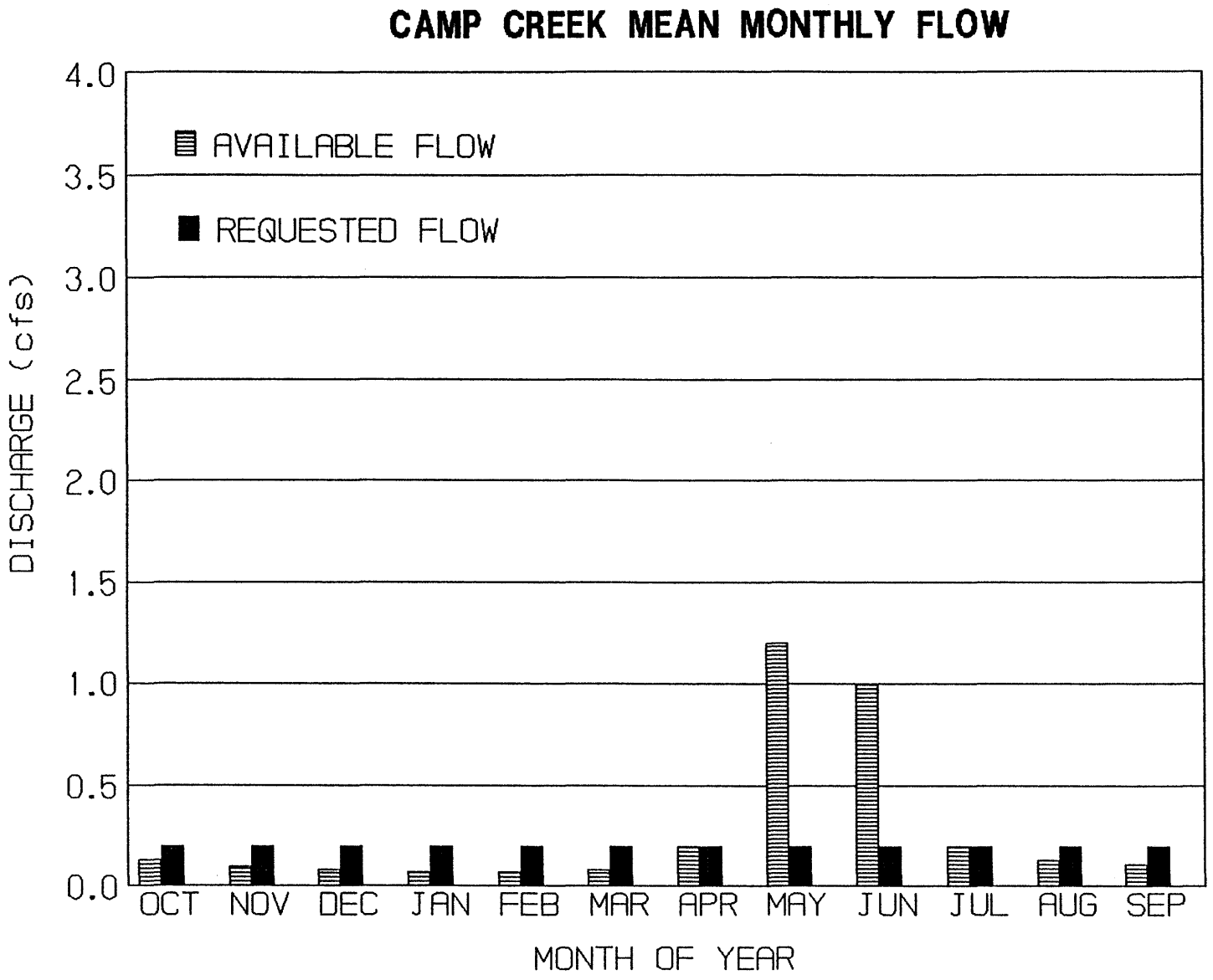

FIGURE 8. COMPARISON OF MEAN MONTHLY FLOWS: CAMP CREEK

VI. DRY YEAR FLOW ANALYSIS

The purpose of the dry year flow analysis is to determine the ability of each river or stream to provide the requested instream flows during periods of relatively minor runoff. Where appropriate, the magnitude of the shortages are identified and the feasibility of a reservoir located upstream of the instream flow segment is discussed.

The dry year flow analysis was conducted with the average annual and monthly flow data previously developed. The annual flow data were ranked in ascending order to identify the driest year of record. The monthly flow values for the driest year of record were then evaluated in accordance with the procedures discussed in Chapter V to determine the flow available to satisfy the instream flow request. Appendix E contains the tables of ranked annual and monthly flow values for each instream flow segment. Figures 9 to 14 display the comparison of mean monthly flows for the driest year of record and the instream flow request. The results of this analysis are presented in the following paragraphs.

6.1 Douglas Creek

The driest year of record for the Douglas Creek instream flow segment is 1977. Table 13 presents the comparison of mean monthly flows versus the flow requested by the WGFD. Figure 9 depicts the comparison graphically. As indicated, shortages predominantly occur in the months of August through March. The annual shortfall for the dry year analysis is approximately 1,565 acre-feet, 1,262 acre-feet, and 1,262 acre-feet respectively for the upstream end of the instream flow segment, at the Foxpark gaging station and at the confluence with the North Platte River.

6.2 Horse Creek, Nugget Gulch Branch, Beaver Creek, Camp Creek and Lake Creek.

Since the data base developed to evaluate the ungaged watersheds is based on the gaging information on Douglas Creek, the driest year of record for all ungaged watersheds is also 1977. Table 14 presents the comparison of mean monthly flow versus the instream flow request. Figures 10 to 14 graphically illustrate the shortfalls within each instream flow segment. Shortfalls for each basin are specifically discussed below.

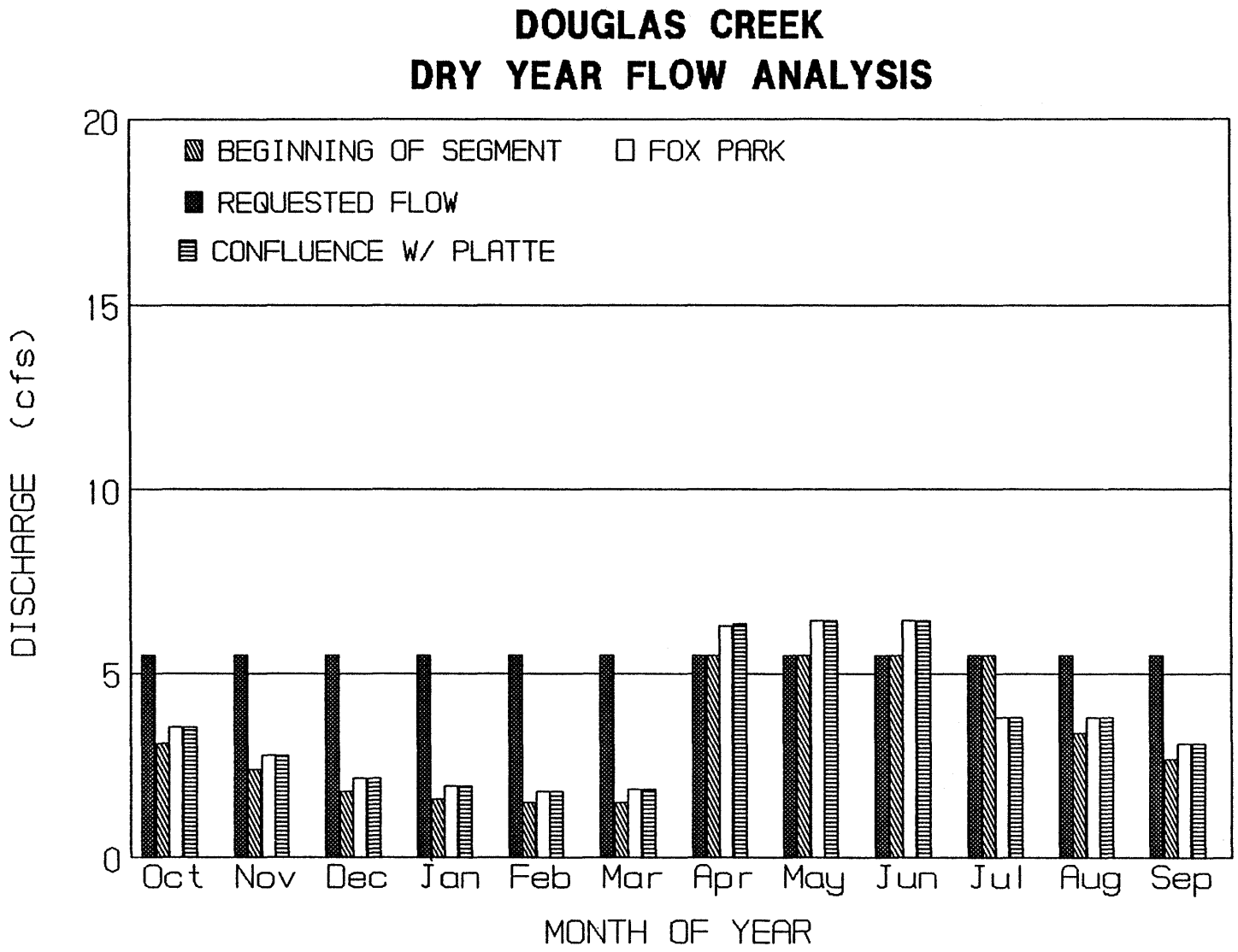

FIGURE 9. COMPARISON OF MONTHLY FLOWS IN DOUGLAS CREEK FOR DRIEST YEAR ON RECORD AND REQUESTED FLOW

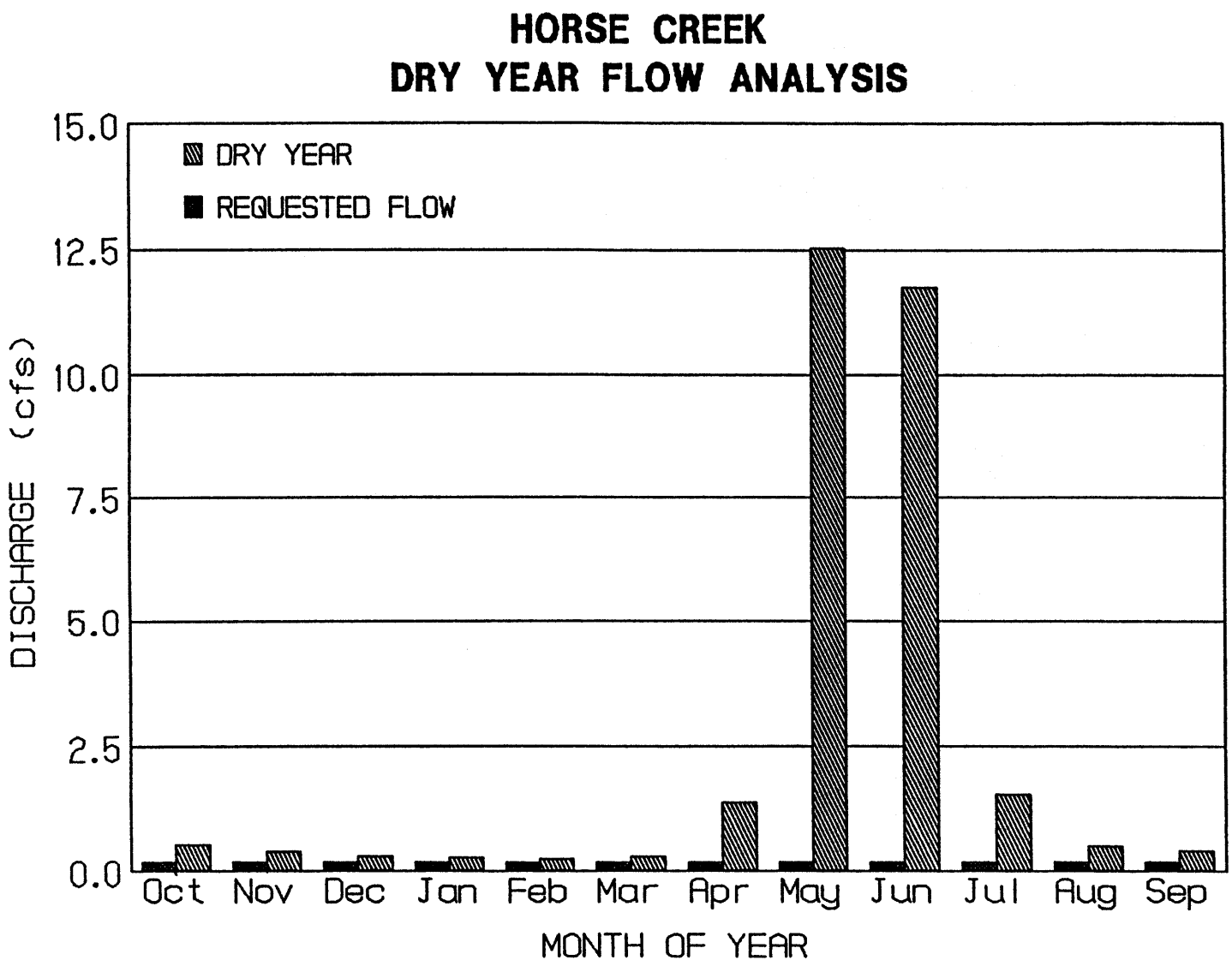

FIGURE 10. COMPARISON OF MONTHLY FLOWS IN HORSE CREEK FOR DRIEST YEAR ON RECORD AND REQUESTED FLOW

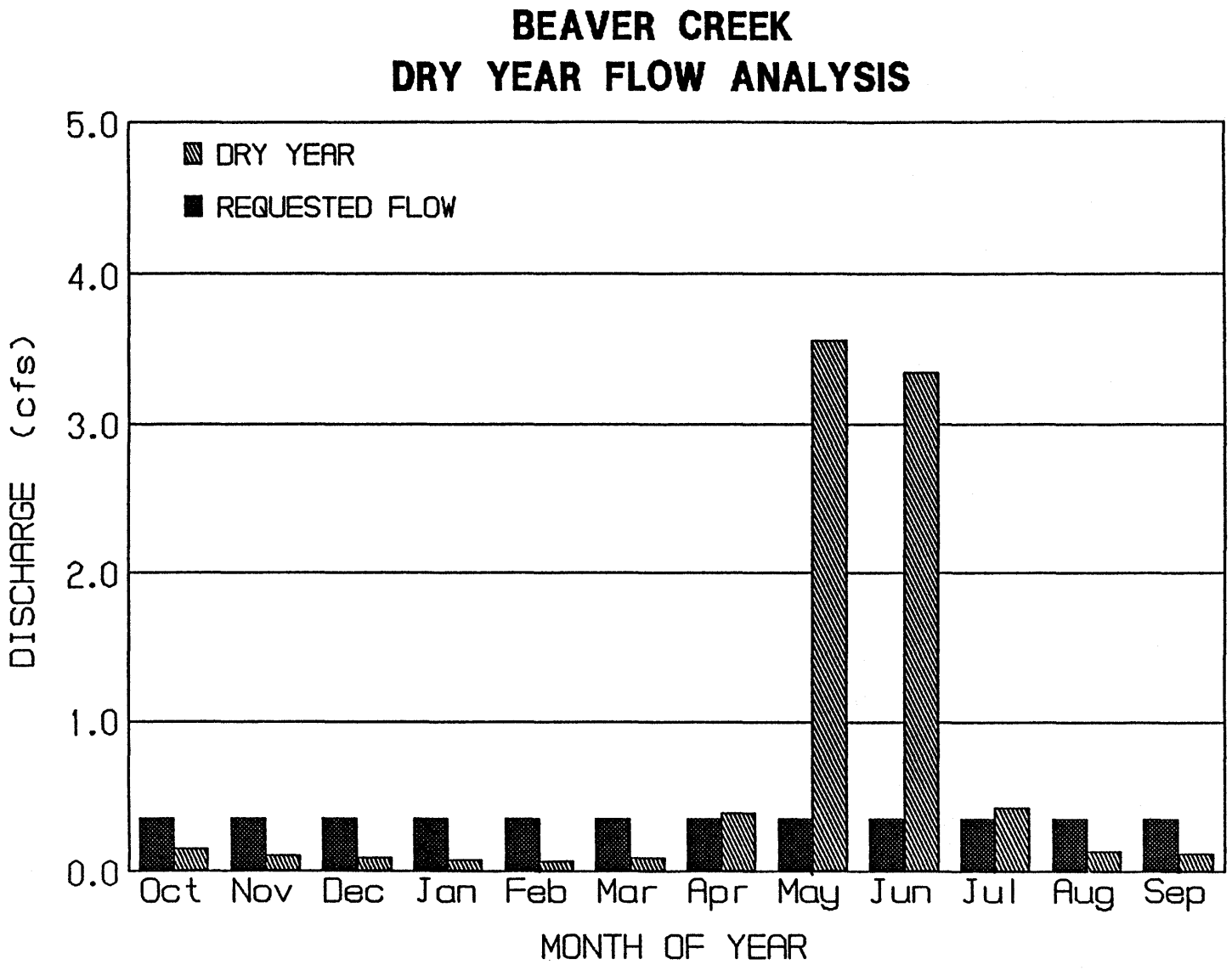

FIGURE 11. COMPARISON OF MONTHLY FLOWS IN BEAVER CREEK FOR DRIEST YEAR ON RECORD AND REQUESTED FLOW

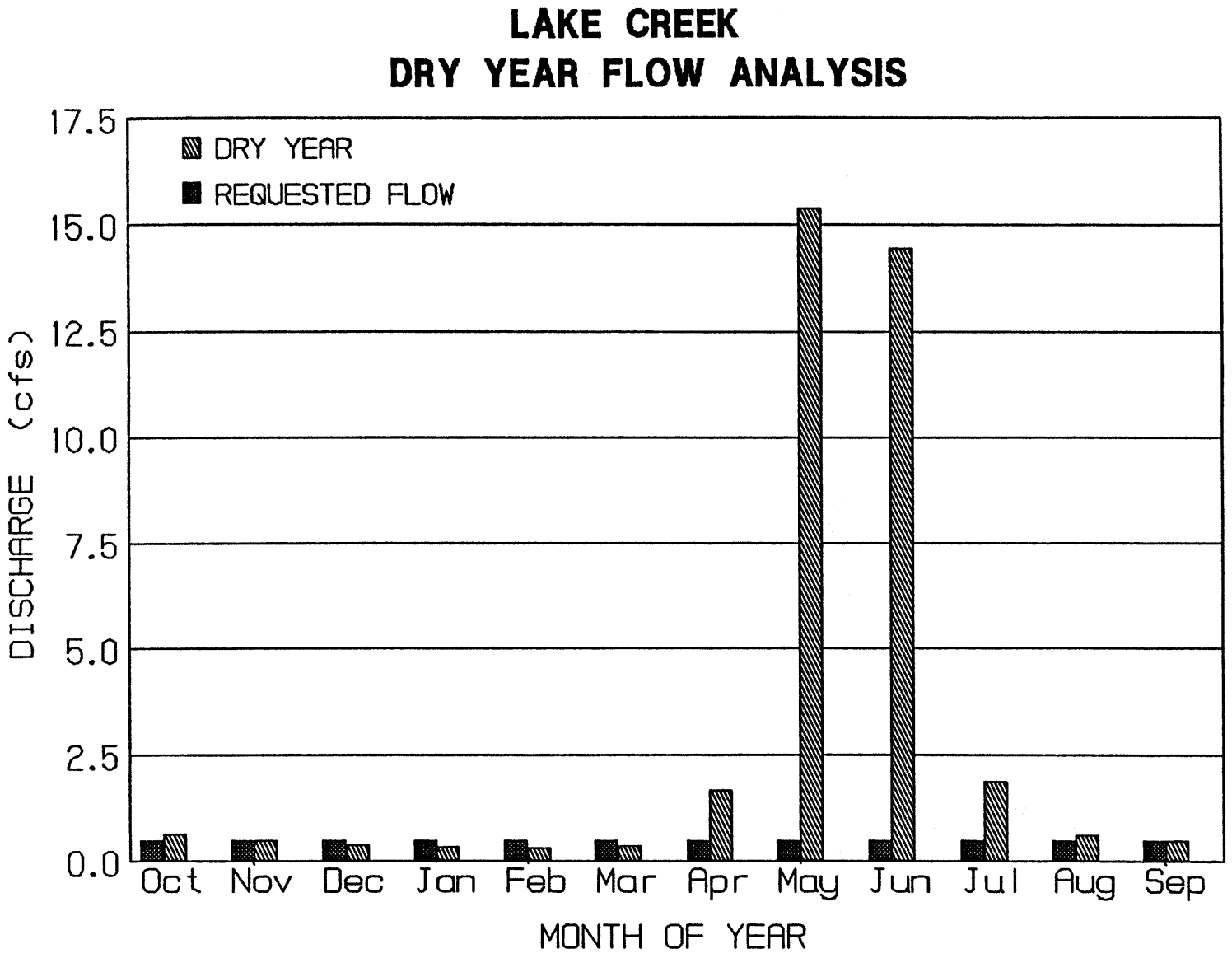

FIGURE 12. COMPARISON OF MONTHLY FLOWS IN LAKE CREEK FOR DRIEST YEAR ON RECORD AND REQUESTED FLOW

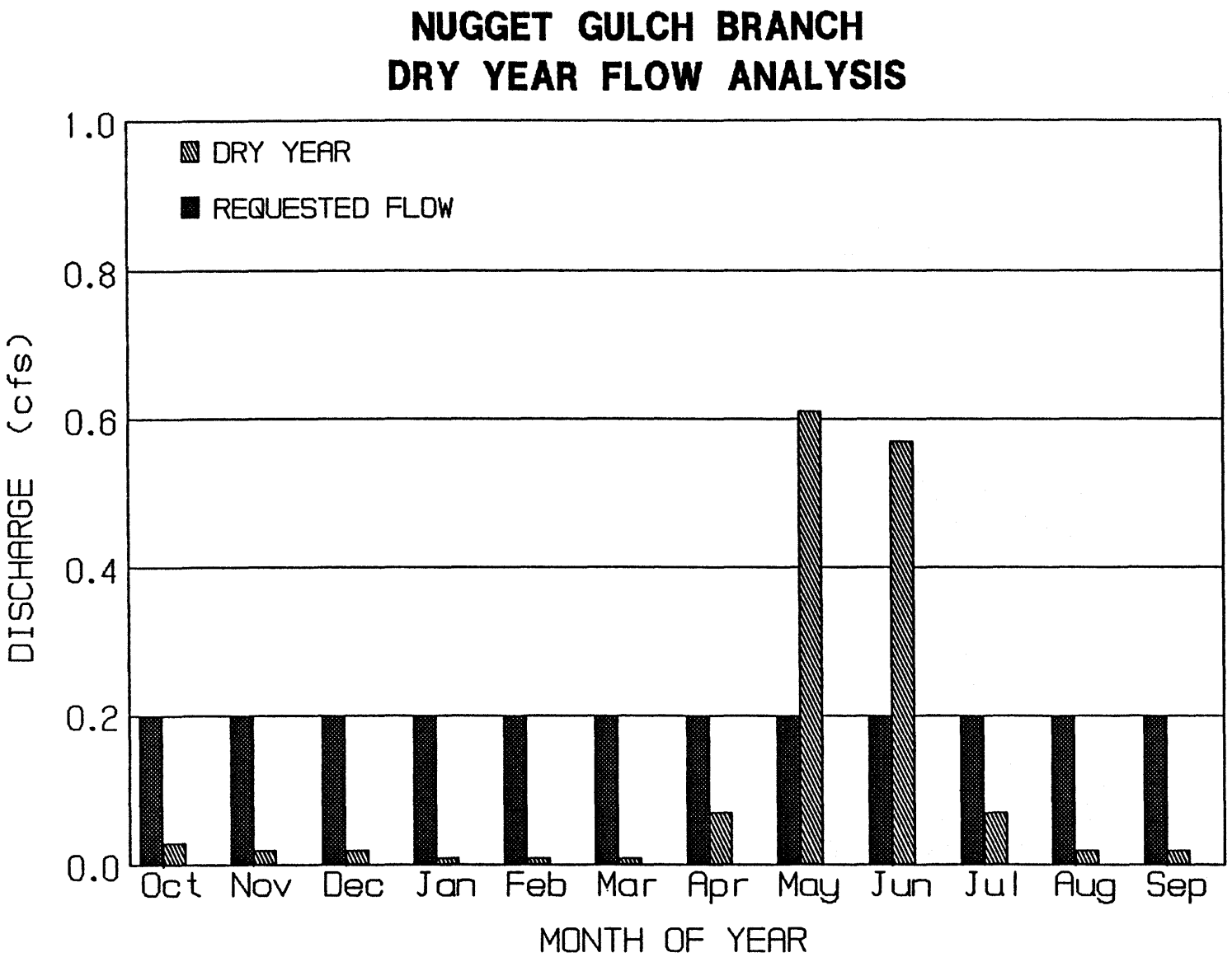

FIGURE 13. COMPARISON OF MONTHLY FLOWS IN NUGGET GULCH BRANCH FOR DRIEST YEAR ON RECORD AND REQUESTED FLOW

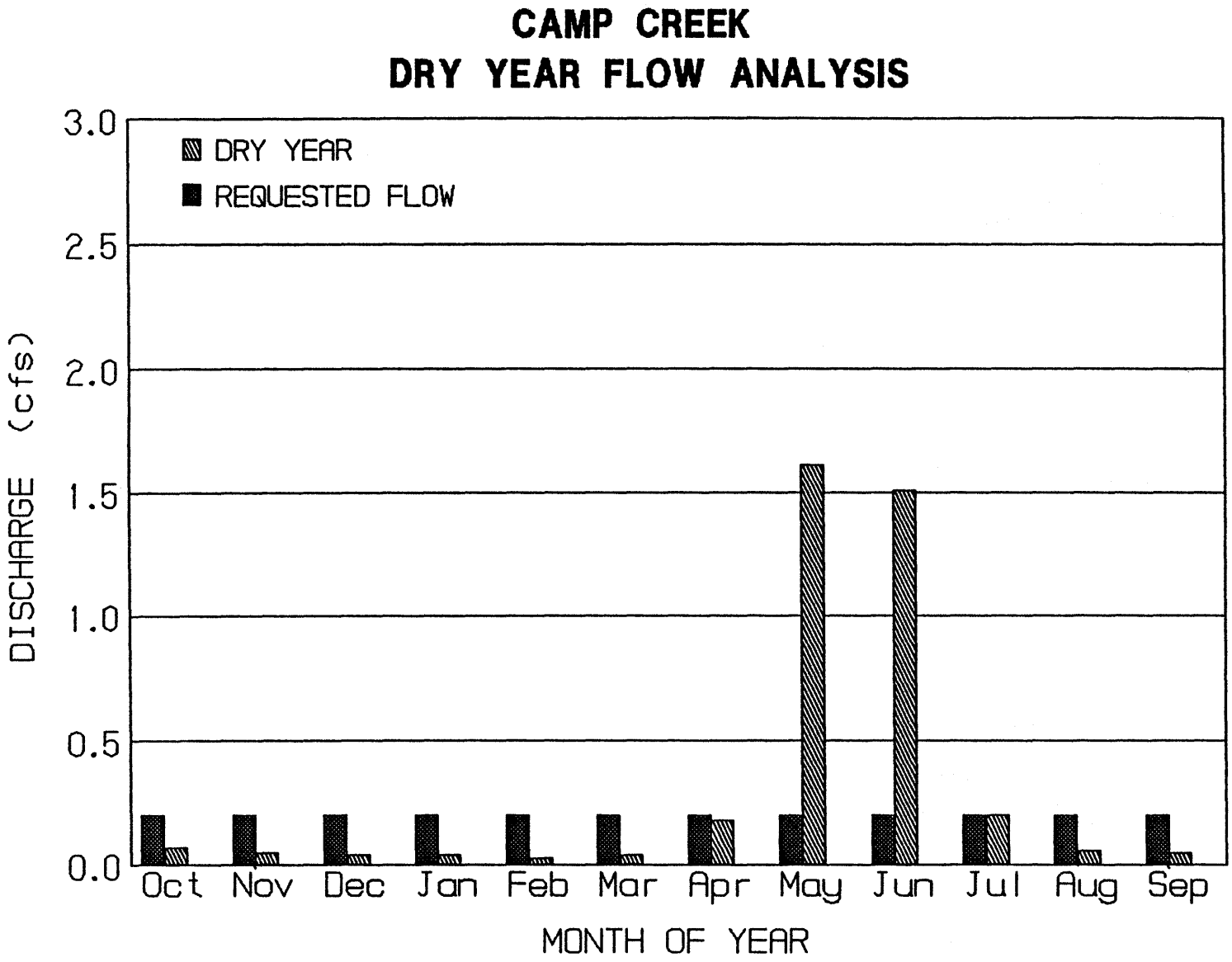

FIGURE 14. COMPARISON OF MONTHLY FLOWS IN CAMP CREEK FOR DRIEST YEAR ON RECORD AND REQUESTED FLOW

Table 13. Comparison of Monthly Flows in Douglas Creek During Driest Year on Record (1977) and Requested Flow.

(Flows Values in CFS)

Stream	Category	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.
Douglas Creek @ Upstream End of Segment	Monthly Flow	3.1	2.4	1.8	1.6	1.5	1.5	6.2	79.1	86.0	10.7	3.4	2.7
	Max Diversion	227.96	227.96	227.96	227.96	227.96	227.96	227.96	227.96	227.96	227.96	227.96	227.96
	Available*	3.1	2.4	1.8	1.6	1.5	1.5	5.5	5.5	5.5	5.5	3.4	2.7
	By-Pass	3.1	2.4	1.8	1.6	1.5	1.5	5.5	5.5	5.5	5.5	3.4	2.7
	ISF Request	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
	Shortfall (cfs)	2.4	3.1	3.7	3.9	4.0	4.0	0.0	0.0	0.0	0.0	2.1	2.8
	Shortfall (AF)	148	184	228	240	222	246	0.0	0.0	0.0	0.0	129	167
	Total Shortfall (AF) = 1,564 AF												
Douglas Creek @ Foxpark	Monthly Flow	4.5	3.6	2.7	2.2	2.2	3.0	15.5	112	88.6	11.7	3.7	3.4
	Max Diversion	280.8	280.8	280.8	280.8	280.8	280.8	280.8	280.8	280.8	280.8	280.8	280.8
	Available*	3.55	2.78	2.15	1.93	1.81	1.84	6.30	6.45	6.45	3.82	3.82	3.09
	By-Pass	3.55	2.78	2.15	1.93	1.81	1.84	6.30	6.45	6.45	3.82	3.82	3.09
	ISF Request	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
	Shortfall (cfs)	1.95	2.72	3.35	3.57	3.69	0.0	0.0	0.0	0.0	1.68	1.68	2.41
	Shortfall (AF)	120	162	206	220	205	0.0	0.0	0.0	0.0	103	103	143
	Total Shortfall (AF) = 1,262 AF												
Douglas Creek @ Confluence with North Platte	Monthly Flow	6.2	5.0	3.7	3.0	3.0	4.1	21.6	156	123	16.2	5.2	4.7
	Max Diversion	280.8	280.8	280.8	280.8	280.8	280.8	280.8	280.8	280.8	280.8	280.8	280.8
	Available*	3.55	2.78	2.15	1.93	1.81	1.84	6.30	6.45	6.45	3.82	3.82	3.09
	By-Pass	3.55	2.78	2.15	1.93	1.81	1.84	6.30	6.45	6.45	3.82	3.82	3.09
	ISF Request	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
	Shortfall (cfs)	1.95	2.72	3.35	3.57	3.69	0.0	0.0	0.0	0.0	1.68	1.68	2.41
	Shortfall (AF)	120	162	200	220	205	0.0	0.0	0.0	0.0	103	103	143
	Total Shortfall (AF) = 1,262 AF												

* equal to by-pass flows mandated by special use permit U.S. Forest Service or natural flows if less than the by-pass flows.

Table 14. Camparison of Douglas Creek Tributary Streams During Driest Year on Record (1977) and Requested Flow.

(Flows Values in CFS)

Stream	Category	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.
Lake Creek	Monthly Flow	0.63	0.49	0.39	0.34	0.32	0.37	1.68	15.4	14.4	1.87	0.62	0.50
	Max Diversion	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Available*	0.63	0.49	0.39	0.34	0.32	0.37	1.68	15.4	14.4	1.87	0.67	0.50
	By-Pass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	ISF Request	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	Shortfall (cfs)	0.0	0.01	0.11	0.16	0.18	0.13	0.0	0.0	0.0	0.0	0.0	0.0
	Shortfall (AF)	0.0	1	7	10	10	8	0.0	0.0	0.0	0.0	0.0	0.0
	Total Shortfall (AF) = 36 AF												
Camp Creek	Monthly Flow	0.07	0.05	0.04	0.04	0.03	0.04	0.18	1.61	1.51	0.2	0.06	0.05
	Max Diversion	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
	Available*	0.07	0.05	0.04	0.04	0.03	0.04	0.18	0.2	0.2	0.2	0.06	0.05
	By-Pass	0.07	0.05	0.04	0.04	0.03	0.04	0.18	0.2	0.2	0.2	0.06	0.05
	ISF Request	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	Shortfall (cfs)	0.13	0.15	0.16	0.16	0.17	0.16	0.02	0.0	0.0	0.0	0.14	0.15
	Shortfall (AF)	8	9	10	10	9	10	1	0.0	0.0	0.0	9	9
	Total Shortfall (AF) = 75 AF												
Beaver Creek	Monthly Flow	0.15	0.11	0.09	0.08	0.07	0.09	0.39	3.5	3.34	0.43	0.14	0.12
	Max Diversion	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
	Available*	0.15	0.11	0.09	0.08	0.07	0.09	0.35	2.1	1.94	0.35	0.14	0.12
	By-Pass	0.15	0.11	0.09	0.08	0.07	0.09	0.35	0.35	0.35	0.35	0.14	0.12
	ISF Request	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
	Shortfall (cfs)	0.20	0.24	0.26	0.27	0.28	0.26	0.0	0.0	0.0	0.0	0.21	0.23
	Shortfall (AF)	12	14	16	17	16	16	0.0	0.0	0.0	0.0	13	13
	Total Shortfall (AF) = 117 AF												

Table 14. Camparison of Douglas Creek Tributary Streams During Driest Year on Record (1977) and Requested Flow. (Continued)

(Flows Values in CFS)

Stream	Category	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.
Nugget Gulch Branch	Monthly Flow	0.03	0.02	0.02	0.01	0.01	0.01	0.07	0.61	0.57	0.07	0.02	0.02
	Max Diversion	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
	Available*	0.03	0.02	0.02	0.01	0.01	0.01	0.07	0.2	0.2	0.07	0.02	0.02
	By-Pass	0.03	0.02	0.02	0.01	0.01	0.01	0.07	0.2	0.2	0.07	0.02	0.02
	ISF Request	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	Shortfall (cfs)	0.17	0.18	0.18	0.19	0.19	0.19	0.13	0.0	0.0	0.13	0.18	0.18
	Shortfall (AF)	11	11	11	12	11	12	8	0.0	0.0	8	11	11
	Total Shortfall (AF) = 106 AF												
Horse Creek	Monthly Flow	0.52	0.40	0.31	0.28	0.26	0.31	1.37	12.5	11.8	1.5	0.5	0.4
	Max Diversion	22.96	22.96	22.96	22.96	22.96	22.96	22.96	22.96	22.96	22.96	22.96	22.96
	Available*	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	By-Pass	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	ISF Request	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	Shortfall (cfs)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Shortfall (AF)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Shortfall (AF) = 0 AF												

* equal to by-pass flows mandated by special use permit U.S. Forest Service or natural flows if less than the by-pass flows.

- No annual shortfall occurs for the Horse Creek instream flow segment.

- For the Beaver Creek instream flow segment, shortages occur during the months from August through March and total approximately 117 acre-feet.

- Shortages occur from November through March within the Lake Creek instream flow segment. The total annual shortfall is approximately 36 acre-feet.

- Shortages occur in every month except May and June for the Nugget Gulch Branch instream flow segment. Approximately 106 acre-feet is the annual shortfall.

- For the Camp Creek instream flow segment, shortages are experienced during the months from August through April. The total annual shortfall is approximately 75 acre-feet.

VII. RESERVOIR FEASIBILITY

The conclusions of the mean monthly flow analysis and the dry year flow analysis indicated that shortages will occur in the instream flow request. This chapter specifically discusses the feasibility of locating a reservoir to satisfy the shortfalls within each instream flow segment. The feasibility investigation is directed by W.S. 41-4-1004(a) which states "the water development commission shall determine the feasibility of providing instream flows for the recommended segments of streams from unappropriated direct flows or from existing storage facilities or from new facilities".

The results of this analysis are presented for informational purposes only since the WGFD does not believe storage is necessary to maintain the existing fishery. Furthermore, the WGFD has stated that reservoir construction would constitute a fishery enhancement which is beyond the scope of their current management program for these streams.

7.1 Douglas Creek

Above the Douglas Creek segment, it is logical to utilize Rob Roy Reservoir for additional storage requirements necessary to supplement the flows available to fully satisfy the instream flow request. Several institutional constraints will need to be evaluated and direct coordination with the Cheyenne Board of Public Utilities and the State Engineer's Office will be necessary.

On an annual basis, the shortage experienced within the instream flow segment ranges from approximately 303 acre-feet on an average year to over 1,560 acre-feet during the driest year of record. Furthermore, due to the diversion to the Douglas Creek Diversion Pipeline, no excess flows occur with in Douglas Creek to compensate for the shortage at the upstream end of the instream flow segment. However, excess flows do occur at the Foxpark gage and at the confluence with the North Platte River. Sufficient excess flow is available during average years to accommodate the shortfalls, however, the excess is not enough to accommodate the shortfalls for the driest year of record. Table 15 presents the results of the analysis.

Table 15. Summary of Annual Flow Shortages and Excess Flow for Douglas Creek.

Stream	Shortfall (AF)	Excess Flow (AF)
Douglas Creek at Upstream end of Segment		
Driest Year	1,564	0
Average Year	575	0
Douglas Creek at Foxpark Gage		
Driest Year	1,262	163
Average Year	303	15,495
Douglas Creek at Confluence with North Platte River		
Driest Year	1,262	163
Average Year	303	34,587

It is important to note that the analysis presented in this report assumes that the requested flow is provided in conjunction with the diversion of water for the Douglas Creek Diversion Pipeline. Water that is stored upstream of the instream flow segment may not be available if the full diversion requirement associated with this water right is obtained. If this scenario occurs, no water is available for storage in Rob Roy Reservoir as all excess water will be depleted by the Douglas Creek Diversion Pipeline.

7.2 Horse Creek, Nugget Gulch Branch, Beaver Creek, Camp Creek and Lake Creek

Within the drainage basins of Nugget Gulch Branch, Beaver Creek, Camp Creek and Lake Creek, a small reservoir can be feasibly located. Even during the driest year of record, the amount of storage necessary to supplement the flows available to fully satisfy the instream flow request is relatively minor. These amounts range from 36 acre-feet (Lake Creek) to approximately 117 acre-feet (Beaver Creek). No storage is required to satisfy the instream flow request for Horse Creek.

Table 16 presents the results of this cursory reservoir study. In general, the excess flows during the driest year of record exceed the annual shortages with the exception of Nugget Gulch Branch. On an average year, the excess flows for Nugget Gulch Branch are sufficient to satisfy the shortages during the remainder of the year.

Table 16. Summary of Annual Flow Shortages and Excess Flow for Douglas Creek Tributaries.

Stream	Shortfall (AF)	Excess Flow (AF)
Horse Creek		
Driest Year	0	N/A
Average Year	0	N/A
Beaver Creek		
Driest Year	117	380
Average Year	66	845
Lake Creek		
Driest Year	36	1,915
Average Year	0	N/A
Nugget Gulch Branch		
Driest Year	106	47
Average Year	86	120
Camp Creek		
Driest Year	75	165
Average Year	50	375

VIII. DAILY FLOW EXCEEDANCE ANALYSIS

A daily flow exceedance analysis was conducted to determine the feasibility of maintaining the criteria established by the WGFD. For the six streams evaluated during this study, the WGFD considers that the instream flow requests are feasible if the requested flow is available 40% of the time during the period of July 1st to September 30th. Exceedance criteria for other times of the year have not been established; however, as stated in the administrative report prepared by the WGFD, the yearly instream flow recommendation should be equal to the instream flow request or the natural flow, whichever is less.

A daily flow duration analysis was conducted for the upstream end of the six instream flow segments. Daily flow data were obtained from the HYDRODATA records available at the Colorado State University Library. For Douglas Creek, the daily flow values for the Keystone gage were initially adjusted to account for a 5% reduction in drainage area (due to the location of the upstream end of the instream flow segment relative to the Keystone gage) and the operation of Rob Roy Reservoir. An extended data base was then developed on the basis of monthly flow correlations with the gaging data at the Foxpark gage and the gage located upstream of Hog Park Creek on the Encampment River. The results of the flow duration analysis at the upstream end of the Douglas Creek instream flow segment are presented in Table 17.

Table 17. Daily Flow Exceedance Summary: Douglas Creek

Period	Instream Flow Request (cfs)	WGFD Exceedance Criteria (%)	Estimated Exceedance (%)
Oct - Mar	5.5	N/A	19.1
Apr - Jun	5.5	N/A	91.8
Jul - Sep	5.5	40	62.0

These results indicate that the criteria adopted by the WGFD is exceeded during the time period from July 1st to September 30th.

For the remaining five instream flow segments, the generation of daily flow values was based on the extended record of daily flows at the upstream end of the instream flow segment for Douglas Creek. The ratio of average monthly flows between

Douglas Creek and the given instream flow segment was utilized to generate the long-term record of daily flow values. The results of the flow duration analysis at the upstream end of the five remaining instream flow segments is presented in Table 18. Tabulated results of the flow duration analysis are presented in Appendix F.

Table 18. Daily Flow Exceedance Summary.

Period	Instream Flow Request (cfs)	WGFD Exceedance Criteria (%)	Estimated Exceedance (%)
Horse Creek			
Oct - Mar	0.2	N/A	99.9
Apr - Jun	0.2	N/A	100.0
Jul - Sep	0.2	40	99.2
Beaver Creek			
Oct - Mar	0.35	N/A	9.5
Apr - Jun	0.35	N/A	90.2
Jul - Sep	0.35	40	36.2
Camp Creek			
Oct - Mar	0.2	N/A	2.8
Apr - Jun	0.2	N/A	85.2
Jul - Sep	0.2	40	28.7
Lake Creek			
Oct - Mar	0.5	N/A	85.7
Apr - Jun	0.5	N/A	99.5
Jul - Sep	0.5	40	93.6
Nugget Gulch Branch			
Oct - Mar	0.5	N/A	0.1
Apr - Jun	0.5	N/A	66.9
Jul - Sep	0.5	40	7.5

The results of Table 18 indicate that the criteria adopted by the WGFD is exceeded by the flows within Horse Creek and Lake Creek. The flows within Beaver Creek, Camp Creek and Nugget Gulch Branch, however, fall short of meeting the exceedance criteria during the time period from July 1st to September 30th.

IX. CONCLUSIONS

The results and conclusions of the analysis of instream flows within the Douglas Creek Basin are presented below.

Mean Monthly Flow Analysis

The requested flow of 5.5 cfs for the *Douglas Creek* instream flow segment is available from March through October at the confluence of the North Platte River and the Foxpark gaging station. At the upstream end of the segment, a shortage occurs during the winter months of November through March and the month of September.

At the upstream end of the *Horse Creek* instream flow segment, the requested flow of 0.2 cfs is available during the entire year.

The requested flow of 0.35 cfs at the upstream end of the *Beaver Creek* instream flow segment is available during the months of April through July.

The requested flow of 0.5 cfs is available every month of the year at the upstream end of the *Lake Creek* instream flow segment.

At the upstream end of the *Nugget Gulch Branch* instream flow segment, the requested flow of 0.2 cfs is available during the months of May and June.

The requested flow of 0.2 cfs at the upstream end of the *Camp Creek* instream flow segment is available from April through July. Shortfalls occur during the remaining months.

Dry Year Flow Analysis

For the Douglas Creek instream flow segment, shortages predominantly occur in the months of August through March. The annual shortfall for the dry year analysis is approximately 1,565 acre-feet, 1,262 acre-feet, and 1,262 acre-feet

respectively for the upstream end of the instream flow segment, at the Foxpark gaging station and at the confluence with the North Platte River. The shortages can be met with storage allocated in Rob Roy Reservoir if institutional constraints can be alleviated.

No annual shortfall occurs in any month for the Horse Creek instream flow segment.

For the Beaver Creek instream flow segment, shortages occur during the months from August through March and total approximately 117 acre-feet.

Shortages occur from November through March within the Lake Creek instream flow segment. The total annual shortfall is approximately 36 acre-feet.

Shortages occur in every month except May and June for the Nugget Gulch Branch instream flow segment. Approximately 106 acre-feet is the annual shortfall.

For the Camp Creek instream flow segment, shortages are experienced during the months from August through April. The total annual shortfall is approximately 75 acre-feet.

Shortages experienced during the dry years may be alleviated with storage upstream of the Beaver Creek, Lake Creek, and Camp Creek instream flow segments. The amount of storage is minimal and several potential storage locations may be feasible.

Daily Flow Exceedance Analysis

The instream flows requested within Douglas Creek, Horse Creek and Lake Creek exceed the criteria adopted by the WGFD. The WGFD considers that the instream flow requests are feasible if the requested flow is available 40% of the time during the time period from July 1st to September 30th.

The instream flows requested within Beaver Creek, Camp Creek and Nugget Gulch Branch fall short of the criteria adopted by the WGFD.

APPENDIX A

WYOMING GAME AND FISH ADMINISTRATIVE REPORT

WYOMING GAME AND FISH DEPARTMENT

FISH DIVISION

ADMINISTRATIVE REPORT

TITLE: Instream Flow Report for Streams Affected by the City of Cheyenne's Stage II Water Development Project

PROJECT: IF-5090-07-9001

AUTHOR: Gerald F. Vogt, Jr. and Thomas A. Wesche

DATE: May 1991

INTRODUCTION

In 1964, construction was completed on Stage I of the City of Cheyenne's Water Development Project. This project involves the diversion of water from two major drainages in south-central and southeastern Wyoming: the North Fork of the Little Snake River drainage and the Douglas Creek drainage, respectively. Water from the North Fork of the Little Snake River drainage is diverted to a tunnel which passes through the Continental Divide. This water enters Hog Park Creek above Hog Park Reservoir, is stored in the reservoir, and is subsequently released into the North Platte River via Hog Park Creek and the Encampment River. Water entering the North Platte River by this system replaces water diverted to Cheyenne's water supply from the Douglas Creek drainage. Water from Douglas Creek and several of its tributaries is diverted to Lake Owen and then to Middle Crow Creek via a series of pipelines; from Middle Crow Creek, the water enters Granite and Crystal Reservoirs for controlled releases to the City of Cheyenne.

Stage II of the City of Cheyenne's Water Development Project is an expansion of the collection systems in both the North Fork of the Little Snake and the Douglas Creek drainages. Water for Stage II is diverted from a total of 16 streams which support trout fisheries (Figures 1 through 16). All of the streams in the North Fork Little Snake River drainage (Table 1) contain Colorado River cutthroat trout, a species whose status is listed as sensitive in Wyoming. Protection, maintenance and improvement of Colorado River cutthroat trout populations and their habitat is a high management priority of both the Wyoming Game and Fish Department (WGFD) and the U.S. Forest Service, as indicated by the signing of a Memorandum of Understanding (signed February 9, 1977) by the two agencies.

Table 1. Instream flow segments for streams in the North Fork Little Snake River drainage from which water is diverted under Stage II of the City of Cheyenne's Water Development Project.

Stream	Class	Upstream Boundary	Downstream Boundary	Approx. Reach Length (miles)
N. Fk. Little Snake R.[1]	3	NW 1/4 S26 T13N, R85W	NW 1/4 S14 T12N, R86W	9.1
Green Timber Creek[1]	4	NE 1/4 S34 T13N, R85W	NE 1/4 S4 T12N, R85W	1.7
Rose Creek[2]	4	NE 1/4 S16 T12N, R85W	NE 1/4 S18 T12N, R85W	2.2
Ted Creek[1]	4	NE 1/4 S27 T13N, R85W	NE 1/4 S27 T13N, R85W	0.3
Third Creek[1]	4	SE 1/4 S21 T13N, R85W	NW 1/4 S27 T13N, R85W	0.7
Deadman Creek[3]	4	NE 1/4 S29 T13N, R85W	NE 1/4 S33 T13N, R85W	1.3
Harrison Creek[3]	4	SE 1/4 S29 T13N, R85W	NW 1/4 S4 T12N, R85W	1.8
Solomon Creek[3]	4	NE 1/4 S31 T13N, R85W	SW 1/4 S7 T12N, R85W	3.4
Rabbit Creek[2]	4	SE 1/4 S24 T13N, R86W	NE 1/4 S26 T13N, R86W	1.2
West Branch, N. Fk. Little Snake R.[3]	3	SE 1/4 S18 T13N, R85W	NW 1/4 S14 T12N, R86W	7.4

1 - Data collected by Jesperson (1980)
2 - Data collected by Jesperson (1979)
3 - Data collected by Wesche (1977)

Streams in the Douglas Creek drainage (Table 2) are all managed as wild trout fisheries. Maintenance of wild trout fisheries is a high priority of the WGFD because they cost less to manage and wild trout are generally preferred over hatchery trout by most anglers. These streams are primarily managed for brook trout only or brook and brown trout.

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Table 2. Instream flow segments for streams in the Douglas Creek drainage from which water is diverted under Stage II of the City of Cheyenne's Water Development Project.

Stream	Class	Upstream Boundary	Downstream Boundary	Approx. Reach Length (miles)
Douglas Creek[1]	3	NE 1/4 S9, T14N, R79W	NW 1/4 S6, T13N, R80W	22.3
Nugget Gulch[1]	4	SE 1/4 S14 T14N, R79W	SE 1/4 S14 T14N, R79W	0.1
Little Beaver Creek[1]	4	SE 1/4 S14 T14N, R79W	SW 1/4 S22 T14N, R79W	1.9
Camp Creek[1]	4	SE 1/4 S13 T14N, R79W	NE 1/4 S19 T14N, R78W	1.2
Lake Creek[1]	3	NW 1/4 S33 T14N, R78W	NW 1/4 S11 T13N, R79W	5.8
Horse Creek[1]	4	SW 1/4 S16 T14N, R79W	SE 1/4 S16 T14N, R79W	0.1

1 - Data collected by Jesperson (1980)

Data were collected during 1976, 1978, and 1979 to conduct instream flow analyses for each of the streams listed in Tables 1 and 2. This report summarizes those studies and was prepared in compliance with instream flow legislation to support a Wyoming Water Development Commission application for an instream flow water right. The specific objective of these studies was to determine year-round instream flows necessary to maintain habitat for trout spawning, cover and aquatic insect production. The maintenance flow recommendations resulting from these studies were incorporated as conditions of the City of Cheyenne's easement on the Medicine Bow National Forest in 1982.

METHODS

Study Sites

The field data used in this study were collected from study sites located at or just downstream from Stage II diversion sites. Legal descriptions for each study site as well as additional instream flow study details are provided in Wesche (1977) and Jesperson (1979, 1980). Each study site contained trout habitat that was representative of habitat features found throughout the instream flow segment of each stream.

For each of the streams listed in Tables 1 and 2, the Stage II diversion structures and the mouth of the stream were identified as the upstream and downstream boundaries of the instream flow segments, respectively. Each of these instream flow segments are contained within the Medicine Bow National Forest and are accessible to

the public. Because they also support important trout fisheries, these stream segments were identified as critical stream reaches.

Models

Two techniques were used to determine instream flow recommendations for the streams listed in Tables 1 and 2. The technique described by Wesche (1977) was used on four of the streams (Table 1) to quantify the available habitat for spawning, cover and food production at a range of simulated flows. Water depth, velocity, top width, wetted perimeter, hydraulic radius, cross-sectional area, and substrate were measured for a single discharge along transects established at each site. Transects were located at 25 foot intervals along the stream bank. Velocity and depth were measured at sufficient intervals along each transect to depict changes in stream bottom morphology.

Available habitat was defined as the area of the stream which met defined hydraulic criteria for depth, velocity and substrate (Table 3). These criteria were compared to the hydraulic data for each habitat, and the width of each transect which met all three of the criteria for a given habitat type was determined. The "habitat" widths for all transects at a site were summed and then divided by the sum of all wetted transect widths for the site. This yielded an estimate of the percentage of the site which met the criteria for a given habitat type. Multiplying this percentage by the total area of the study site produced an estimate of the available habitat.

Manning's equation was used to calculate discharges at various water stages. For each of these discharges, the amount of available habitat was determined. A plot of available habitat versus discharge for several "key" cross-sections (cross-sections which provided the majority of the given habitat type) was then generated. The flow recommendation was identified as the flow below which decreases in discharge resulted in the greatest reductions in available habitat (the inflection point of the curve). Since trout spawning habitat and/or cover were determined to be the habitat types most limiting to trout populations in these streams, recommendations for these streams were based on available habitat for these two habitat types.

Table 3. Criteria used to define habitat for trout spawning, cover and food production areas (from Jesperson 1980).

Habitat Type	Depth (feet)	Velocity (feet/second)	Substrate
Spawning			
Brown trout	≥ 0.3	0.45-1.50	fine to coarse gravel
Brook trout	≥ 0.2	0.12-1.11	fine to coarse gravel
Cutthroat trout	0.2-0.9	0.35-1.25	fine to coarse gravel
Cover (resting)	≥ 0.5	< 0.5	cobble or boulder
Food production	< 1.0	> 0.5	cobble

The technique described by Jesperson (1979, 1980) was used for the remaining 12 streams (Tables 1 and 2). Data from single transects placed across each type of fish habitat within a study area were analyzed with the R-2 Cross computer program (Silvey 1976). The R-2 Cross program was used to simulate depths and velocities over a range of discharges. Flows which provided the hydraulic parameters at a level satisfying species-habitat criteria (Table 3) were identified for each cross-section in a study site. The final flow recommendation resulted from the average of the flows from all transects in a study site.

Rose Creek presented special problems, since the stream was divided into three channels at the diversion site. This prevented the application of the habitat measurement techniques used on other streams. Since flow data could not be collected in Rose Creek at the diversion site, the recommendation for Rose Creek was based on a comparative analysis of streams with similar trout habitat. For each of those other streams, the recommended instream flow was divided by the average daily flow (ADF) and expressed as a percentage of ADF. The percentages of ADF for each of these streams were then averaged and multiplied by the average daily flow of Rose Creek to determine the flow recommendation for Rose Creek.

RESULTS

Flow recommendations derived from the methods described by Wesche (1977) and Jesperson (1979, 1980) are summarized for each stream (Table 4). These recommendations apply to each stream segment defined by the location of the Stage II diversion downstream to the mouth of the stream (Table 2). Each instream flow recommendation applies to the entire year.

Table 4. Summary of year-round instream flow recommendations to maintain existing trout fisheries in streams affected by Stage II of the City of Cheyenne's water project.

Stream	Year-Round Instream Flow Recommendation[1] (cfs)
Douglas Creek	5.5
Rose Creek	0.75
Green Timber Creek	1.0
North Fork Little Snake River	2.0
Ted Creek	1.0
Third Creek	1.0
Deadman Creek	2.0
Harrison Creek	1.0
Solomon Creek	1.0
Rabbit Creek	1.5
West Branch, North Fork Little Snake R.	3.5
Nugget Gulch Creek	0.2
Little Beaver Creek	0.35
Camp Creek	0.2
Lake Creek	0.5
Horse Creek	0.2

1 - Or the natural flow, whichever is less

REFERENCES

Jesperson, D.M. 1980. Instream flow determination for stream affected by Stage I and Stage II of the city of Cheyenne water development project in the Douglas Creek drainage and supplemental flow recommendations in the North Fork of the Little Snake River drainage. U.S. Forest Service Report, Medicine Bow National Forest, Laramie, WY. 129 pp.

_____. 1979. Instream flow determination and impact evaluation of water diversion on the Colorado River cutthroat trout and brook trout in the North Fork and Roaring Fork of the Little Snake River drainage. U.S. Forest Service Report, Medicine Bow National Forest, Laramie, WY. 109 pp.

Silvey, L. 1976. R-2 Cross Program, a sag-tape method of channel cross section measurement for use with instream flow determinations. A U.S.F.S. publication, Region 2.

Wesche, T.A. 1977. Fishery resources and instream flow recommendations for streams to be impacted by Cheyenne's proposed Phase II development. Report submitted to

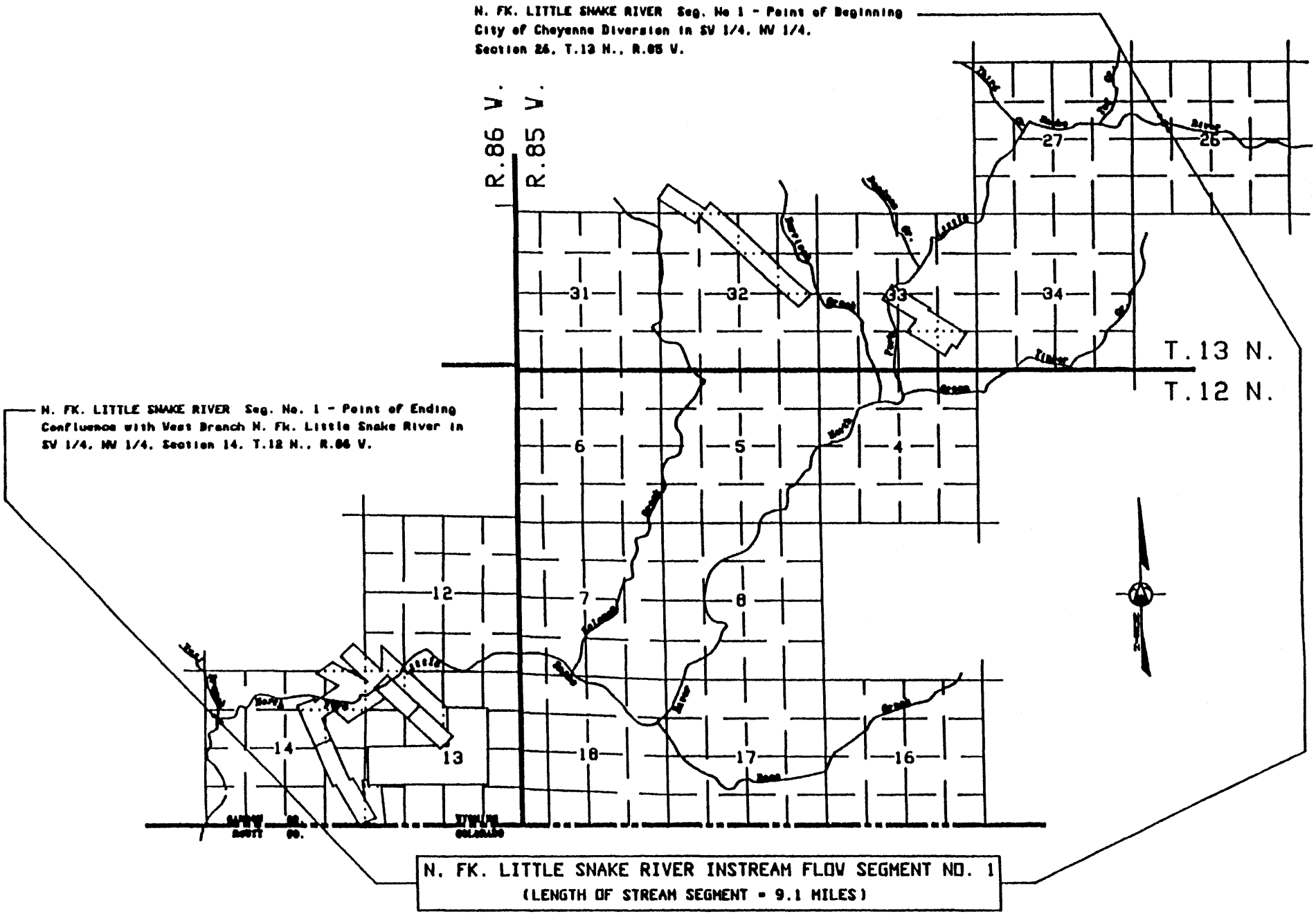


Figure 1. Location of the instream flow reach on North Fork of the Little Snake River.

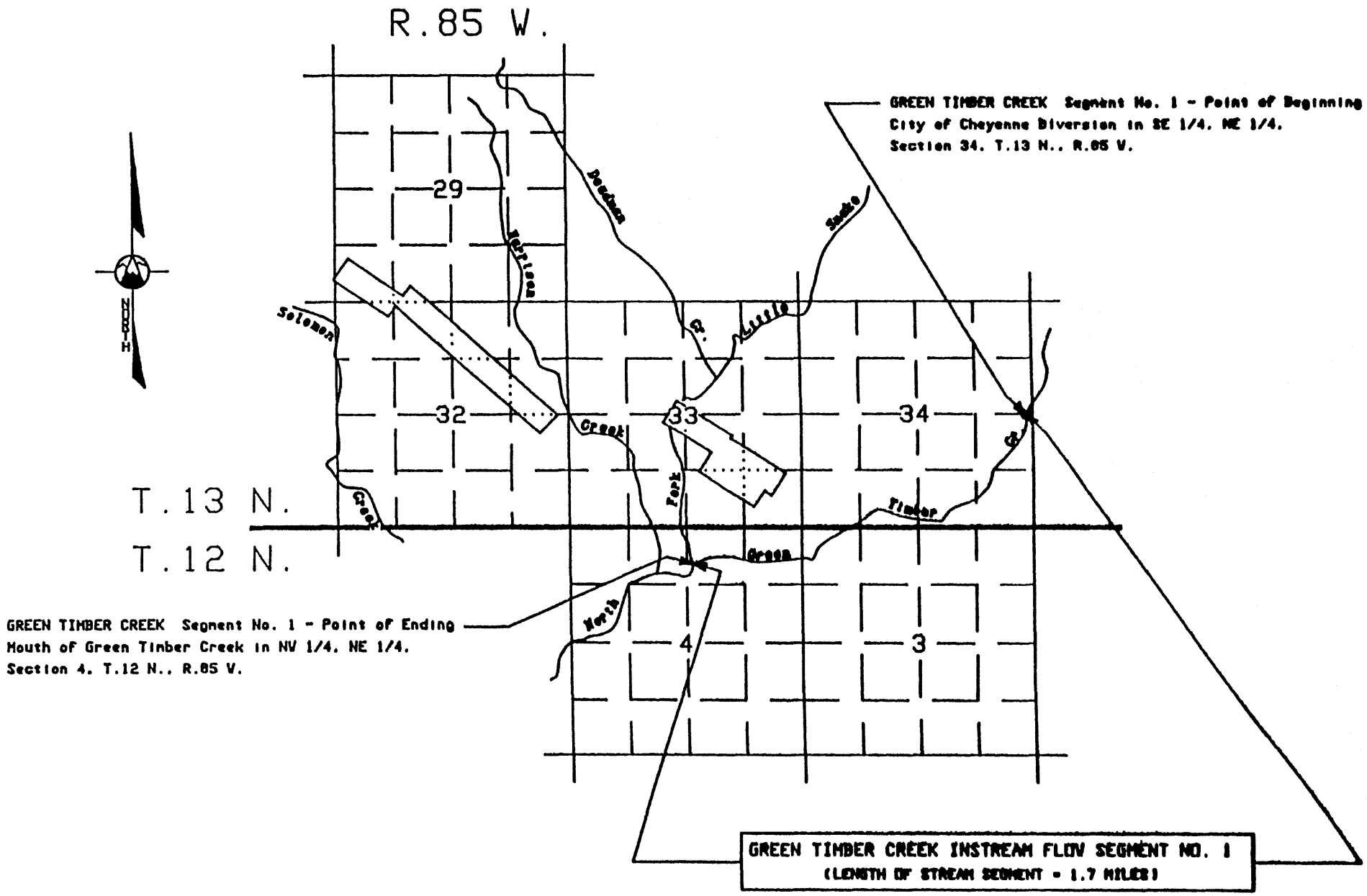


Figure 2. Location of the instream flow reach on Green Timber Creek.

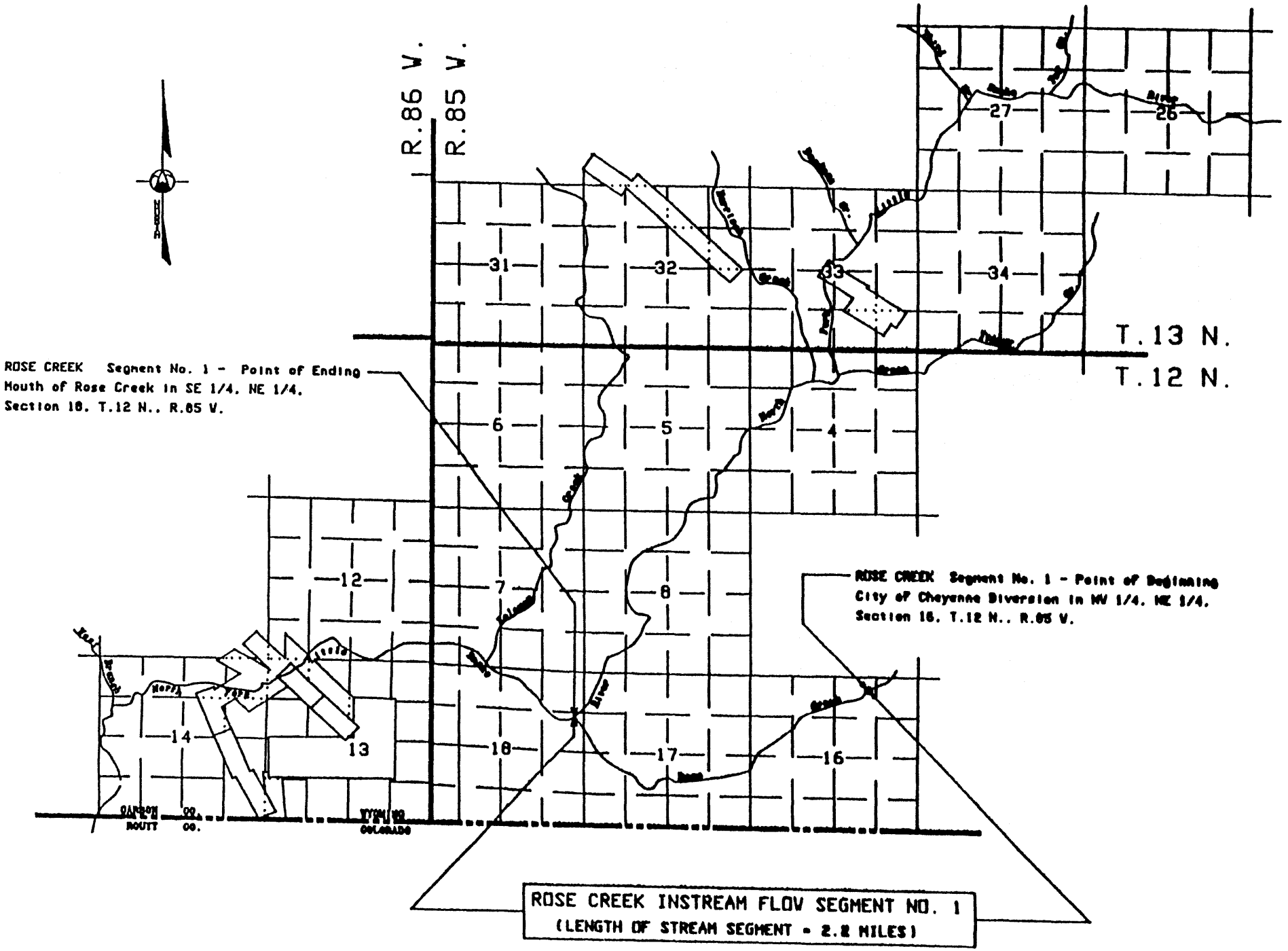


Figure 3. Location of the instream flow reach on Rose Creek.

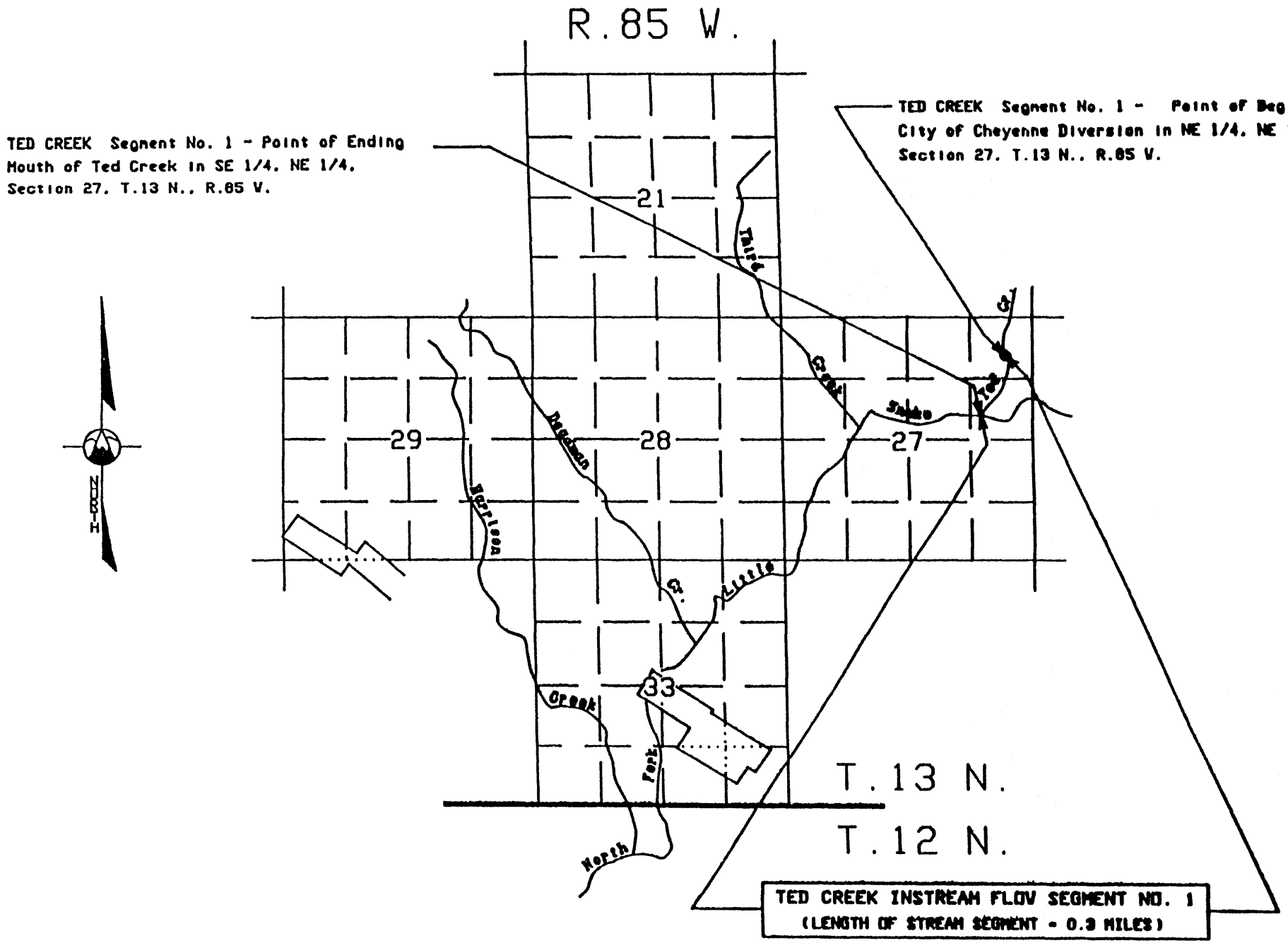


Figure 4. Location of the instream flow reach on Ted Creek.

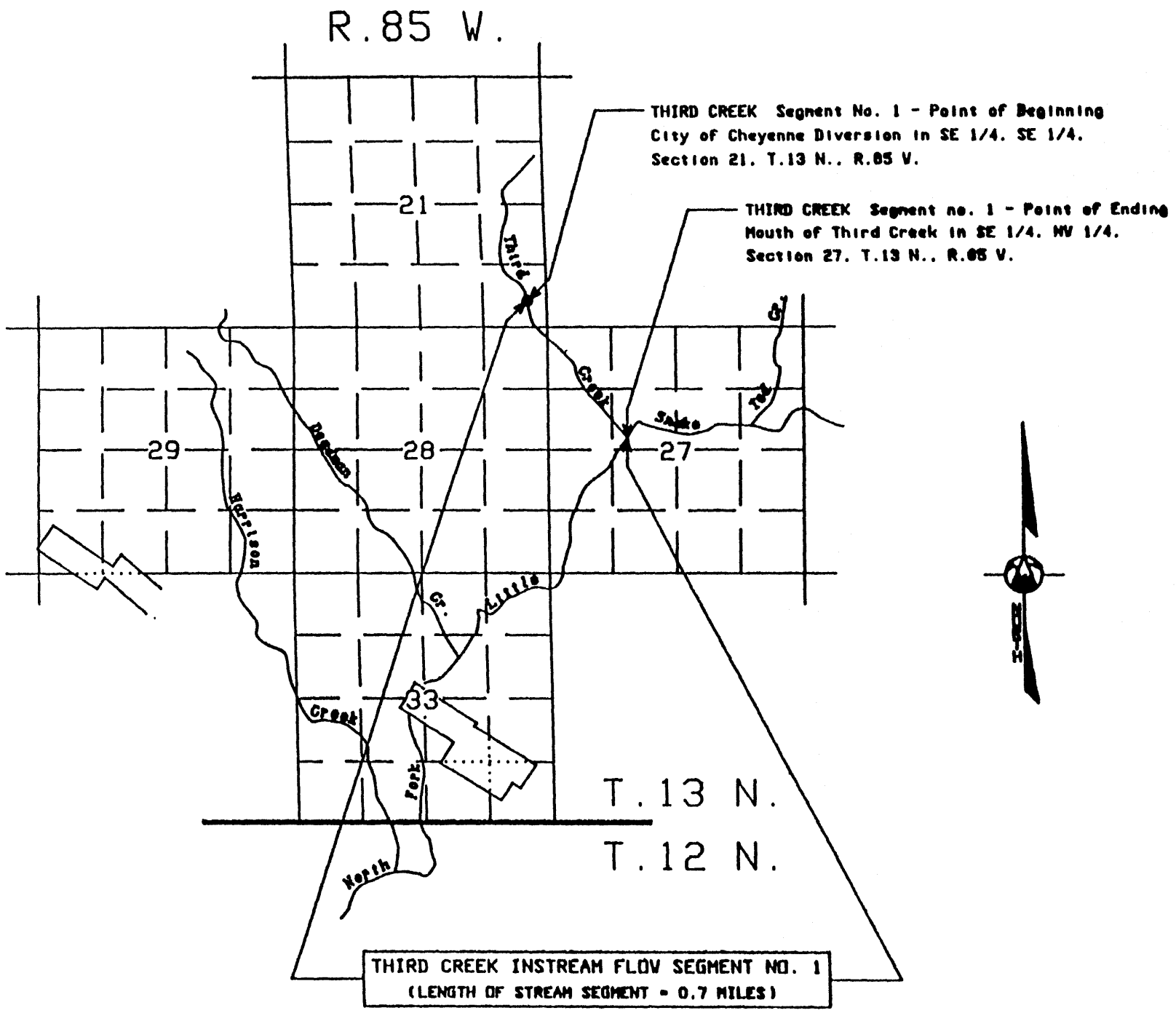


Figure 5. Location of the instream flow reach on Third Creek.

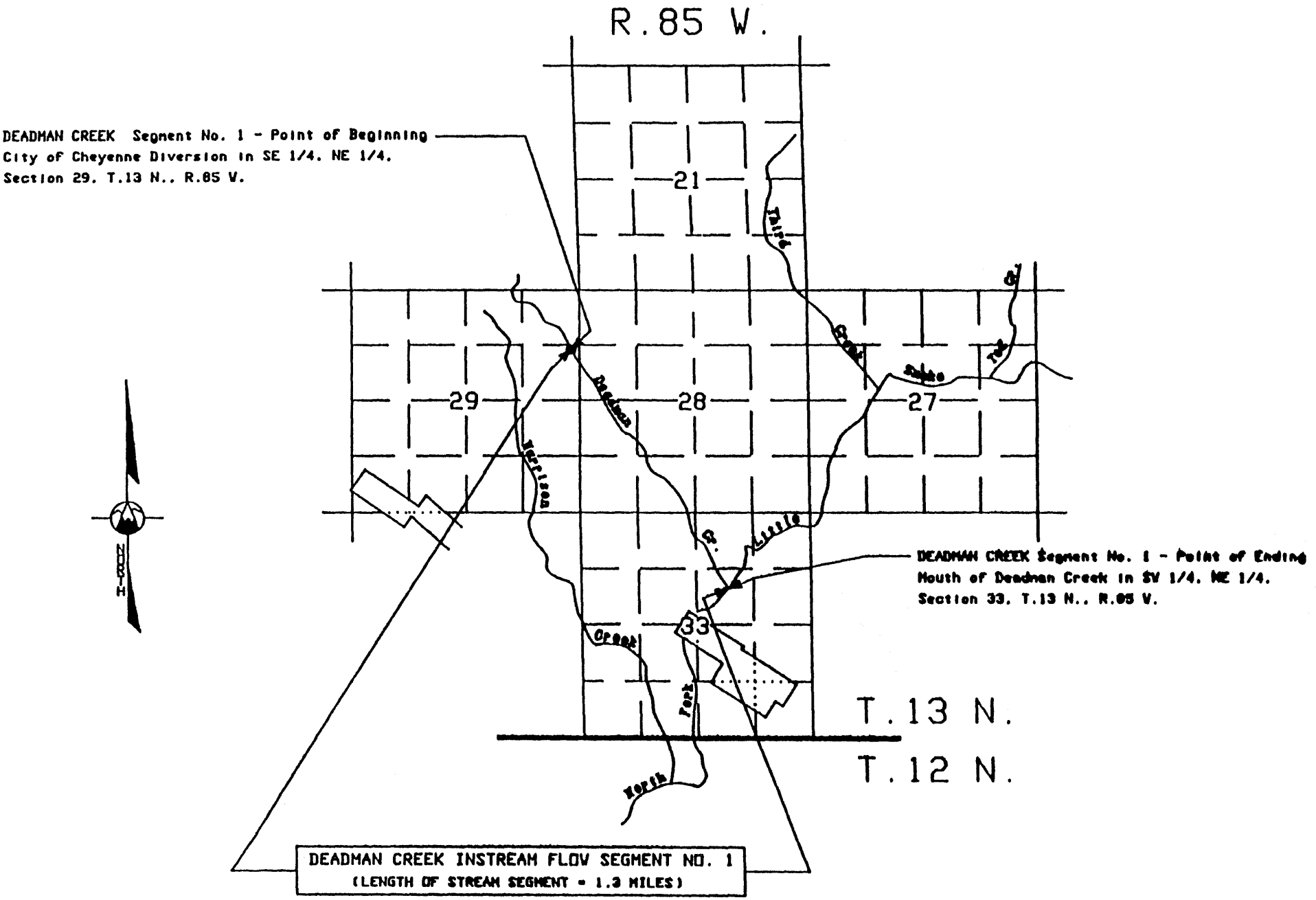


Figure 6. Location of the instream flow reach on Deadman Creek.

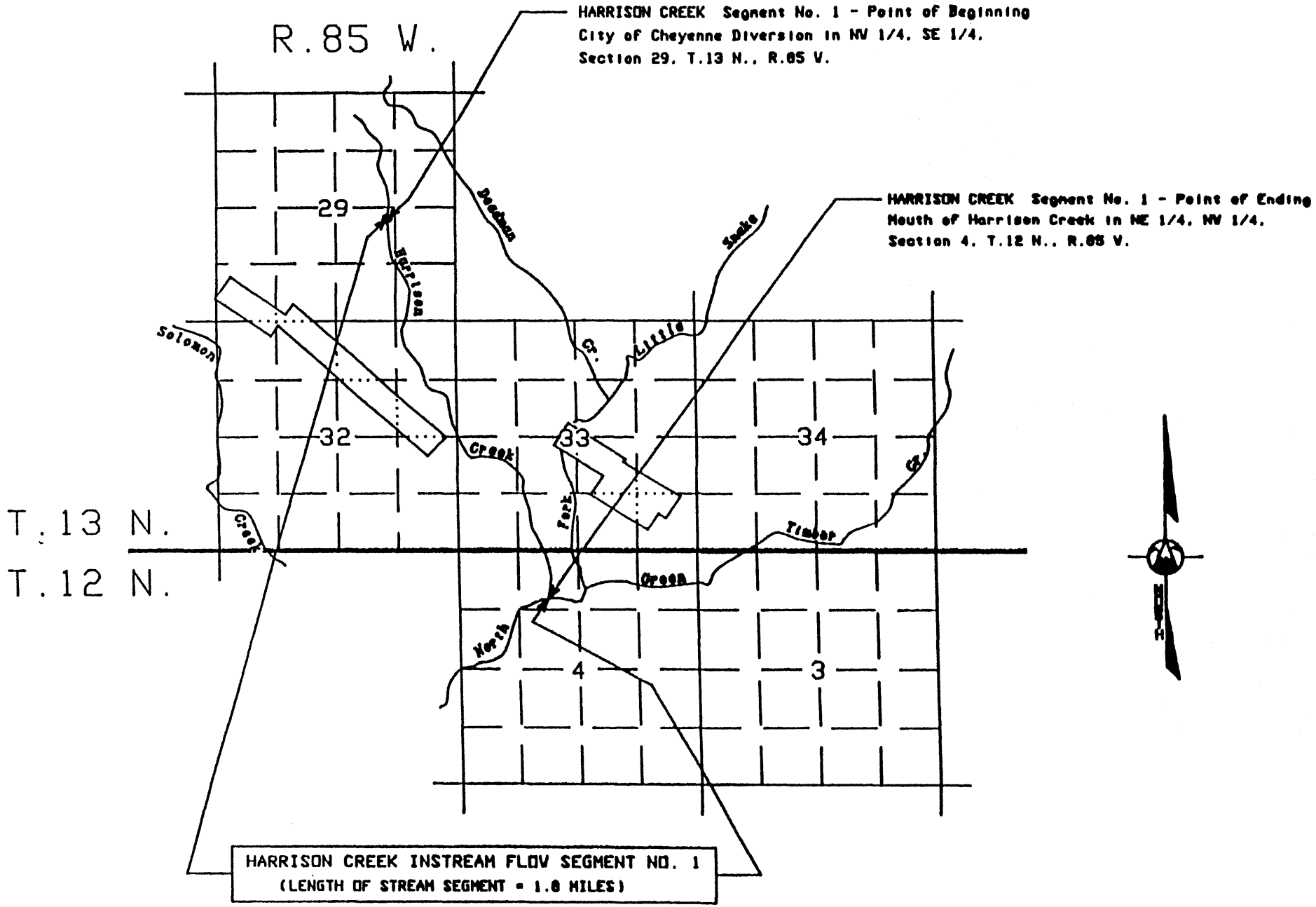


Figure 7. Location of the instream flow reach on Harrison Creek.

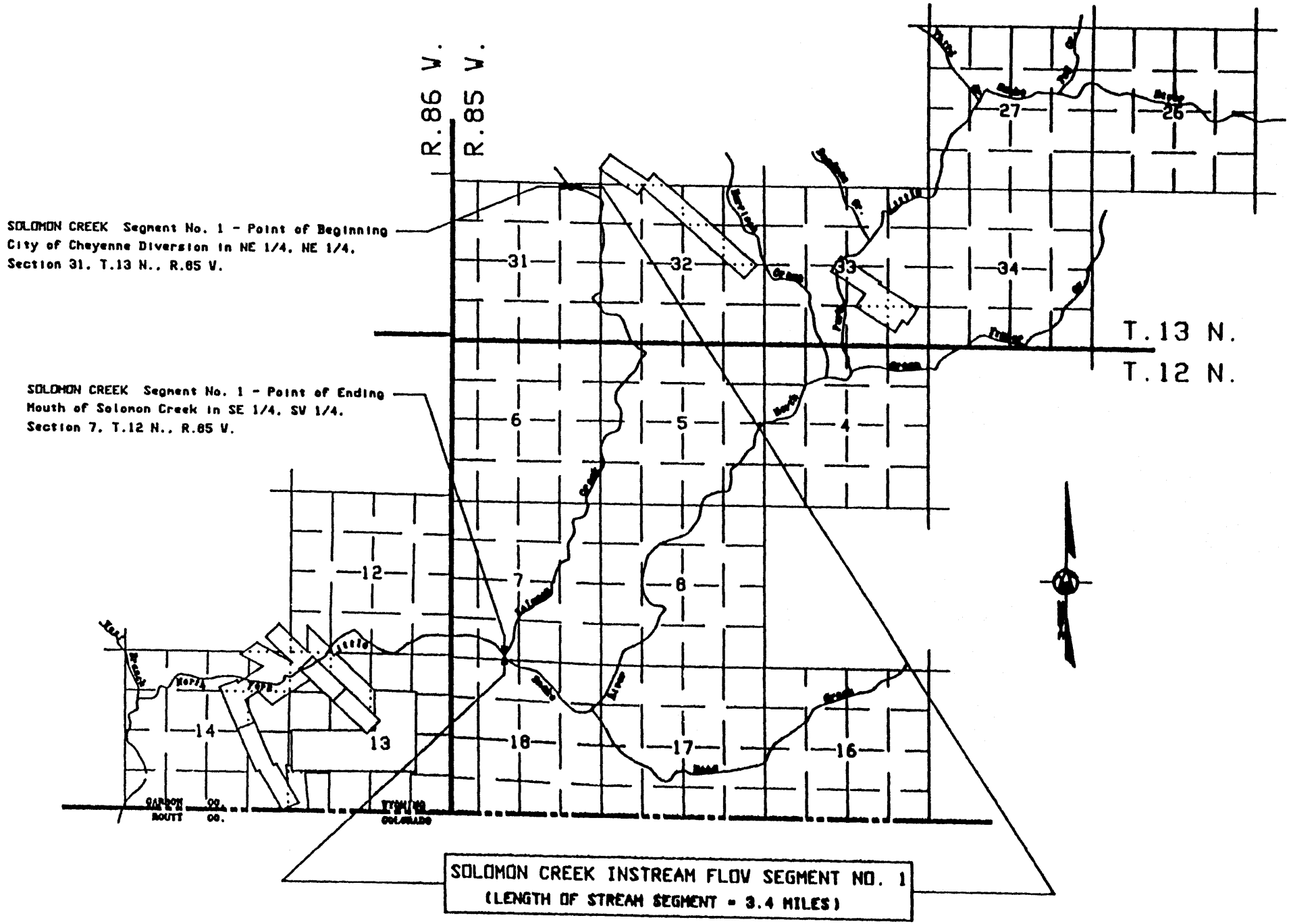
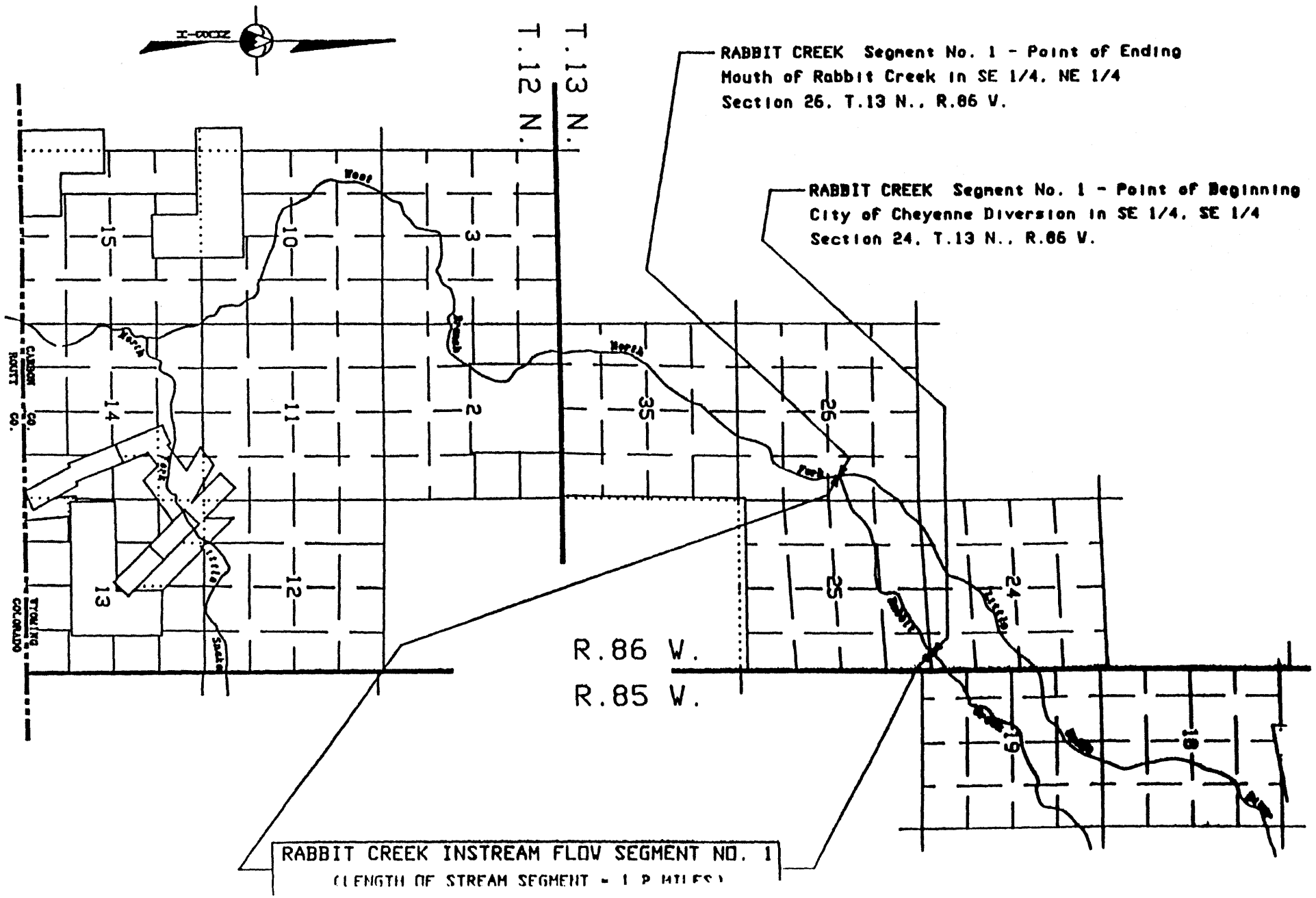
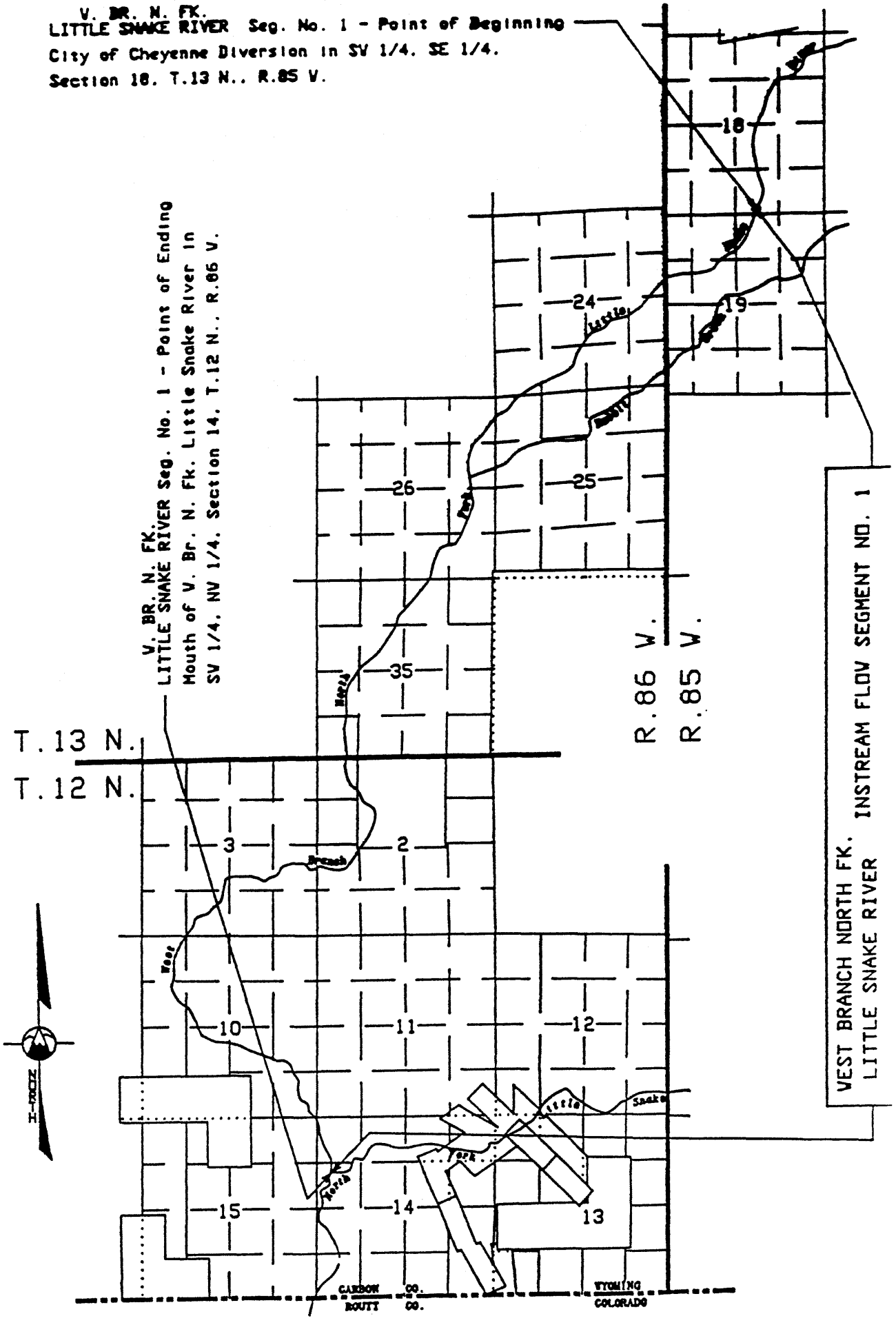


Figure 8. Location of the instream flow reach Soloman Creek.


RABBIT CREEK Segment No. 1 - Point of Ending
Mouth of Rabbit Creek in SE 1/4, NE 1/4
Section 26, T.13 N., R.86 V.
RABBIT CREEK Segment No. 1 - Point of Beginning
City of Cheyenne Diversion in SE 1/4, SE 1/4
Section 24, T.13 N., R.86 V.
T.13 N.
T.12 N.
R.86 W.
R.85 W.
CARBON COUNTY
WYOMING
COLORADO
RABBIT CREEK INSTREAM FLOW SEGMENT NO. 1
(LENGTH OF STREAM SEGMENT = 1.2 MILES)


V. BR. N. FK.
LITTLE SNAKE RIVER Seg. No. 1 - Point of Beginning
City of Cheyenne Diversion in SV 1/4. SE 1/4.
Section 18. T.13 N.. R.85 V.
V. BR. N. FK.
LITTLE SNAKE RIVER Seg. No. 1 - Point of Ending
Mouth of V. Br. N. Fk. Little Snake River in
SV 1/4. NV 1/4. Section 14. T.12 N.. R.86 V.
T.13 N.
T.12 N.
R.86 W.
R.85 W.
18
19
24
25
26
35
3
2
10
11
12
15
14
13
CARBON CO.
ROUTT CO.
WYOMING
COLORADO
VEST BRANCH NORTH FK.
LITTLE SNAKE RIVER
INSTREAM FLOW SEGMENT NO. 1

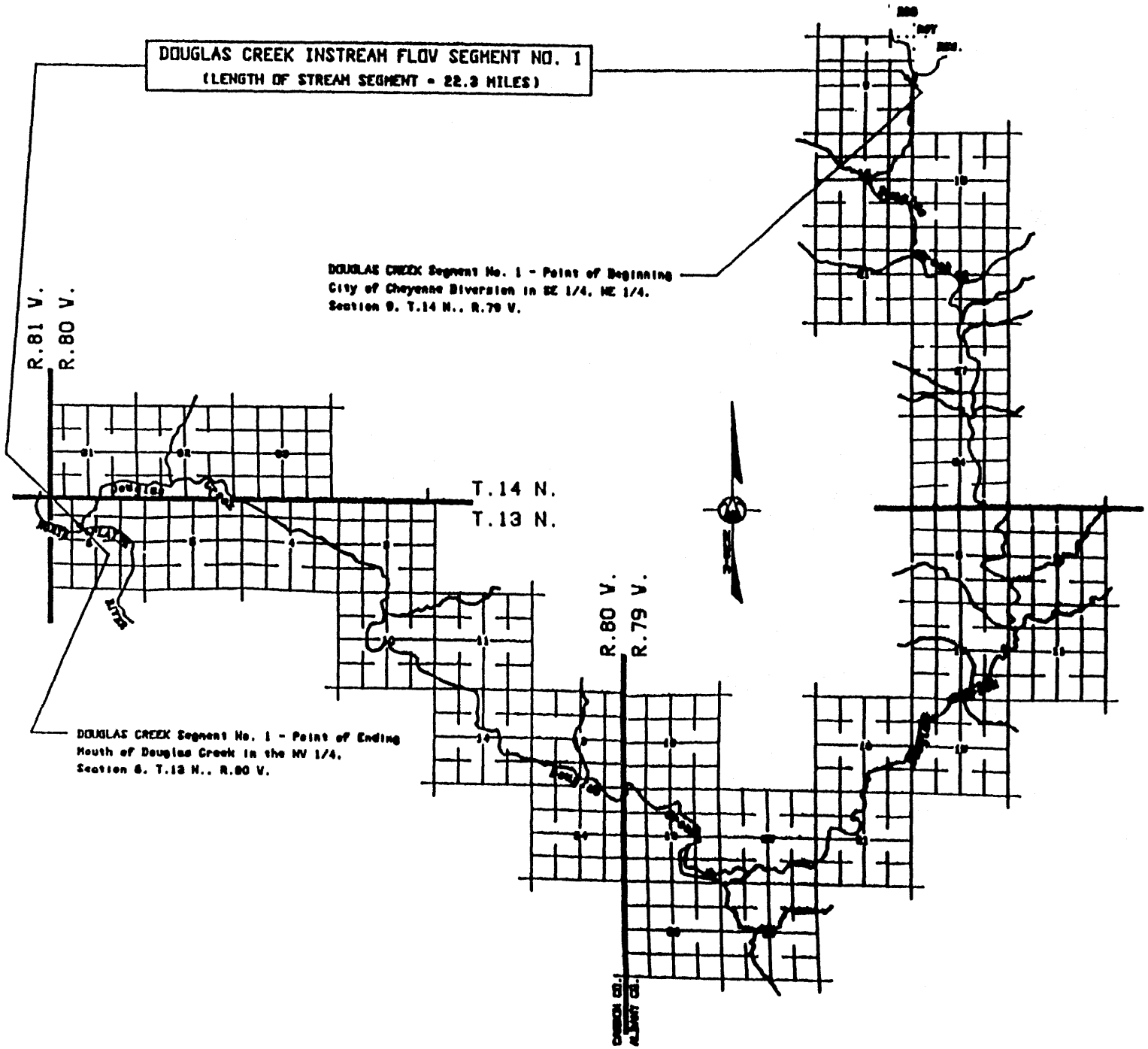


Figure 11. Location of the instream flow reach on Douglas Creek.

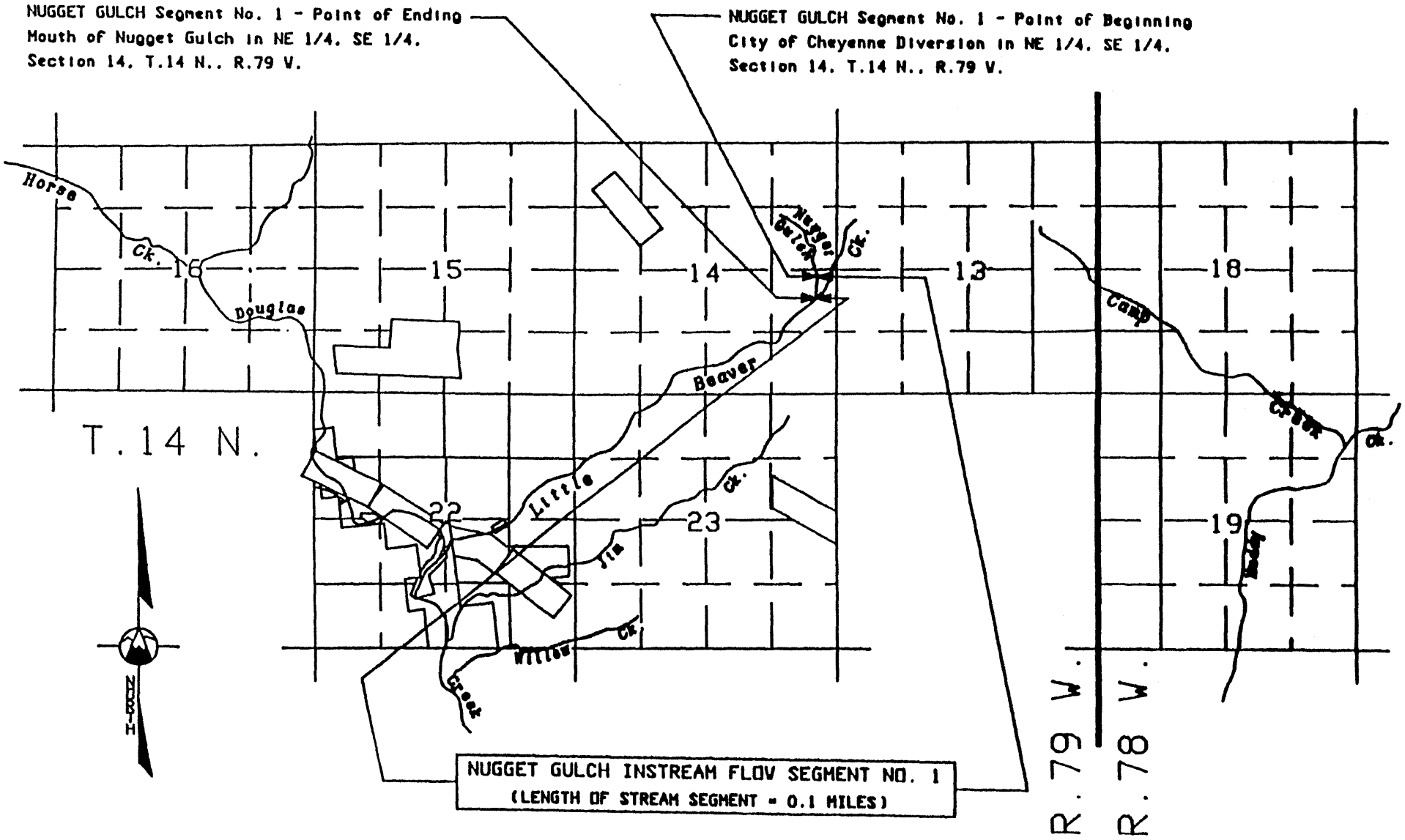


Figure 12. Location of the instream flow reach on Nugget Gulch.

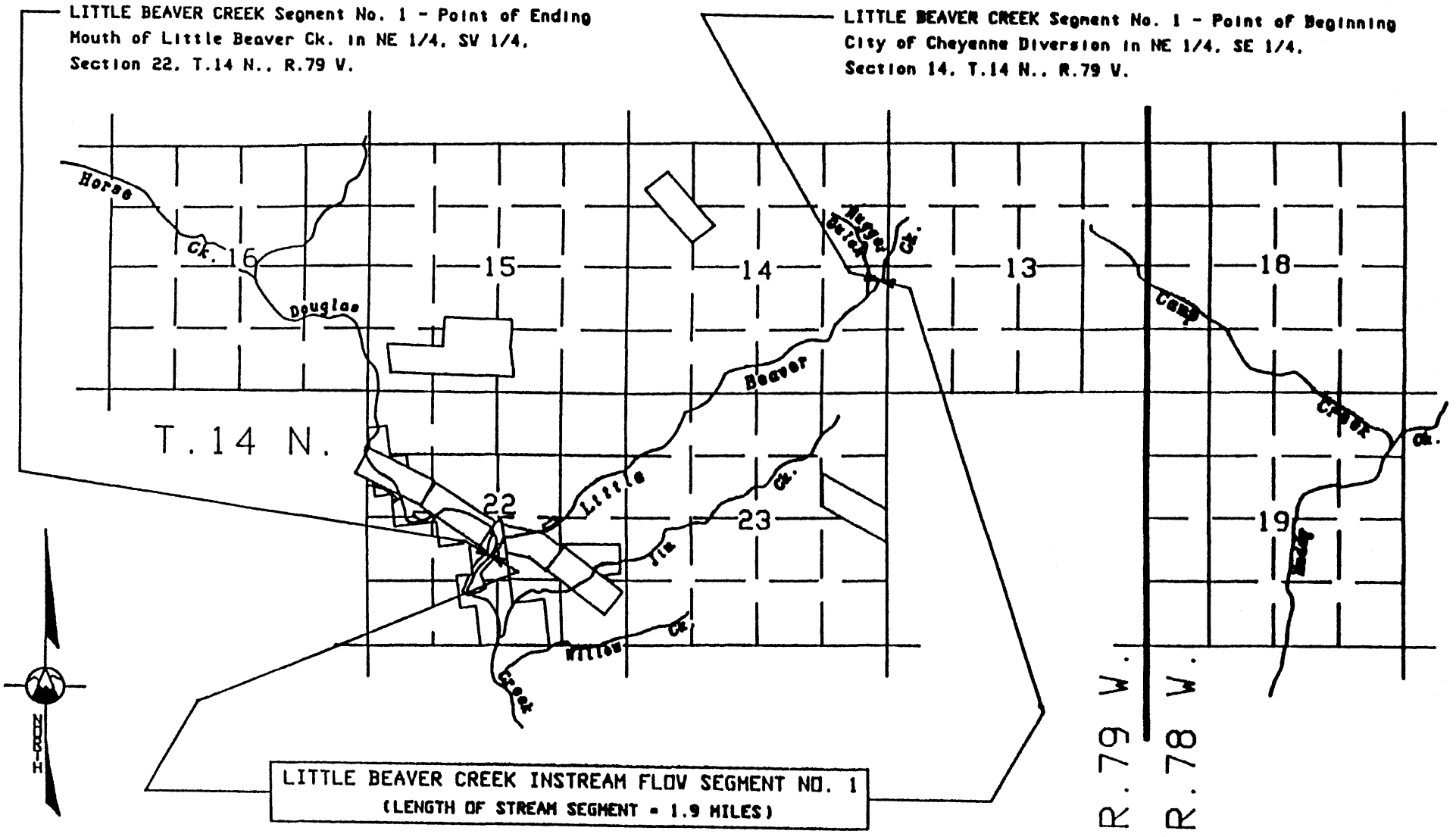


Figure 13. Location of the instream flow reach on Little Beaver Creek.

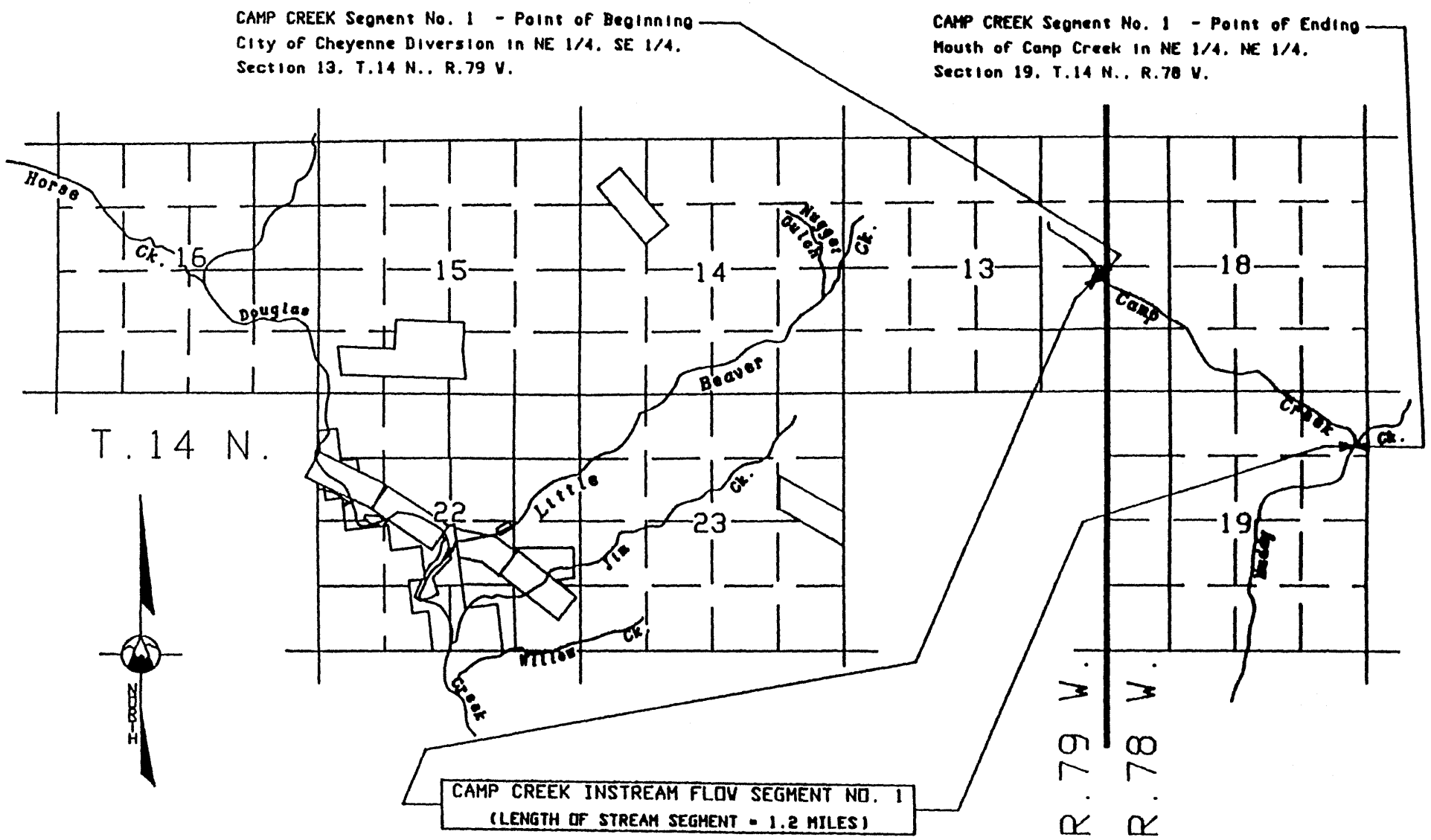


Figure 14. Location of the instream flow reach on Camp Creek.

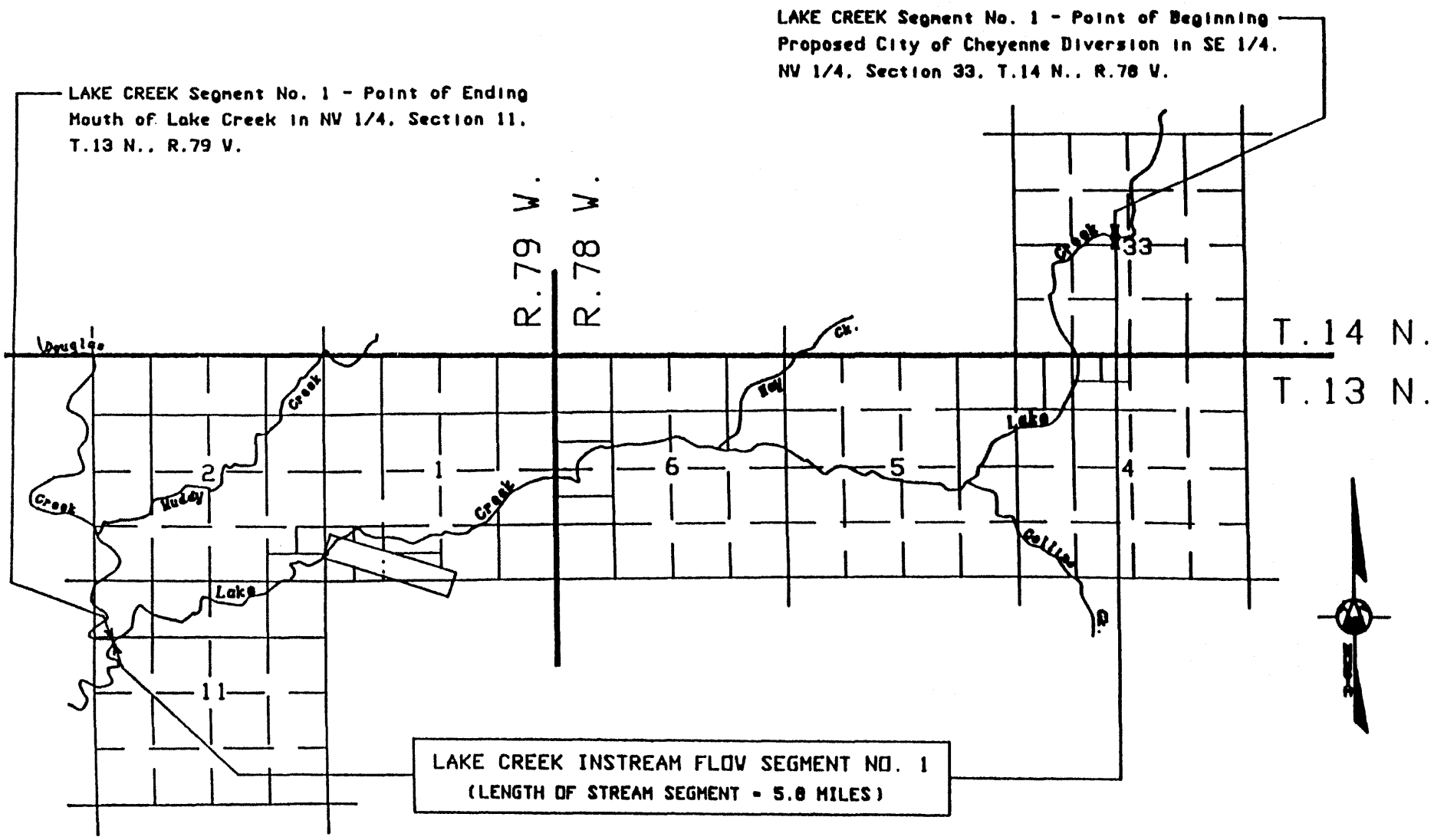


Figure 15. Location of the instream flow reach on Lake Creek.

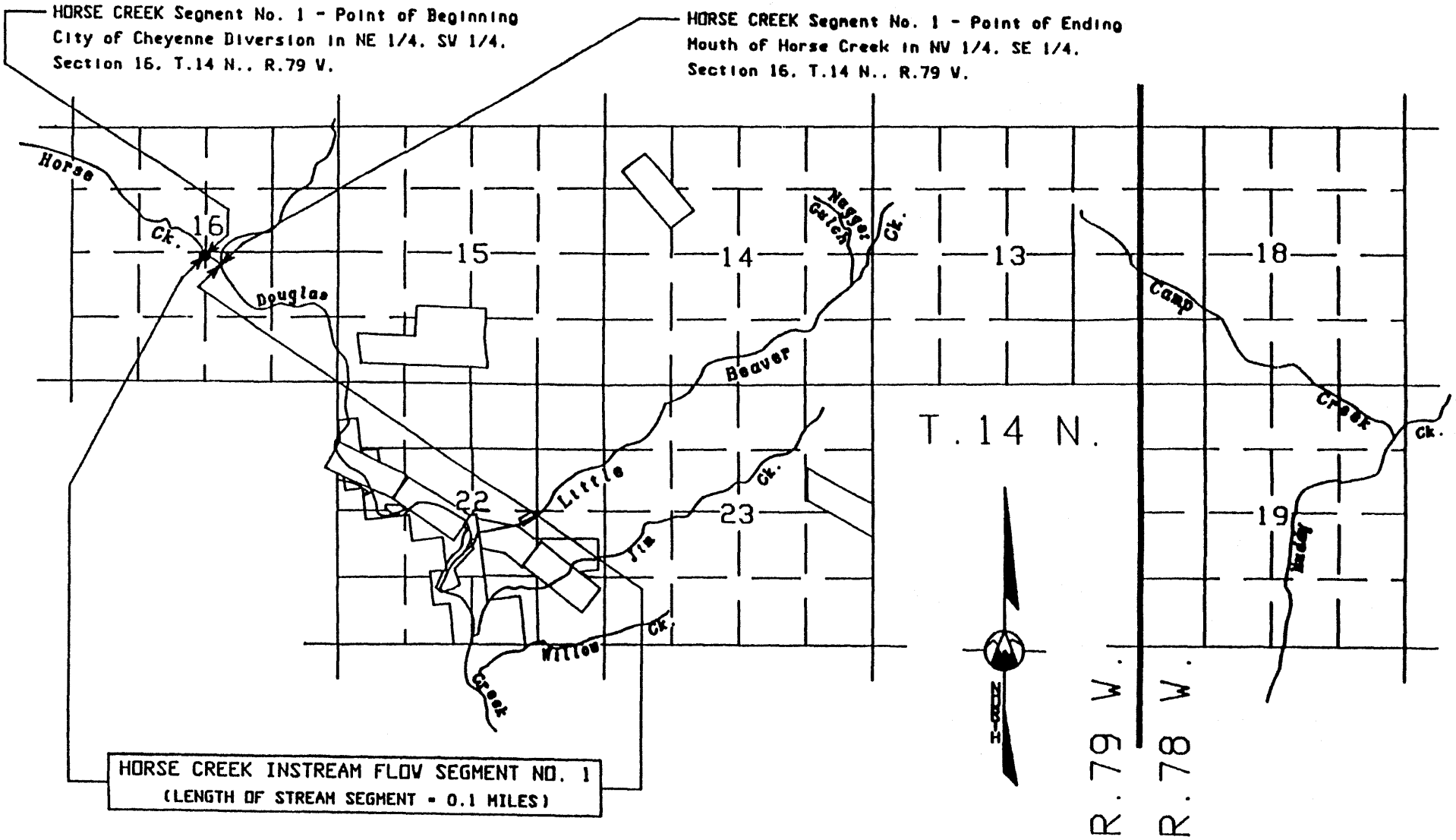


Figure 16. Location of the instream flow reach on Horse Creek.

APPENDIX B

USGS GAGE DATA
ROB RESERVOIR STORAGE DATA

STATION : 06620400 DOUGLAS CREEK ABOVE KEYSTONE WYO
LOCATION : LATITUDE N41:11:00, LONGITUDE W106:16:10, HYDROLOGICAL UNIT 10180002
DRAINAGE AREA : 22.10 mi2 (57.25 km2)
PERIOD OF RECORD: 05/1955 - 09/1965
GAGE ALTITUDE : 9280.00 (2828. m)

Flow in CFS

YEAR	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Year AF
54-55	---	---	---	---	---	---	---	123	67	14	8.4	3.5	---
55-56	3.7	3.5	3.5	4.0	3.5	4.0	9.8	224	101	11	5.5	3.1	22917
56-57	3.8	3.2	2.8	2.2	2.0	1.8	2.2	42	369	67	11	4.9	30668
57-58	6.7	3.5	3.0	2.5	1.8	1.3	20	277	165	11	4.8	4.2	30392
58-59	2.9	2.5	2.1	1.8	1.7	1.6	3.2	101	241	18	6.1	5.0	23250
59-60	12	6.0	3.5	3.0	2.5	2.5	22	157	105	12	4.2	3.3	20194
60-61	3.2	3.6	3.0	2.5	2.0	2.3	8.1	136	115	11	6.4	13	18584
61-62	17	12	7.1	5.4	5.4	5.9	39	201	149	22	5.9	3.9	28719
62-63	4.4	2.8	2.0	1.7	2.0	2.5	4.3	174	75	10	6.1	4.6	17584
63-64	3.4	3.5	3.2	3.4	3.4	3.4	5.8	115	193	25	7.1	4.6	22420
64-65	3.7	3.9	4.6	4.5	4.4	4.1	4.3	114	225	23	6.4	4.1	24257

STATION : 06621000 DOUGLAS CREEK NEAR FOXPARK,WYO.
LOCATION : LAT. N41:04:52, LONG. W106:18:25, HYDROLOGICAL UNIT 10180002
DRAINAGE AREA : 120.00 mi2 (310.8 km2)
PERIOD OF RECORD : 10/1946 - 10/1972
GAGE ALTITUDE : 8200.00 (2499. m)

FLOW IN CFS

YEAR	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Avg
1947	19	13	10	5.0	5.0	7.0	25	550	394	78	26	16	96
1948	19	14	11	9.5	9.0	9.5	62	508	166	35	12	9.3	72
1949	18	13	11	10	11	17	85	491	472	58	17	16	102
1950	19	13	10	9.0	9.4	10	35	389	437	52	13	20	85
1951	15	14	13	12	11	11	27	599	412	51	18	9.8	100
1952	26	15	13	11	10	13	75	648	332	30	12	6.9	100
1953	8.1	8.4	8.0	10	10	12	25	208	291	38	20	7.3	54
1954	9.1	13	11	10	9.0	11	64	246	56	12	5.8	6.2	38
1955	9.4	8.0	8.0	7.0	6.5	7.0	32	180	101	19	12	5.0	33
1956	7.3	7.5	7.5	8.0	7.5	12	66	454	136	18	11	5.4	62
1957	7.1	9.0	8.5	8.0	7.5	9.0	17	362	757	124	23	12	112
1958	21	15	15	14	13	12	47	617	255	23	9.5	8.6	88
1959	8.3	11	9.5	9.0	9.5	12	43	435	367	36	13	11	81
1960	31	26	14	12	11	26	131	334	163	22	6.3	6.1	65
1961	9.5	9.2	7.7	7.2	7.0	9.4	32	346	209	23	15	33	59
1962	41	32	17	11	11	12	172	618	267	43	13	9.8	104
1963	15	9.2	6.3	3.9	5.2	11	61	345	121	17	13	8.4	52
1964	5.0	7.5	4.5	2.9	2.9	3.1	9.5	279	308	33	6.9	7.4	56
1965	5.8	5.4	4.0	3.9	4.0	3.8	13	437	455	45	16	25	85
1966	43	26	22	17	10	18	80	231	84	16	7.1	5.5	47
1967	9.4	7.4	8.2	7.6	4.7	13	42	253	292	25	4.2	9.7	56
1968	23	11	8.5	7.7	7.2	8.2	35	282	621	65	17	20	92
1969	14	8.5	7.7	8.9	9.4	11	95	458	190	94	8.9	6.1	76
1970	12	10	7.6	5.3	4.8	4.0	37	529	599	73	21	23	111
1971	31	22	14	13	12	11	111	591	734	74	21	47	140

STATION : 06623800 ENCAMPMENT RIV AB HOG PARK CR NR ENCAMPMENT WYO
LOCATION : LAT. N41:01:25, LONG. W106:49:27, HYDROLOGICAL UNIT 10180002
DRAINAGE AREA : 72.70 mi2 (188.3 km2)
PERIOD OF RECORD : 10/1964 - 09/1990
GAGE ALTITUDE : 8270.00 (2520. m)

(Flow in cfs)

YEAR	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Avg
1965	20	22	22	21	26	21	29	182	715	307	72	59	125
1966	61	35	28	27	20	21	51	332	281	62	28	19	81
1967	21	16	15	13	15	15	21	195	577	251	52	40	103
1968	26	19	15	14	13	14	21	136	707	187	59	34	103
1969	33	20	12	11	11	11	50	399	424	147	39	26	99
1970	30	25	24	22	22	25	26	283	737	298	52	44	133
1971	39	31	30	29	28	25	49	265	876	366	63	43	154
1971	33	26	22	19	17	24	39	258	496	87	31	28	90
1972	30	28	22	19	17	21	21	211	577	192	54	31	102
1973	23	20	15	14	16	18	33	468	785	142	36	25	133
1974	27	25	20	17	16	15	19	142	673	471	64	31	127
1975	30	27	25	21	18	18	30	277	531	192	49	29	104
1976	26	16	20	16	12	12	40	151	229	48	25	19	51
1977	22	16	22	18	19	21	43	246	914	355	53	30	146
1978	21	18	20	19	17	17	31	301	897	334	54	25	146
1979	23	27	22	22	21	20	34	309	825	200	39	27	130
1980	24	23	21	18	17	17	60	180	291	65	27	24	64
1981	37	25	25	21	16	15	36	285	854	475	71	41	159
1982	44	35	27	26	23	23	24	135	872	453	75	37	148
1983	45	35	32	23	20	21	25	357	797	341	71	63	152
1984	50	39	26	22	20	20	61	424	580	139	43	33	122
1985	38	29	27	25	26	31	69	371	868	229	53	43	151
1986	46	32	29	23	20	20	65	298	181	50	28	19	68
1987	19	21	17	19	16	17	43	279	608	92	34	30	99
1988	20	18	18	17	17	20	76	269	287	69	30	22	72
1989	18	20	19	17	17	18	50	180	488	119	33	23	83

HISTORICAL DIVERSIONS TO LAKE OWEN FROM ROB ROY RESERVOIR (AF)

YEAR	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	YEAR-AF
1963												303	303
1964	248	255	252	241	208	190	237	434	511	434	336	137	3483
1965	173	197	217	121	168	172	217	839	1042	669	311	180	4306
1966	83	97	60	62	63	173	49	192	172	186	186	200	1423
1967	290	517	461	425	329	220	355	689	816	381	92	176	4751
1968	243	263	400	433	292	146	88	0	0	180	245	260	2550
1969	279	270	279	279	252	279	256	635	859	822	100	281	4591
1970	341	330	341	314	308	341	330	513	272	317	326	373	4106
1971	477	420	178	155	140	155	150	222	318	763	955	596	4529
1972	127	120	124	124	100	53	430	693	1095	989	1244	1071	6170
1973	643	618	477	355	239	207	144	268	239	657	394	266	4507
1974	461	263	230	217	180	232	279	673	1186	767	27	0	4515
1975	0	654	809	766	658	698	640	796	13	583	307	313	6237
1976	519	789	707	872	802	642	1123	1295	1270	1101	1078	1014	11,212
1977	612	216	507	661	508	472	598	712	672	733	235	32	5958
1978	271	178	114	124	112	124	120	276	445	879	403	267	3313
1979	265	333	378	506	714	591	411						3198

ROB ROY RESERVOIR
MONTHLY CHANGES IN STORAGE (AF)

YEAR	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	YEAR-AF
1966					0	326	326	3432	413	-81	-186	-136	4094
1967	-257	-442	-399	-396	-275	-158	-295	-87	3697	1291	77	-96	2660
1968	-131	-790	-152	-204	-121	-36	-88	0	4249	414	0	-431	2710
1969	-124	-120	-124	-123	-112	-124	-464	2044	901	-3719	233	-116	-1848
1970	-155	-150	-155	-155	-140	-153	-152	765	3204	693	-109	-112	3381
1971	0	-178	-6	0	0	0	-270	675	-171	121	-677	-2088	-2594
1972	-16	0	0	0	0	0	-239	1514	1556	-381	-938	-783	713
1973	-471	-498	-353	-231	-127	-83	-24	1709	2180	0	-10	-74	2018
1974	-306	-113	-75	-62	-40	-77	-87	428	416	0	0	0	84
1975	0	-295	-296	-413	-473	-469	157	1582	207	0	-88	-237	-325
1976	-226	-797	-1131	-880	-749	-502	-1316	5493	-2697	138	-976	-922	-4565
1977	-504	-222	-514	-663	-508	-149	-238	2411	627	-593	-303	-34	-690
1978	-316	-153	-42	-70	-55	-84	0	139	5306	-2917	-69	-155	1584
1979	-160	-241	-301	-411	-673	-574	-197						

APPENDIX C

U.S. FOREST SERVICE SPECIAL USE PERMIT

No. 720078 filed for record this 26th day of July, 1982, at 2:29 o'clock P m.

BOOK 318 354

EASEMENT (Dam, etc.)

THIS EASEMENT, dated this 26th day of July, 1982, from the UNITED STATES OF AMERICA, acting by and through the Regional Forester, Forest Service, U. S. Department of Agriculture, hereinafter called "Grantor," to the City of Cheyenne, Wyoming - Board of Public Utilities, hereinafter called "Grantee."

WHEREAS, the Grantee has requested authorization to construct the Cheyenne Stage II Water Diversion Project on National Forest lands within the Medicine Bow National Forest, State of Wyoming.

WHEREAS, the Grantee constructed Stage I of the Cheyenne Water Diversion Project on Medicine Bow National Forest lands under authorization of the Act of June 4, 1897, as documented in a Special Use Permit issued by Forest Supervisor W. E. Augsbach on May 15, 1962 and amended November 23, 1964.

WHEREAS, the passage of the Federal Land Policy and Management Act of October 21, 1976 (90 Stat. 2743, et seq) repealed that part of the Act of June 4, 1897 that applies to the issuance of rights-of-way on National Forest System lands.

NOW THEREFORE, Grantor does hereby grant to Grantee, an easement under 36 CFR 251.53 (1.)(1.) for a right-of-way for the construction, operation, and maintenance of the Cheyenne Water Diversion Project (Stages I and II). The area authorized by this easement is limited to those improvement areas within the Medicine Bow National Forest that are depicted on a map entitled "Exhibit B - Cheyenne Water Project - Location Map," a copy of which is attached and hereby made a part of this project.

The improvement areas will occupy 1,900 acres and/or 67.47 miles, more or less, and will consist of the Little Snake Diversion Pipeline, Hog Park Tunnel, Hog Park Drop, Hog Park Dam and Reservoir, Rob Roy Dam and Reservoir, Lake Owen Dam and Reservoir, Rob Roy to Douglas Creek Diversion Dam Pipeline, Douglas Creek to Lake Owen Pipeline and Interceptors, Lake Creek Diversion Pipeline, Lake Owen to Crow Creek Pipeline, South Middle Crow Delivery System, and the necessary access roads. The rights-of-way for pipelines and roads are limited to 100 feet in width plus such additional width as needed to accommodate cuts and fills. The rights-of-way for reservoirs, dams, and appurtenant structures, other than pipelines and roads are limited to the area actually occupied.

This grant is made subject to the following conditions applicable to Grantee, its permittees and contractors:

1. This grant is issued for a period of 30 years ending December 31, 2011, but is renewable provided Grantee will comply with the then-existing rules and regulations governing the occupancy and use of National Forest land.

   Upon completion of construction, however, the Grantee shall furnish the Forest Service with three sets of "as-constructed" location plats. This easement will then be revised as deemed necessary by the Regional Forester to authorize the continued occupancy and maintenance of the rights-of-way as constructed.

2. The Grantee recognizes and accepts the fact that this easement, insofar as endangered and threatened wildlife species are affected, is granted by virtue of a no-jeopardy biological opinion issued by the U. S. Fish and Wildlife Service on May 29, 1981. Should the U. S. Fish and Wildlife Service subsequently issue a "jeopardy" opinion the Grantor will withdraw this easement.

3. Grantee will pay to Grantor the sum of Four Thousand Seven Hundred Thirty and no/100 dollars ($4,730) for the period from the date hereof to December 31, 1982, and thereafter annually on January 1, will pay the sum of Eleven Thousand Three Hundred Fifty and no/100 dollars ($11,350): Provided, however, that the method of fee determination and/or the annual flat fee may be adjusted by the Forest Service as of, and effective on January 1, 1988, and each five years thereafter in order to place the charges on a basis commensurate with the value of use authorized by this grant.

   A late payment charge in addition to the regular fees shall be made for failure to meet the fee payment due date or any of the dates specified for submission of statements required for fee calculation. The late payment charge shall be $15, or an amount calculated by applying the current rate prescribed by Treasury Fiscal Requirements Manual Bulletins to the overdue amount for each 30-day period or fraction thereof that the payment is overdue, whichever is greater. If the due date falls on a nonworkday, the late payment charge shall not apply until the end of the next workday.

4. This grant is subject to all outstanding valid rights existing on the date of the grant.

5. This grant shall not be conveyed, or otherwise transferred in whole or in part, without the advance written approval of the Regional Forester.

6. The Chief of the Forest Service may take action to suspend, revoke, or terminate this easement, (1) upon abandonment, (2) for noncompliance with any conditions of this grant; provided, however, that the Grantee shall have been given written notice of the grounds for such action and reasonable time to cure any noncompliance. Such action will be in accordance with the Rules of Practice Governing Formal Adjudicatory Proceedings and Instituted by the Secretary under 7 CFR 1.130-1.151.

7. The conditions set forth below shall attach to and run with the land:

   The described property and its appurtenant areas and its structures and facilities whether or not on the land therein granted will be operated as part of the Cheyenne municipal water system in full compliance with Title VI of the Civil Rights Act of 1964 and all requirements imposed by or pursuant to the regulations issued thereunder by the Department of Agriculture and in effect on the date of this document to the end that no person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any programs or activities provided thereon; and

   The United States shall have the right to judicial enforcement of these conditions not only as to the Grantee, its successors and assigns, but also as to lessees and licensees doing business or extending services under contractual or other arrangements on the land herein conveyed.

   In the event of a breach of any of the conditions set forth above, all right, title, and interest in and to the above described property shall, at the option of the Grantor, revert to and become the property of the United States of America, which shall have an immediate right of entry thereon, and the Grantee, its successors or assigns, shall forfeit all right, title, and interest in and to the above described property; provided, however, that the failure of the Grantor to insist in any one or more instances upon complete performance of any of the said conditions shall not be construed as a waiver or a relinquishment of the future

performance of any such conditions, but the obligations of the Grantee with respect to such future performance shall continue in full force and effect. The procedures applicable to the foregoing shall be in accordance with 7 CFR 15 and other pertinent laws and regulations.

8. This grant confers no rights upon the Grantee to the use of water involved; such rights must be obtained under State law.

9. Except for such restrictions as the Grantee and the Forest Supervisor may agree to be necessary to protect the installation and operation of authorized structures and developments, the lands and waters covered by this grant shall remain open to the public for all lawful purposes. To facilitate public use of this area, all existing roads or such roads as may be constructed by the Grantee, shall remain open to the public except for such sections as may be closed by joint agreement of the Grantee and the Forest Supervisor. Access roads constructed under this grant west of the Continental Divide will be closed to public use during construction.

10. The Forest Service reserves the right to issue additional authorizations to other applicants to increase the storage capacity of the improvements if such action proves feasible. No authorization will be granted for additional facilities that will jeopardize the privileges granted by this grant. Any additional grants authorizing larger facilities will provide for payment of costs, including the cost of construction of the original project works, on a cost-benefit ratio mutually agreeable to the Grantee and the new applicant. If the Grantee and applicant cannot agree on division of costs, the Forest Service shall decide on an equitable division between the old and new works.

11. The Grantee shall prepare and submit to the Forest Service, prior to filling of the reservoirs, an "Emergency Preparedness Plan" for possible dam failure that includes warning plans as well as emergency procedures to be taken if conditions occur which could be potentially dangerous to the safety of the dams. Pertinent features that must be included in the plan are: a breach inundation map, actions to prevent or reduce consequences of failure, public notification plan, assignment of responsibility for evacuation of people from downstream threatened areas, and designation of the individual responsible for implementing the plan.

12. The Grantee shall have the authorized structures inspected annually and after each flood that overflows the impoundment spillways. The inspection shall be made by a qualified engineer to ensure protection to the structures. Repairs shall be made in accordance with recommendations by the inspecting engineer. A qualified engineer is one authorized to practice engineering in the State either by reason of his employment by the State or Federal Government or by registration as provided by law of the State. The engineer shall sign a written report of said inspection. Three copies of each report shall be mailed to the Forest Supervisor of the Medicine Bow National Forest.

13. The Grantee further agrees that Forest Service representatives may inspect the right-of-way and the structures thereon at any time and if not satisfied with the then-existing protection to control soil erosion on the dam and in and below the spillway to streambed, upon written notice thereof, the Grantee shall take action to provide protection to control erosion. If the Forest Service is not satisfied with any safety, operation, maintenance, or other feature or physical condition of the structures and appurtenances, upon a finding and written notice thereof, the Grantee shall comply with a request to correct, adjust, or change same.

14. The Grantee shall take necessary precautions to prevent pollution or deterioration of lands, air, or waters which may result from the exercise of the privileges extended by this grant. The Grantee shall be responsible for securing any permits, certificates, licenses, or other forms of approval required to comply with Federal and State standards for public health and safety, environmental protection, siting, construction, operation, or maintenance.

15. Before water is stored in the reservoirs, the Grantee shall construct and install a log boom above the emergency and mechanical spillways in a position acceptable to the Forest Service. Booms shall be of sound material, constructed according to specifications as established or approved by the Forest Supervisor.

16. Any lands described in this easement which have been withdrawn for waterpower purposes under the act of March 3, 1879, or act of June 25, 1910 (or are embraced in an application or license under the Federal Power Act of June 10, 1920), or have been withdrawn under the Reclamation Act of June 17, 1902, are subject at any time to use in connection with the development of waterpower or for reclamation purposes. This easement, therefore, is issued with the specific understanding that (1) its use shall not interfere with such waterpower or reclamation development and that (2) the easement may be, if necessary, terminated upon ninety (90) days notice when the judgment of the Federal Energy Regulatory Commission, or of the Bureau of Reclamation in the event of reclamation withdrawals, the lands occupied are needed for use in connection with the generation of hydroelectric power, reclamation developments, or other purposes contemplated by the act or acts under which the lands have been withdrawn. No claim shall be made against the Grantor or power licensees for or on account of prospective profits or for any injury or damage to properties, improvements, or operations due to such development. The Grantee will be allowed ninety (90) days in which to remove his improvements.

17. This easement is issued subject to the provisions of the Boulder Canyon Project Act of December 21, 1928 (45 Stat., 1064), particularly Section 13, and to the provisions of the Upper Colorado River Compact.

18. A comprehensive boating safety plan shall be jointly prepared by the Grantee and the Forest Officer in charge and the provisions thereof will be executed and enforced by the Grantee. This plan shall be reviewed annually and revised as needed. It will include consideration of all hazards involved in the use and enjoyment of the granted area and lake facilities. It will include provisions for adequate instructions, signs, warnings, signals, banners, buoys, and other safety precautions necessary to provide public safety regarding mechanical equipment and other sources of personal injury.

19. To provide and maintain public recreation opportunities, the Grantee shall annually prepare a release schedule for Hog Park Reservoir and Rob Roy Reservoir for approval by the Forest Supervisor. The Grantee shall implement and follow the release schedule as approved.

20. To provide and maintain favorable conditions of waterflows, the Grantee shall:

    a. Release an instantaneous minimum flow of 15 cubic feet per second (cfs) from the Hog Park Reservoir outlet at all times.

    b. Control maximum releases through the Hog Park Reservoir outlet works so as not to exceed 200 cfs at any time except that the natural flow may be released if it exceeds 200 cfs.

c. Release an instantaneous minimum flow of 5.5 cubic feet per second (cfs) into Douglas Creek from the Rob Roy Reservoir outlet at all times.

d. Control maximum releases to the stream through the Rob Roy Reservoir outlet works so as not to exceed 130 cfs except that the natural flow may be released if it exceeds 130 cfs.

e. Annually release through the Rob Roy Reservoir outlet a flushing flow of 130 cfs for a minimum of 72 continuous hours (3 days) coinciding with the period of peak spring runoff.

f. Maintain, as an instantaneous minimum, the maintenance flow or the natural flow, whichever is less, immediately below the diversion structure in each stream as listed in Table I.

g. Provide as a minimum the flushing flow or the natural flow immediately below the diversion structures in each stream as listed in Table I for a continuous 72-hour (3 days) period each year coinciding with the period of natural peak spring runoff.

Table I

Stream	Maintenance Flow (cfs)	Flushing Flows (cfs)
Rose Creek	0.75	9.0
Green Timber Creek (Granite)	1.0	14.0
North Fork	2.0	30.0
Ted Creek	1.0	19.0
Third Creek	1.0	11.0
Deadman Creek	2.0	35.0
Harrison Creek	1.0	9.0
Solomon Creek	1.0	12.5
Rabbit Creek	1.5	18.0
West Branch	3.5	92.0
Nugget Gulch Creek	0.2	4.5
Little Beaver Creek	0.35	7.0
Camp Creek	0.2	2.0
Lake Creek	0.5	8.5
Horse Creek	0.2	N/A

h. Install and maintain an acceptable measuring device immediately below each diversion structure on all streams listed in Table I and immediately below the dams of Hog Park and Rob Roy Reservoirs. The measuring device shall be such that it can be readily monitored by visual observation at all times.

i. On all streams not listed in Table I which have diversion structures, provide a blanket minimum flow by releasing the entire natural flow during the period of July 1 to November 1 or as late as adequate access is available.

j. Not at any time lower the water level of Lake Owen below its natural level. This water level is established at an elevation of 8,948 feet.

k. Provide a screen of one-inch-square openings for the outlet of Lake Owen.

l. Annually prepare a full augmentation plan for Bamford Creek (South Fork of Middle Crow Creek) for approval by the Forest Supervisor. Flow releases into Bamford Creek during the first year of operation will not exceed 1 cfs at each drop point or total more than 2 cfs from all drop points. Releases after the first year may be increased only if it is determined that higher flows will not cause undesirable flooding or bank erosion. Releases from all drop points totaling more than 8 cfs will not be approved. Releases will not be made during the period of peak spring runoff.

21. The Grantor shall have unrestricted use of the granted right-of-way and any road constructed thereon for all purposes deemed necessary or desirable in connection with the protection, administration, management, and utilization of Federal lands or resources; and shall have the right alone to extend rights and privileges for use of the right-of-way and road thereon to States and local subdivisions thereof, and to other users including members of the public, except users of land or resources owned or controlled by the Grantee: Provided, That such use shall be controlled by the Forest Service so as not unreasonably to interfere with use of the right-of-way or road by the Grantee or cause the Grantee to bear a share of the cost of maintenance greater than the Grantee's use bears to all use of the road.

22. Grantee shall provide maintenance made necessary by his use of any roads constructed under this easement.

23. The Grantee will grant without charge, road rights-of-way, satisfactory to the Forest Service across lands owned by the Grantee, for those Forest Development Roads relocated as a result of construction of Rob Roy Reservoir. Grantee shall also provide Grantor with a surface management easement for its private lands above the high waterline at Rob Roy Reservoir.

24. The Grantee, in the exercise of the privileges granted by this easement, shall require that its employees, sublessees, contractors, subcontractors, or renters and their employees comply with all applicable conditions of this easement and that the conditions of this easement be made a part of all subleases, contracts, subcontracts, or rental agreements.

25. The Grantee shall take such soil and resource conservation and protection measures, including weed control, on the land covered by this grant as the Grantor may request.

26. All activities under this easement shall be subject to provisions of the "Memorandum of Understanding Among the State of Wyoming Historic Preservtion Officer, the Forest Service U.S.D.A., and the City of Cheyenne Board of Public Utilities" regarding cultural resources and signed by Donald L. Rollens, Forest Supervisor on May 10, 1982.

27. The Grantee shall not use chemical materials to control undesirable weedy and herbaceous vegetation, aquatic plants, insects, rodents, fish and other pests without prior approval of the Grantor.

28. The Grantee shall protect the scenic aesthetic values and the fish and wildlife habitat values of the area under this easement, and the adjacent land, during operations and maintenance of the authorized use.

29. The Grantee shall take action, both independently and on request of any duly authorized representative of the United States, to prevent and suppress fires on or near the lands to be occupied under this grant, including making available such maintenance forces and equipment as may be reasonably obtainable for the suppression of such fires.

30. The Grantee shall be held liable for all injury, loss, or damage, including fire suppression costs, directly or indirectly resulting from or caused by the Grantee's use and occupancy of the area covered by the easement, regardless of whether the Grantee is negligent or otherwise at fault, provided that the maximum liability without fault shall not exceed $1,000,000 for any one occurrence and provided further that the Grantee shall not be liable when such injury, loss, or damage results wholly, or in part, from a negligent act of the United States, or an act of a third party not involving the facilities of the Grantee.

Liability for injury, loss, or damage, including fire suppression costs, in excess of the specified maximum, shall be determined by the laws governing ordinary negligence.

31. The Grantee shall indemnify the United States against any liability for damage to life or property arising from the Grantee's authorized occupancy or use.

32. Grantee will comply with the attached Stipulation consisting of eighteen clauses as contained on the enclosed pages numbered 1 through 5, which are hereby made a part of this grant.

33. This easement cancels and supersedes the Special Use Permit for Stage I of the Cheyenne Water Diversion Project issued by Forest Supervisor W. E. Augsbach and designated: City of Cheyenne, Board of Public Utilities, Reservoir-Water Transmission Line, 5/15/62.

IN WITNESS WHEREOF, the Grantor, by its Regional Forester, Forest Service, has executed this easement pursuant to the delegation of authority by the Secretary of Agriculture to the Assistant Secretary for Natural Resources and Environment, 7 CFR Section 2.19, the delegation of authority by the Assistant Secretary for Natural Resources and Environment to the Chief, Forest Service, 7 CFR Section 2.60, and the delegation of authority by the Chief, Forest Service, 36 CFR Part 200 Subpart B.

UNITED STATES OF AMERICA

By Craig W Rupp
Regional Forester, Forest Service
United States Department of Agriculture

ACKNOWLEDGMENT

STATE OF COLORADO)
) ss
COUNTY OF JEFFERSON)

On this 26th day of July, 1982, before me, Jean L. Meisenbach, the undersigned officer, personally appeared Craig W. Rupp, known to me or satisfactorily proven to be the person whose name is subscribed to the within instrument and acknowledged that he executed the same for the purposes therein contained.

IN WITNESS WHEREOF I hereunto set my hand and official seal.

JEAN L. MEISENBACH NOTARY PUBLIC STATE OF COLORADO

My Commission Expires: 9/10/84

Jean L. Meisenbach
(Signed)

JEAN L. MEISENBACH
*Notary Public: Please print or type name beneath signature.

STIPULATION

As referred to in Condition 32 of the dam, etc., easement deed between the United States, acting through the Regional Forester, and the Grantee, the Grantee will carry out the terms of the following Stipulation during the Construction Stage. The Construction Stage begins when construction activities are ready to commence on lands administered by the Forest Service. Construction Stage ends when the Forest Service and the Grantee mutually agree that any work done thereafter will be considered as operation or maintenance, EXCEPT, that the Forest Service reserves the right to reinstate the terms of this Stipulation if the Grantee subsequently submits plans for reconstruction or alteration of the project works covered by the aforesaid easement.

This Stipulation may be revised or amended by mutual consent of the Grantor and Grantee at any time for any purpose, including but not limited to adjusting to changed physical conditions in the land, water, air, wildlife, or other relevant environmental factors, or to correct an oversight. The Grantor and Grantee shall monitor the Grantee's operation and use of the grant throughout the life of the grant in a mutual endeavor to determine the feasibility and need for amending the existing Stipulation.

The following terms of this Stipulation apply to the Grantee:

1. The grantee shall file with the Forest Supervisor in advance of any construction, five copies of the plans, specifications, and designs of all proposed dams, canals, weirs, roads, ditches, siphons, tunnels, and appurtenant structures; shall begin no construction until such plans have been approved by the Forest Supervisor; shall construct all works in accordance with the plans so approved; and shall make such repairs in all structures as may be required by the Forest Supervisor.

2. It shall be the responsibility of the Grantee to employ a qualified engineer to stake out the project prior to construction, and said engineer shall supervise construction operations and furnish the certification of compliance with the final drawings and specifications. Written copies of each inspection report, including soil compaction and concrete tests, are to be furnished the District Ranger during construction. When the project is completed, the Grantee shall have the qualified engineer make a final inspection of the project in company with the Regional Forester's representative and submit to the Forest Supervisor a certified statement that the project was constructed in accordance with the approved plans, designs, and specifications.

3. The Grantee agrees to remove all timber and brush from the area to be flooded and extending five (5) feet horizontally back from the high-water line. Such clearing work shall progress with the construction of the dams and be completed before any water is stored in the enlarged reservoirs.

4. The Grantee shall protect all survey monuments, benchmarks, witness corners, reference and other monuments, and bearing trees against destruction, obliteration, and damage. If any monument or corner is in an area subject to disturbance or destruction, the monument will be referenced by a registered land surveyor in such a manner that it can be replaced within 0.1 foot of its original position and properly recorded in compliance with State and/or Federal specifications.

5. No waste or byproducts shall be discharged if it contains any substances in concentrations which will result in substantial harm to fish and wildlife, or to human water supplies.

6. Storage facilities for materials capable of causing water pollution, if accidentally discharged, shall be located so as to prevent any spillage into waters, or channels leading into water, that would result in substantial harm to fish and wildlife or to human water supplies.

7. The Grantee shall carry on all operations in a workmanlike manner, having due regard for the safety of employees; and shall safeguard with fences, barriers, fills, covers, or other effective devices, pits, cuts, and other excavations which otherwise would unduly imperil life, safety, or property of other persons.

8. The Grantee shall transport, store, handle and use explosives as follows:

   a. Only electronic detonators shall be used for blasting.

   b. In the use of explosives, the Grantee shall exercise the utmost care not to endanger life or property and shall be responsible for any and all damages resulting from the use of explosives and shall adopt precautions that will prevent damage to surrounding objects. The Grantee shall furnish and erect special signs to warn the public of its blasting operations. Such signs shall be placed and maintained so as to be clearly evident to the public during all critical periods of the blasting operations, and shall include a warning statement to have radio transmitters turned off.

   c. All explosives shall be stored in a secure manner, in compliance with local laws and ordinances, and all such storage places shall be marked "DANGEROUS - EXPLOSIVES." Where no local laws or ordinances apply, storage shall be provided satisfactory to the Forest Officer in charge, and in general, not closer than 1,000 feet from the road or from any building or camping area.

   d. When using explosives, the Grantee shall adopt precautions which will prevent damage to landscape features and other surrounding objects. When directed by the Forest Officer in charge, trees within an area designated to be cleared shall be left as a protective screen for surrounding vegetation during blasting operations. Trees so left shall be removed and disposed of after blasting has been completed. When necessary, and at any point of special danger, the Grantee shall use suitable mats or some other approved method to smother blasts.

9. If, during excavation work, items of substantial archeological or paleontological value are discovered, or a known deposit of such items is disturbed, the Grantee will cease excavation in the area so affected. He will then notify the Forest Service and will not resume excavation until written approval is given.

10. The Grantee will ensure slope stabilization and prevent soil loss throughout the authorized area by carrying out the following erosion control provisions:

    a. Topsoil shall be stripped from construction areas and be deposited in storage piles apart from other excavated material. After construction has been completed, and the resulting disturbed areas have been reshaped and smoothed as required, the stored topsoil shall be evenly spread over exposed topsoil to the extent that may be practicable, and shall be revegetated.

b. All earth cut or fill slopes favorable to revegetation, or other areas on which ground cover is destroyed in the course of construction, will be revegetated to grasses or other suitable vegetation as required by the Forest Service. Seeding or planting will be done at a time of the year, in a manner, and with species which the District Ranger considers offer the best chance of success and will be repeated annually until such areas are accepted in writing by the District Ranger as satisfactorily revegetated and stabilized.

11. Prior to beginning construction on the project the Grantee shall prepare an Operation Plan for the project for approval by the Forest Supervisor. Approval of the Operation Plan will be based upon requirements deemed necessary by the Forest Supervisor for proper management of the project. The Operation Plan shall include but not be limited to the following:

a. A schedule for the development and construction of all facilities needed for the project. The schedule shall include a list of planned improvements and the scheduled date for completion. The Grantee may accelerate the scheduled date for construction of any improvement authorized, provided the other scheduled priorities are met and that all authorized priority installations are completed to the satisfaction of the Forest Supervisor prior to the scheduled due date. All required plans and specification for site improvement and structures included in the construction schedule shall be submitted to the Forest Supervisor at least 45 days before the construction date stipulated in the development schedule.

b. A fire plan that details the fire prevention, presuppression, and suppression measures that will be taken by the Grantee, its employees, contractors, and subcontractors and their employees in all operations during the construction stage. The Grantee shall ensure its contractors comply with all provisions of the fire plan and burning permits required for disposal of flammable materials.

c. Plans for controlling soil erosion on the granted area and adjacent lands during construction, operation, and maintenance of the project. This shall include identification of areas and depth when topsoil will be stripped and stockpiled, methods to be used to obtain revegetation, and areas to be rip-rapped.

d. Designation of the location and standards of all gates, crossings, cattle guards, fences, roads, campgrounds, habitat improvement work, and other improvements to property owned by the Grantor that will be constructed, relocated or performed by the Grantee to mitigate impacts on wildlife, livestock, ranchers, recreationists, and other users of the National Forest as required by the Forest Service. The plan shall include provision for the following as specified on pages 75 and 76 of the Final Environmental Impact Statement for the Cheyenne Stage II Water Diversion Proposal: (1) Fencing of 100 acres of potential riparian habitat, (2) Seeding 400 acres of clearcuts to wildlife plant species, (3) Treatment of 160 acres of decadent Aspen to induce sprouting. The plan shall specify the mutually agreeed upon time frame for completing the required work and maintaining the improvements.

e. Precautions to be taken in using explosives.

f. Identification of specific areas to be cleared and methods of disposal of the timber cut including mechantable material and slash.

g. Identification of any construction camp locations and operations within the easement area and dates during which construction activities will occur.

h. Post construction cleanup.

i. Annual schedule of construction activities.

12. As a further guarantee of the faithful performance of the provisions of clauses 1, 2, 5, 8, 11, and 12 of this Stipulation, the Grantee agrees to deliver and maintain a surety bond in the amount of One Hundred Thousand Dollars ($100,000). Prior to undertaking additional construction or alteration work not provided for in the above clauses or when the improvements are to be removed and the area restored, the Grantee shall deliver and maintain a surety bond in an amount set by the Forest Service, which amount shall not be in excess of the estimated loss which the Grantor would suffer upon default in performance of this work. Should the sureties or the bonds delivered under this Stipulation become unsatisfactory to the Forest Service, the Grantee shall, within thirty (30) days of demand, furnish a new bond with surety, solvent and satisfactory to the Forest Service. In lieu of surety bond, the Grantee may deposit into a Federal depository, as directed by the Forest Service, and maintain therein, cash in the amounts provided for above, or negotiable securities of the Grantor having a market value at time of deposit of not less than the dollar amounts provided above.

The Grantee's surety bond will be released, or deposits in lieu of bond, will be returned thirty (30) days after certification by the Forest Service that priority installations under the development plan are complete, and upon furnishing by the Grantee of proof satisfactory to the Forest Service that all claims for labor and material on said installations have been paid or released and satisfied. The Grantee agrees that all moneys deposited under this stipulation may, upon failure on his part to fulfill all and singular the requirements herein set forth or made a part hereof, be retained by the Grantor to be applied as far as may be to the satisfaction of his obligations assumed hereunder, without prejudice whatever to any other rights and remedies of the Grantor.

13. The Grantee shall be responsible for the prevention and control of soil erosion and gullying on the area covered by this grant and lands adjacent thereto, and shall take preventive measures as required by the Forest Supervisor.

14. A muffler or spark arrester satisfactory to the Forest Service shall be maintained on the exhausts of all trucks and tractors or other internal combustion engines used in connection with this grant.

15. Each gasoline powersaw shall be equipped at all times with spark-arresting muffler, in good working condition, adapted to that machine. During periods of dangerous fire weather, as determined by the Forest Service, the Grantee shall be required to transport and keep with each powersaw at all times such fire tools and portable extinguishers as specified and to take other precautionary measures as may be required by the Forest Service.

16. The City of Cheyenne (or its contractors) will be required to obtain a Road Use Permit from the Forest Service for the use of any Forest Development Roads or other roads on National Forest lands to be used by the City's contractors, subcontractors, suppliers, employees, or other users involved in construction of the Cheyenne Water Project. Such permit will identify any reconstruction and maintenance requirements.

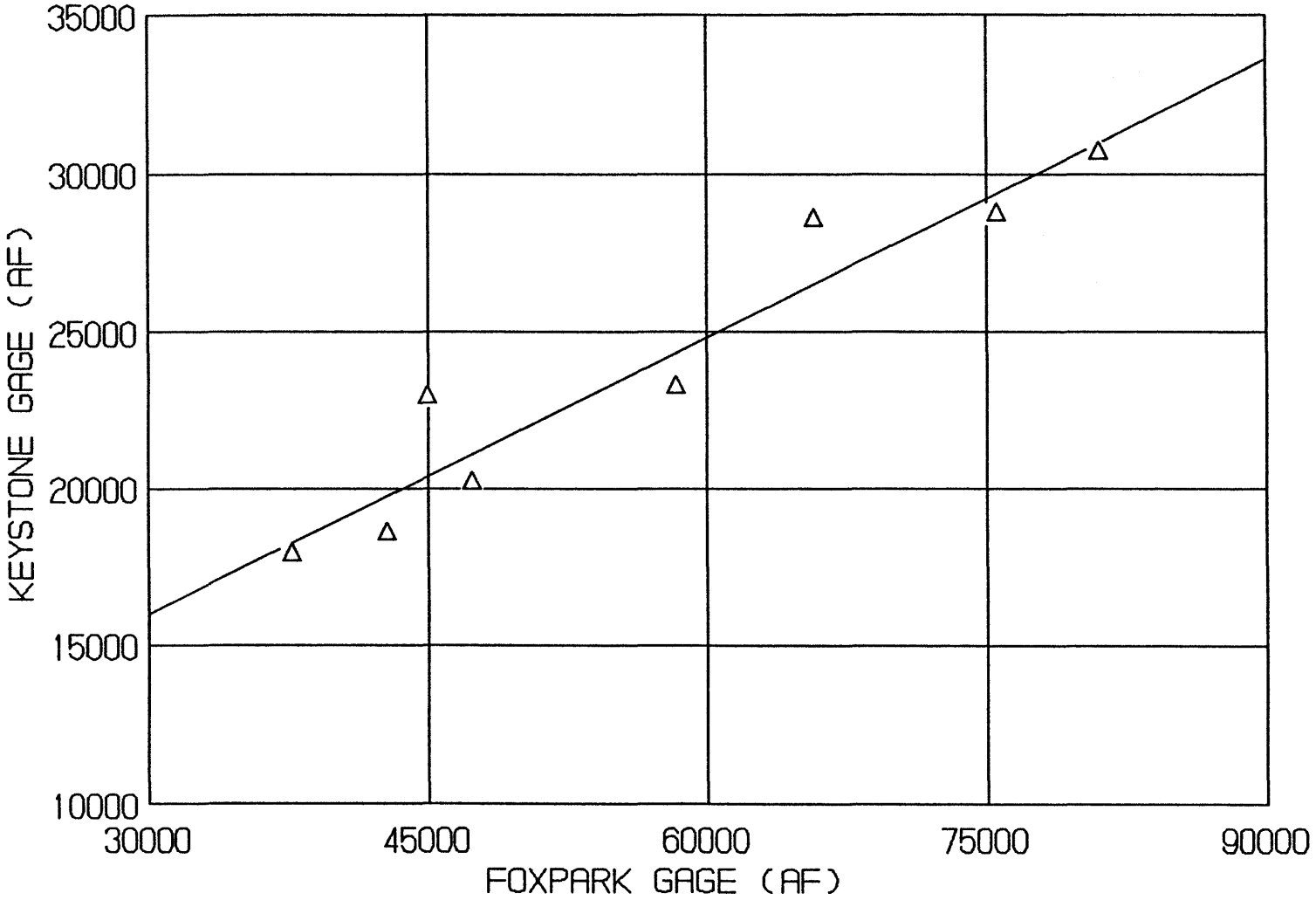
17. The Grantee will assign an inspector who will assure that all matters referred to in the Operation Plan are followed. The Grantee shall inform the Forest Supervisor, Laramie, Wyoming, in writing of the name and address of the inspector. If a substitute inspector is appointed, the applicant shall immediately inform the Forest Supervisor

18. No storage or transportation of water on the National Forest lands covered by this grant shall be made until the facility or the component to be used has been constructed in accordance with the approved plans a specifications, the Grantee has submitted certification thereof by a registered professional engineer, and the Grantee has received written approval from the Forest Service.

APPENDIX D

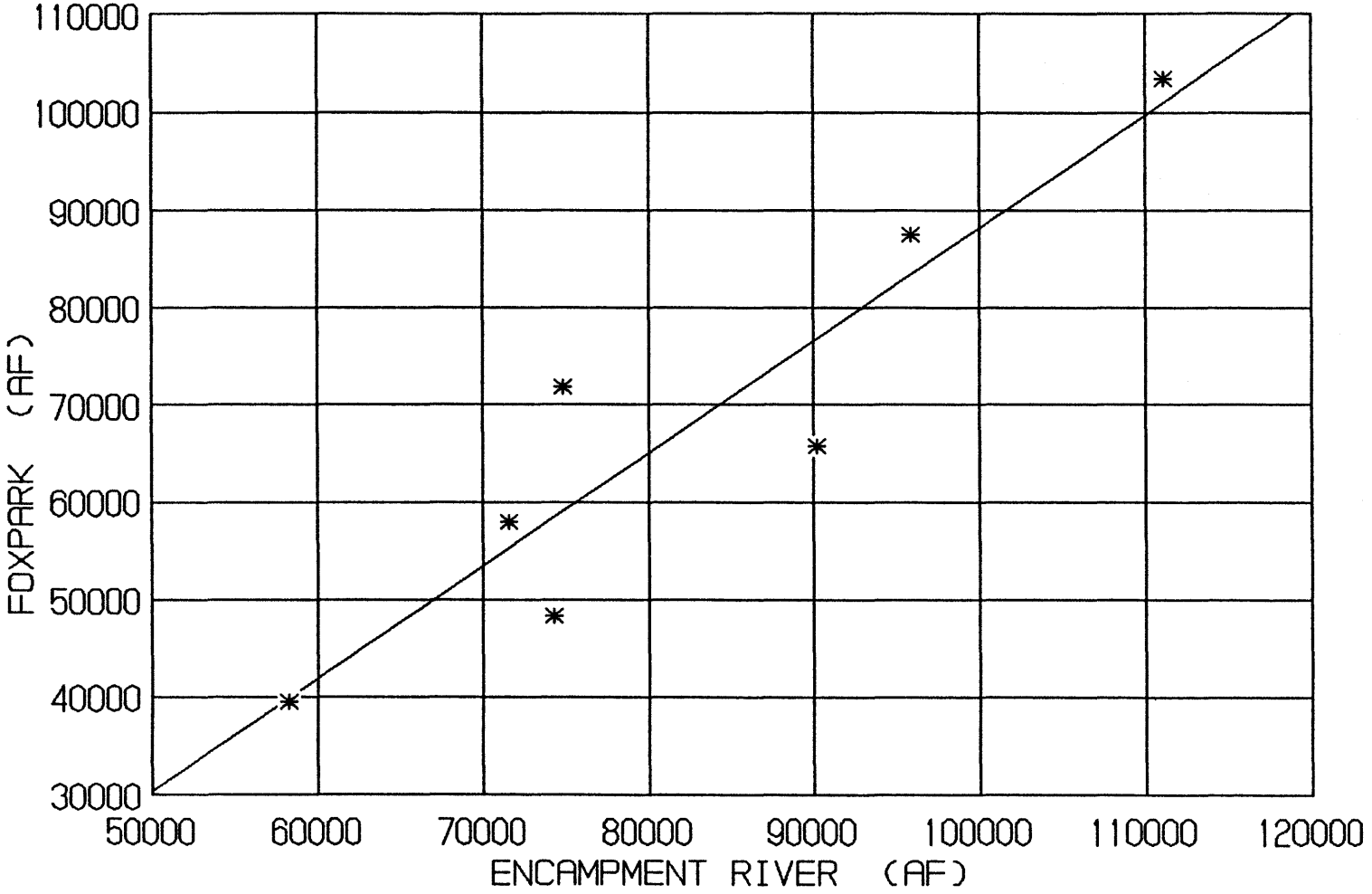
REGRESSION CURVES AND MONTHLY FLOW ANALYSIS
DOUGLAS CREEK

DOUGLAS CREEK
REGRESSION ANALYSIS



REGRESSION KEYSTONE - FOXPARK

DOUGLAS CREEK
REGRESSION ANALYSIS



REGRESSION: FOXPARK - ENCAMPMENT RIVER NR HOG PARK

Lidstone & Anderson, Inc.
Water Resources and Environmental Consultants

OWNER–PROJECT	BY	DATE	PROJECT NO.
W7WDC-04	CMJ		
FEATURE	**CHECKED BY**	**DATE**	**SHEET OF**

Douglas Creek Regression analysis. for Foxpark and Keystone. Need to incorporate adjustment to gage flow values due to the impact of Rob Roy Reservoir and diversions to Lake Owen. (develop virgin flows).

Note - Regression analysis is for Time base of 1955-56 to 1964-65

Year	Gage Douglas Crk @ Keystone	Adjustment	Virgin Flow Keystone	Gage Douglas Crk @ Foxpark	Adjustment	Virgin Flow Foxpark
1955-56	22,917 AF	–	22,917 AF	45,069 AF	–	45,069 AF
56-57	30,668	–	30,668	81,059	–	81,059
57-58	30,392	–	30,392	63,874	–	63,874
58-59	23,250	–	23,250	58,408	–	58,408
59-60	20,194	–	20,194	47,364	–	47,364
60-61	18,584	–	18,584	42,908	–	42,908
61-62	28,719	–	28,719	75,652	–	75,652
62-63	17,584	+ 303 AF	17,584	37,486	+303 AF	37,789
63-64	22,420	+ 3483	22,420	40,469	+3483	43,952
64-65	24,257	+ 4306	24,257	61,539	+4306	65,845
	end gage					
65-66	–	–	–	34,057	+ 5517	39,574
66-67	–	–	–	40,867	+ 7411	48,278
67-68	–	–	–	66,618	+ 5260	71,878
68-69	–	–	–	55,357	+ 2743	58,100
69-70	–	–	–	80,104	+ 7487	87,591
70-71	–	–	–	101,453	+1953	103,388

Note - the adjustmeant listed above accounts for the diversions to Lake Owen and the storage changes in RobRoy Reservoir.

Virgin flow values for Keystone + Foxpark were used in the Regression analysis.

Douglas Crk. USGS Gage Data - Keystone

Keystone Gage 66204
Monthly Flow Values in AF

	Oct	Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	Sept	YEAR
55	373	267	213	191	161	181	708	7575	3979	834	516	210	15,208
55-56	226	208	215	246	201	246	584	13755	6012	698	341	184	22917
56-57	235	190	172	135	111	111	131	2568	21961	4100	661	293	30668
57-58	409	208	184	154	100	80	1190	17048	9824	651	293	250	30392
58-59	176	152	129	111	94	98	188	6212	14311	1104	378	296	23250
59-60	721	357	215	184	144	154	1329	9648	6270	714	261	197	20194
60-61	196	215	184	154	111	142	479	8352	6865	706	393	786	18584
61-62	1050	728	436	332	302	360	2329	12359	8854	1372	362	234	28719
62-63	274	167	125	102	109	156	253	10688	4449	613	372	276	17584
63-64	211	208	194	210	195	207	344	7068	11510	1563	438	272	22420
64-65	227	235	280	279	246	252	256	7027	13379	1438	394	244	24257
MEAN	372.5	266.8	213.4	190.7	161.3	180.6	708.3	9300.0	9764.9	1253.9	400.8	294.7	23,108

Monthly Flow Distribution

Keystone Gage - Flow Percentages

Oct - 1.61	Apr - 3.06
Nov. - 1.16	May - 40.2
Dec - 0.92	Jun - 42.3
Jan - 0.83	Jul - 5.43
Feb - 0.70	Aug - 1.73
Mar - 0.78	Sep - 1.28

Douglas Crk. USGS Gage Data - Foxpark

Douglas Creek at Foxpark Flow Volumes in AF

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Year
47	1194	799	615	307	278	430	1488	33824	23460	4814	1619	970	69799
48	1168	833	676	584	518	584	3689	31228	9882	2182	714	551	52610
49	1111	785	676	615	611	1045	5058	30208	28070	3568	1041	966	73755
50	1172	752	615	553	522	615	2083	23942	26007	3221	782	1213	61478
51	899	819	799	738	611	676	1579	36861	24541	3140	1132	585	72380
52	1597	893	799	676	575	799	4463	39862	19745	1831	765	412	72417
53	497	498	492	615	555	738	1468	12772	17304	2354	1230	432	38955
54	557	762	676	615	500	676	3784	15146	3312	718	360	369	27476
55	579	476	492	430	361	430	1918	11072	5994	1144	749	296	23941
56	451	446	461	492	431	738	3943	27919	8079	1115	670	323	45069
57	435	535	523	492	417	553	1012	22247	45068	7626	1410	742	81059
58	1291	899	922	861	722	738	2805	37942	15158	1436	587	515	63874
59	511	657	584	553	528	738	2569	26741	21830	2210	810	678	58408
60	1898	1519	861	738	633	1577	7783	20551	9671	1382	386	365	47364
61	582	546	476	445	389	579	1920	21273	12430	1396	914	1958	42908
62	2531	1932	1027	676	621	751	10235	37970	15905	2648	774	582	75652
63	914	548	390	239	288	683	3628	21231	7218	1073	772	502	37486
64	309	444	278	180	166	192	564	17155	18301	2016	424	441	40469
65	358	324	247	238	221	232	777	26844	27047	2743	1010	1497	61539
66	2658	1573	1382	1049	572	1103	4770	14204	4982	995	438	330	34057
67	579	443	504	467	263	788	2515	15535	17373	1562	261	577	40867
68	1418	668	521	476	412	505	2059	17355	36936	4019	1071	1176	66618
69	880	505	474	545	521	649	5647	28185	11290	5750	547	362	55357
70	712	611	466	323	265	247	2198	32519	35665	4465	1295	1339	80104
71	1920	1285	853	795	647	690	6631	36317	43680	4544	1277	2813	101453
Mean	1048.8	782.1	632.4	548.1	465.1	670.2	3383.4	25556.1	19557.9	2718.1	841.5	799.8	57003.8

Monthly Flow distribution

Foxpark Gage - Flow Percentages

Oct - 1.84
Nov - 1.37
Dec - 1.11
Jan - 0.96
Feb - 0.82
Mar - 1.18
Apr - 5.94
May - 44.8
Jun - 34.3
Jul - 4.77
Aug - 1.48
Sep - 1.40

APPENDIX E

RANKED FLOW VALUES

DOUGLAS CREEK BEGINNING OF INSTREAM FLOW SEGMENT/CO-WY STATE LINE
Ranked Monthly Flow Values in cfs

YEAR	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	ANNUAL (AF)
1977	3.1	2.4	1.8	1.6	1.5	1.5	6.2	79.1	86.0	10.7	3.4	2.7	12,102
1955	5.2	4.0	2.9	2.6	2.4	2.5	10.6	116.5	63.2	12.9	7.9	3.3	14,202
1954	3.8	2.8	2.2	2.0	1.8	1.8	7.4	94.2	102.5	12.8	4.1	3.1	14,411
1981	3.9	2.8	2.2	2.0	1.9	1.9	7.6	96.0	104.5	13.0	4.2	3.1	14,690
1987	4.1	3.0	2.4	2.1	2.0	2.0	7.9	101.3	110.2	13.7	4.4	3.3	15,508
1989	4.3	3.2	2.5	2.2	2.1	2.1	8.4	107.0	116.5	14.5	4.6	3.5	16,374
1963	4.3	2.7	1.9	1.6	1.9	2.4	4.1	164.3	70.7	9.5	5.7	9.2	16,909
1961	3.0	3.4	2.8	2.4	1.9	2.2	7.7	128.4	109.1	10.9	6.1	12.5	17,567
1953	4.6	3.4	2.7	2.4	2.2	2.3	9.1	115.0	125.1	15.5	4.9	3.8	17,591
1966	4.6	3.5	2.7	2.4	2.3	2.3	9.2	116.1	126.3	15.7	5.0	3.9	17,762
1990	4.9	3.6	2.8	2.6	2.4	2.4	9.6	122.2	132.9	16.5	5.3	4.1	18,694
1960	11.1	5.7	3.3	2.8	2.5	2.4	21.1	148.3	99.6	11.0	4.0	3.1	19,089
1972	5.3	3.9	3.0	2.7	2.6	2.6	10.3	131.2	142.7	17.7	5.7	4.4	20,073
1967	5.3	4.0	3.0	2.7	2.6	2.6	10.4	131.9	143.4	17.8	5.7	4.4	20,173
1948	5.6	4.2	3.2	2.9	2.7	2.7	11.0	139.7	152.0	18.9	6.1	4.6	21,373
1956	3.5	3.3	3.3	3.8	3.4	3.8	9.3	211.5	95.6	10.7	5.2	2.9	21,663
1959	2.7	2.5	2.0	1.7	1.6	1.5	3.0	95.5	227.4	17.0	5.8	4.7	21,978
1988	5.8	4.3	3.3	2.9	2.7	2.7	11.3	143.7	156.3	19.4	6.1	4.7	21,978
1973	5.9	4.4	3.4	3.0	2.8	2.8	11.5	146.9	159.8	19.9	6.3	4.8	22,471
1969	6.0	4.4	3.4	3.1	2.9	2.9	11.8	149.6	162.8	20.2	6.4	4.9	22,893
1976	6.0	4.4	3.4	3.1	2.9	2.9	11.8	149.8	163.1	20.2	6.4	4.9	22,927
1950	6.2	4.6	3.6	3.2	3.0	3.0	12.3	155.8	169.4	21.1	6.7	5.1	23,829
1964	7.1	7.4	6.8	6.9	6.9	6.1	9.3	115.3	191.1	30.7	11.9	6.5	24,486
1947	6.9	5.1	3.9	3.5	3.3	3.3	13.4	171.0	186.0	23.1	7.4	5.7	26,162
1985	6.9	5.2	4.0	3.6	3.3	3.4	13.6	173.4	188.6	23.4	7.5	5.7	26,523
1968	7.0	5.2	4.0	3.6	3.4	3.4	13.7	174.6	189.9	23.5	7.6	5.8	26,709
1951	7.0	5.2	4.0	3.6	3.4	3.4	13.8	175.5	191.0	23.7	7.6	5.8	26,848
1952	7.0	5.2	4.0	3.6	3.4	3.4	13.8	175.5	191.0	23.7	7.6	5.8	26,859
1965	6.1	6.9	7.7	6.1	7.1	6.5	7.6	114.7	229.1	32.4	11.3	6.7	27,001
1962	16.2	11.5	6.7	5.1	5.1	5.6	37.1	190.0	140.7	21.1	5.6	3.7	27,148
1949	7.1	5.3	4.1	3.7	3.4	3.5	14.0	178.0	193.6	24.0	7.7	5.9	27,229
1975	7.3	5.4	4.2	3.8	3.5	3.5	14.2	180.7	196.6	24.4	7.8	6.0	27,647
1980	7.5	5.5	4.3	3.8	3.6	3.6	14.6	185.4	201.7	25.1	7.9	6.1	28,365
1958	6.3	3.3	2.8	2.4	1.7	1.2	18.9	262.0	156.1	10.0	4.5	4.0	28,730
1974	7.6	5.7	4.4	3.9	3.7	3.7	14.8	188.6	205.2	25.5	8.1	6.2	28,857
1957	3.6	3.0	2.7	2.1	1.9	1.7	2.1	39.5	349.0	63.1	10.1	4.6	28,990
1970	8.1	6.1	4.6	4.2	3.9	4.0	16.0	203.1	220.8	27.4	8.7	6.7	31,062
1979	8.2	6.1	4.7	4.3	4.0	4.0	16.2	205.4	223.5	27.7	8.8	6.8	31,425
1978	8.2	6.1	4.7	4.3	4.0	4.0	16.3	206.6	224.7	27.9	8.9	6.8	31,600
1983	8.3	6.2	4.8	4.4	4.1	4.1	16.5	208.5	226.9	28.2	9.0	6.9	31,904
1986	8.5	6.3	4.8	4.4	4.1	4.2	16.7	212.2	230.8	28.6	9.2	7.0	32,472
1984	8.6	6.4	4.9	4.4	4.2	4.2	16.9	215.2	234.2	29.0	9.3	7.1	32,929
1982	8.9	6.6	5.1	4.6	4.4	4.4	17.6	223.1	242.8	30.2	9.6	7.4	34,134
1971	9.3	6.9	5.3	4.8	4.4	4.4	18.2	231.6	252.0	31.3	10.0	7.7	35,437

DOUGLAS CREEK @ FOX PARK GAGE
Ranked Monthly Flow Values in cfs

YEAR	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	ANNUAL (AF)
1977	4.5	3.6	2.7	2.2	2.2	3.0	15.5	112.2	88.6	11.7	3.7	3.4	15,364
1955	9.4	8.0	8.0	7.0	6.5	7.0	32.2	180.0	100.8	18.6	12.2	5.0	23,941
1981	7.6	6.1	4.6	3.8	3.7	5.1	26.2	189.3	149.5	19.8	6.3	5.7	25,935
1954	9.1	12.8	11.0	10.0	9.0	11.0	63.6	246.3	55.7	11.7	5.9	6.2	27,476
1987	8.6	6.9	5.2	4.3	4.2	4.2	5.7	213.7	168.8	22.4	7.1	6.4	29,274
1989	9.6	7.7	5.9	4.8	4.7	6.4	33.1	239.6	189.2	25.1	8.0	7.2	32,816
1963	14.9	9.3	6.3	3.9	5.2	11.1	61.0	345.2	121.3	17.5	12.6	13.5	37,789
1953	8.1	8.4	8.0	10.0	10.0	12.0	24.7	207.7	290.9	38.3	20.0	7.3	38,955
1966	44.6	28.1	23.4	18.1	11.4	24.4	86.5	289.9	93.6	17.9	7.1	6.6	39,574
1990	12.5	9.7	7.8	6.7	6.4	8.2	39.9	294.0	228.0	32.9	10.4	8.8	42,288
1961	9.5	9.2	7.7	7.2	7.0	9.4	32.3	345.9	208.9	22.7	14.9	32.9	42,908
1964	9.1	11.8	88.6	6.8	6.7	6.2	13.5	286.0	316.2	39.8	12.4	9.7	43,952
1956	7.3	7.5	7.5	8.0	7.8	12.0	66.3	454.0	135.8	18.1	10.9	5.4	45,069
1960	30.9	25.5	14.0	12.0	11.4	25.6	130.8	334.2	162.6	22.5	6.3	6.1	47,364
1972	14.0	11.3	8.6	7.0	6.9	9.3	48.3	349.9	276.3	36.6	11.7	13.0	47,919
1967	9.8	8.7	9.2	8.6	5.7	13.8	43.3	262.4	367.9	52.6	7.0	11.0	48,278
1948	19.0	14.0	11.0	9.5	9.3	9.5	62.0	507.8	166.1	35.5	11.6	9.3	52,610
1988	16.3	13.1	10.0	8.1	8.0	10.9	56.2	406.7	321.2	42.6	13.6	12.2	55,701
1973	16.9	13.6	10.3	8.4	8.3	11.3	58.2	421.4	332.8	44.1	14.1	12.6	57,716
1969	16.8	11.0	10.2	11.4	11.9	13.1	91.4	501.8	219.4	46.4	14.3	8.9	58,100
1959	8.3	11.0	9.5	9.0	9.5	12.0	43.2	434.8	367.0	35.9	13.2	11.4	58,408
1976	17.4	14.0	10.7	8.7	8.6	11.6	60.1	435.0	343.5	45.5	14.5	13.0	59,579
1950	19.1	12.6	10.0	9.0	9.4	10.0	35.0	389.3	437.2	52.4	12.7	20.4	61,478
1958	21.0	15.1	15.0	14.0	13.0	12.0	47.2	616.9	254.8	23.3	9.5	8.7	63,874
1965	8.6	8.8	7.5	5.8	7.0	6.6	16.7	450.1	472.2	55.5	21.5	28.2	65,845
1947	19.4	13.4	10.0	5.0	5.0	7.0	125.0	550.0	394.4	78.3	26.3	16.3	69,799
1968	24.9	11.2	12.5	11.5	10.5	10.0	34.6	282.2	692.3	75.0	21.4	16.9	71,878
1951	14.6	13.8	13.0	12.0	11.0	11.0	26.5	599.4	412.5	51.1	18.4	9.8	72,380
1952	26.0	15.0	13.0	11.0	10.4	13.0	75.0	648.2	331.9	29.8	12.4	6.9	72,417
1949	18.1	13.2	11.0	10.0	11.0	17.0	85.0	491.2	471.9	58.0	16.9	16.2	73,755
1985	21.7	17.5	13.3	10.9	10.7	14.5	74.9	542.2	428.2	56.7	18.1	16.2	74,265
1962	41.2	32.5	16.7	11.0	11.2	12.2	172.1	617.4	267.4	43.1	12.6	9.8	75,652
1975	23.1	18.6	14.1	11.5	11.4	15.4	79.5	575.5	454.7	60.3	19.2	17.2	78,859
1957	7.1	9.0	8.5	8.0	7.5	9.0	17.0	361.7	757.6	124.	22.9	12.5	81,059
1980	23.9	19.2	14.6	12.0	11.8	16.0	82.5	597.1	471.6	62.5	20.0	17.9	81,787
1974	24.5	19.7	15.0	12.3	12.1	16.4	84.5	611.8	483.2	64.0	20.4	18.3	83,800
1970	14.6	13.3	10.6	7.8	7.8	7.0	40.0	549.5	658.0	89.0	24.6	26.9	87,591
1979	27.8	22.3	17.0	13.9	13.7	18.5	95.6	692.3	546.7	72.5	23.1	20.7	94,825
1978	27.8	22.4	17.0	13.9	13.7	18.5	95.8	693.6	547.8	72.6	23.2	20.8	95,005
1983	28.2	22.6	17.2	14.1	13.9	18.8	97.1	702.7	554.9	73.5	23.5	21.0	96,244
1986	28.8	23.2	17.6	14.4	14.2	19.2	99.4	719.6	568.3	75.3	24.0	21.5	98,565
1984	29.4	23.6	18.0	14.7	14.5	19.6	101.3	733.2	579.1	76.7	24.5	22.0	100,430
1971	39.0	25.7	16.7	15.4	14.2	13.7	111.5	605.1	736.7	88.3	25.3	22.2	103,388
1982	30.8	24.8	18.8	15.4	15.2	20.6	106.3	769.1	607.4	80.5	25.7	23.0	105,351

DOUGLAS CREEK @ CONFLUENCE WITH PLATTE RIVER
Ranked Monthly Flow Values in CFS

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANNUAL (AF)
1977	6.2	5.0	3.7	3.0	3.0	4.1	21.6	156.0	122.9	16.2	5.2	4.7	21,156
1955	13.0	11.1	11.0	9.4	8.9	9.7	44.8	250.2	139.8	25.7	17.0	6.9	32,967
1981	10.5	8.5	6.3	5.1	5.1	7.0	36.5	263.1	207.4	27.4	8.8	7.8	35,712
1954	12.6	17.8	15.1	13.5	12.3	15.2	88.5	342.4	77.3	16.2	8.2	8.5	37,834
1987	11.9	9.6	7.1	5.8	5.8	7.9	41.1	297.0	234.1	31.0	9.9	8.8	40,310
1989	13.2	10.7	8.1	6.5	6.4	8.8	46.1	333.0	262.4	34.7	11.2	9.9	45,188
1963	20.6	12.9	8.7	5.3	7.1	15.3	84.9	479.8	168.2	24.2	17.6	18.6	52,035
1953	11.2	11.7	11.0	13.5	13.7	16.5	34.4	288.7	403.5	52.9	27.9	10.1	53,641
1966	61.5	39.0	32.2	24.4	15.6	33.6	120.4	403.0	129.8	24.7	9.9	9.1	54,493
1990	17.3	13.5	10.7	9.0	8.8	11.3	55.5	408.7	316.2	45.5	14.5	12.1	58,231
1961	13.1	12.8	10.6	9.7	9.6	13.0	45.0	480.8	289.7	31.4	20.8	45.3	59,084
1964	12.6	16.4	11.8	9.2	9.2	8.5	18.8	397.5	438.6	55.0	17.3	13.4	60,522
1956	10.1	10.4	10.3	10.8	10.7	16.5	92.3	631.1	188.4	25.0	15.2	7.4	62,060
1960	42.6	35.4	19.2	16.2	15.6	35.3	182.1	464.5	225.5	31.1	8.8	8.4	65,220
1972	19.3	15.7	11.8	9.4	9.5	12.8	67.2	486.4	383.2	50.6	16.3	17.9	65,984
1967	13.5	12.1	12.6	11.6	7.8	19.0	60.3	364.7	510.3	72.7	9.8	15.1	66,479
1948	26.2	19.4	15.1	12.8	12.8	13.1	86.3	705.8	230.4	49.1	16.2	12.8	72,444
1988	22.5	18.2	13.7	10.9	11.0	15.0	78.2	565.3	445.5	58.9	19.0	16.8	76,700
1973	23.3	18.9	14.2	11.3	11.4	15.6	81.0	585.7	461.6	60.9	19.7	17.4	79,475
1969	23.2	15.3	14.0	15.4	16.3	18.1	127.2	697.5	304.3	64.1	19.9	12.3	80,004
1959	11.5	15.3	13.1	12.1	13.0	16.5	60.1	604.4	509.0	49.6	18.4	15.7	80,428
1976	24.0	19.4	14.7	11.7	11.8	16.0	83.7	604.7	476.4	62.9	20.2	17.9	82,040
1950	26.4	17.5	13.7	12.1	12.9	13.8	48.7	541.1	606.4	72.4	17.7	28.1	84,655
1958	29.0	21.0	20.6	18.9	17.8	16.5	65.7	857.5	353.4	32.2	13.2	12.0	87,954
1965	11.9	12.2	10.3	7.8	9.6	9.1	23.2	625.6	654.9	76.7	30.0	38.8	90,669
1947	26.8	18.6	13.7	6.7	6.9	9.7	34.8	764.5	547.0	108.2	36.7	22.4	96,113
1968	34.4	15.5	17.2	15.5	14.4	13.8	48.2	392.3	960.2	103.6	29.8	23.3	98,976
1951	20.1	19.2	17.9	16.2	15.1	15.2	36.9	833.2	572.1	70.6	25.6	13.5	99,667
1952	35.9	20.8	17.9	14.8	14.3	17.9	104.4	901.0	460.3	41.2	17.3	9.5	99,718
1949	25.0	18.3	15.1	13.5	15.1	23.4	118.3	682.8	654.5	80.2	23.6	22.3	101,561
1985	29.9	24.3	18.3	14.7	14.7	20.0	104.3	753.7	593.9	78.4	25.2	22.3	102,263
1962	56.9	45.1	22.9	14.8	15.4	16.8	239.6	858.2	370.9	59.6	17.6	13.5	104,173
1975	31.9	25.8	19.4	15.5	15.6	21.2	110.7	800.2	630.7	83.3	26.8	23.7	108,589
1957	9.8	12.5	11.7	10.8	10.3	12.4	23.7	502.8	050.8	171.4	31.9	17.2	111,618
1980	33.0	26.6	20.1	16.2	16.2	22.1	114.8	830.0	654.1	86.4	27.9	24.6	112,621
1974	33.8	27.3	20.6	16.6	16.6	22.6	117.6	850.4	670.2	88.4	28.4	25.2	115,393
1970	20.1	18.5	14.6	10.5	10.7	9.7	55.7	763.8	912.6	123.0	34.3	37.0	120,613
1979	38.4	31.0	23.4	18.7	18.8	25.5	133.1	962.3	758.3	100.2	32.2	28.5	130,574
1978	38.4	31.1	23.4	18.7	18.8	25.5	133.4	964.1	759.8	100.3	32.3	28.6	130,822
1983	38.9	31.4	23.6	19.0	19.1	25.9	135.2	976.8	769.6	101.6	32.8	28.9	132,528
1986	39.7	32.2	24.2	19.4	19.5	26.5	138.4	1000.2	788.2	104.1	33.5	29.6	135,724
1984	40.6	32.8	24.7	19.8	19.9	27.0	141.0	1019.1	803.2	106.0	34.2	30.3	138,292
1971	53.8	35.7	22.9	20.7	19.5	18.9	155.2	841.1	1021.8	122.0	35.3	30.6	142,365
1982	42.5	34.4	25.8	20.7	20.9	28.4	148.0	1069.0	842.5	111.3	35.8	31.7	145,068

HORSE CREEK
Ranked Monthly Flow Values in CFS

YEAR	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	ANNUAL AF
1977	0.52	0.40	0.31	0.28	0.26	0.31	1.37	12.53	11.75	1.53	0.50	0.41	1,826
1955	0.61	0.47	0.37	0.33	0.31	0.36	1.61	14.70	13.79	1.79	0.59	0.48	2,142
1953	0.62	0.48	0.37	0.33	0.31	0.36	1.63	14.92	14.00	1.82	0.59	0.49	2,174
1981	0.63	0.49	0.38	0.34	0.32	0.37	1.66	15.21	14.27	1.86	0.61	0.50	2,216
1987	0.67	0.52	0.40	0.36	0.34	0.39	1.75	16.05	15.06	1.96	0.64	0.52	2,339
1989	0.71	0.54	0.43	0.38	0.36	0.41	1.85	16.95	15.90	2.07	0.67	0.55	2,470
1963	0.73	0.56	0.44	0.39	0.37	0.43	1.91	17.50	16.42	2.14	0.70	0.57	2,551
1961	0.76	0.58	0.46	0.40	0.38	0.44	1.99	18.18	17.06	2.22	0.72	0.59	2,650
1952	0.76	0.58	0.46	0.40	0.38	0.44	1.99	18.21	17.08	2.22	0.72	0.59	2,654
1966	0.77	0.59	0.46	0.41	0.39	0.45	2.01	18.39	17.25	2.24	0.73	0.60	2,679
1990	0.81	0.62	0.49	0.43	0.41	0.47	2.11	19.35	18.16	2.36	0.77	0.63	2,820
1960	0.82	0.63	0.50	0.44	0.41	0.48	2.16	19.76	18.54	2.41	0.79	0.64	2,880
1972	0.87	0.67	0.52	0.46	0.44	0.51	2.27	20.78	19.49	2.54	0.83	0.68	3,028
1967	0.87	0.67	0.52	0.46	0.44	0.51	2.28	20.88	19.59	2.55	0.83	0.68	3,043
1947	0.92	0.71	0.56	0.49	0.46	0.54	2.42	22.12	20.76	2.70	0.88	0.72	3,224
1956	0.94	0.72	0.56	0.50	0.47	0.55	2.45	22.42	21.04	2.74	0.89	0.73	3,268
1959	0.95	0.73	0.57	0.50	0.48	0.56	2.49	22.75	21.35	2.78	0.91	0.74	3,315
1988	0.95	0.73	0.57	0.50	0.48	0.56	2.49	22.75	21.35	2.78	0.91	0.74	3,315
1973	0.97	0.75	0.58	0.52	0.49	0.57	2.54	23.26	21.82	2.84	0.93	0.76	3,390
1969	0.99	0.76	0.60	0.53	0.50	0.58	2.59	23.70	22.23	2.89	0.94	0.77	3,453
1976	0.99	0.76	0.60	0.53	0.50	0.58	2.59	23.73	22.27	2.90	0.94	0.77	3,459
1949	1.03	0.79	0.62	0.55	0.52	0.60	2.70	24.67	23.14	3.01	0.98	0.80	3,595
1964	1.06	0.81	0.64	0.56	0.53	0.62	2.77	25.35	23.78	3.09	1.01	0.83	3,694
1946	1.13	0.87	0.68	0.60	0.57	0.66	2.96	27.08	25.41	3.30	1.08	0.88	3,947
1985	1.15	0.88	0.69	0.61	0.58	0.67	3.00	27.45	25.76	3.35	1.09	0.89	4,001
1968	1.15	0.89	0.69	0.61	0.58	0.67	3.02	27.65	25.94	3.37	1.10	0.90	4,029
1950	1.16	0.89	0.70	0.62	0.58	0.68	3.04	27.79	26.08	3.39	1.11	0.91	4,050
1951	1.16	0.89	0.70	0.62	0.58	0.68	3.04	27.80	26.09	3.39	1.11	0.91	4,052
1965	1.17	0.90	0.70	0.62	0.59	0.68	3.05	27.95	26.22	3.41	1.11	0.91	4,073
1962	1.17	0.90	0.71	0.62	0.59	0.69	3.07	28.10	26.37	3.43	1.12	0.92	4,095
1948	1.18	0.90	0.71	0.63	0.59	0.69	3.08	28.19	26.45	3.44	1.12	0.92	4,108
1975	1.19	0.92	0.72	0.63	0.60	0.70	3.13	28.62	26.85	3.49	1.14	0.93	4,171
1980	1.22	0.94	0.74	0.65	0.62	0.72	3.21	29.36	27.55	3.58	1.17	0.96	4,279
1958	1.24	0.95	0.75	0.66	0.62	0.73	3.25	29.74	27.90	3.63	1.18	0.97	4,334
1974	1.25	0.96	0.75	0.66	0.63	0.73	3.26	29.87	28.03	3.65	1.19	0.97	4,353
1957	1.25	0.96	0.75	0.67	0.63	0.73	3.28	30.01	28.16	3.66	1.19	0.98	4,373
1970	1.34	1.03	0.81	0.71	0.68	0.78	3.51	32.15	30.17	3.92	1.28	1.05	4,686
1979	1.36	1.04	0.82	0.72	0.68	0.79	3.55	32.53	30.52	3.97	1.29	1.06	4,740
1978	1.36	1.05	0.82	0.73	0.69	0.80	3.57	32.71	30.69	3.99	1.30	1.07	4,767
1983	1.38	1.06	0.83	0.73	0.69	0.81	3.61	33.02	30.99	4.03	1.31	1.08	4,813
1986	1.40	1.08	0.84	0.75	0.71	0.82	3.67	33.61	31.54	4.10	1.34	1.10	4,898
1984	1.42	1.09	0.86	0.76	0.72	0.83	3.72	34.08	31.98	4.16	1.36	1.11	4,967
1982	1.47	1.13	0.89	0.78	0.74	0.86	3.86	35.33	33.15	4.31	1.41	1.15	5,149
1971	1.53	1.18	0.92	0.81	0.77	0.90	4.01	36.68	34.42	4.48	1.46	1.20	5,346

BEAVER CREEK
Ranked Monthly Flow Values in CFS

YEAR	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	ANNUAL (AF)
1977	0.15	0.11	0.09	0.08	0.07	0.09	0.39	3.56	3.34	0.43	0.14	0.12	518
1955	0.17	0.13	0.1	0.09	0.09	0.1	0.46	4.18	3.92	0.51	0.17	0.14	608
1953	0.18	0.14	0.11	0.09	0.09	0.1	0.46	4.24	3.98	0.52	0.17	0.14	617
1981	0.18	0.14	0.11	0.1	0.09	0.11	0.47	4.32	4.05	0.53	0.17	0.14	629
1987	0.19	0.15	0.11	0.1	0.1	0.11	0.5	4.56	4.28	0.56	0.18	0.15	664
1989	0.2	0.15	0.12	0.11	0.1	0.12	0.53	4.81	4.52	0.59	0.19	0.16	702
1963	0.21	0.16	0.12	0.11	0.1	0.12	0.54	4.97	4.66	0.61	0.2	0.16	724
1961	0.22	0.17	0.13	0.11	0.11	0.13	0.56	5.16	4.85	0.63	0.21	0.17	753
1952	0.22	0.17	0.13	0.11	0.11	0.13	0.57	5.17	4.85	0.63	0.21	0.17	754
1966	0.22	0.17	0.13	0.12	0.11	0.13	0.57	5.22	4.9	0.64	0.21	0.17	761
1990	0.23	0.18	0.14	0.12	0.12	0.13	0.6	5.5	5.16	0.67	0.22	0.18	801
1960	0.23	0.18	0.14	0.12	0.12	0.14	0.61	5.61	5.27	0.68	0.22	0.18	818
1972	0.25	0.19	0.15	0.13	0.12	0.14	0.64	5.9	5.54	0.72	0.23	0.19	860
1967	0.25	0.19	0.15	0.13	0.12	0.14	0.65	5.93	5.56	0.72	0.24	0.19	864
1947	0.26	0.2	0.16	0.14	0.13	0.15	0.69	6.28	5.9	0.77	0.25	0.2	916
1956	0.27	0.2	0.16	0.14	0.13	0.16	0.7	6.37	5.98	0.78	0.25	0.21	928
1959	0.27	0.21	0.16	0.14	0.14	0.16	0.71	6.46	6.06	0.79	0.26	0.21	942
1988	0.27	0.21	0.16	0.14	0.14	0.16	0.71	6.46	6.06	0.79	0.26	0.21	942
1973	0.28	0.21	0.17	0.15	0.14	0.16	0.72	6.61	6.2	0.81	0.26	0.22	963
1969	0.28	0.22	0.17	0.15	0.14	0.16	0.74	6.73	6.31	0.82	0.27	0.22	981
1976	0.28	0.22	0.17	0.15	0.14	0.16	0.74	6.74	6.32	0.82	0.27	0.22	982
1949	0.29	0.22	0.18	0.16	0.15	0.17	0.77	7.01	6.57	0.85	0.28	0.23	1,021
1964	0.3	0.23	0.18	0.16	0.15	0.18	0.79	7.2	6.75	0.88	0.29	0.23	1,049
1946	0.32	0.25	0.19	0.17	0.16	0.19	0.84	7.69	7.22	0.94	0.31	0.25	1,121
1985	0.33	0.25	0.2	0.17	0.16	0.19	0.85	7.8	7.32	0.95	0.31	0.25	1,136
1968	0.33	0.25	0.2	0.17	0.16	0.19	0.86	7.85	7.37	0.96	0.31	0.26	1,144
1950	0.33	0.25	0.2	0.18	0.17	0.19	0.86	7.89	7.41	0.96	0.31	0.26	1,150
1951	0.33	0.25	0.2	0.18	0.17	0.19	0.86	7.9	7.41	0.96	0.31	0.26	1,151
1965	0.33	0.25	0.2	0.18	0.17	0.19	0.87	7.94	7.45	0.97	0.32	0.26	1,157
1962	0.33	0.26	0.2	0.18	0.17	0.19	0.87	7.98	7.49	0.97	0.32	0.26	1,163
1948	0.33	0.26	0.2	0.18	0.17	0.2	0.87	8	7.51	0.98	0.32	0.26	1,167
1975	0.34	0.26	0.2	0.18	0.17	0.2	0.89	8.13	7.63	0.99	0.32	0.26	1,185
1980	0.35	0.27	0.21	0.18	0.18	0.2	0.91	8.34	7.82	1.02	0.33	0.27	1,215
1958	0.35	0.27	0.21	0.19	0.18	0.21	0.92	8.45	7.92	1.03	0.34	0.28	1,231
1974	0.35	0.27	0.21	0.19	0.18	0.21	0.93	8.48	7.96	1.04	0.34	0.28	1,236
1957	0.36	0.27	0.21	0.19	0.18	0.21	0.93	8.52	8	1.04	0.34	0.28	1,242
1970	0.38	0.29	0.23	0.2	0.19	0.22	1	9.13	8.57	1.11	0.36	0.3	1,331
1979	0.39	0.3	0.23	0.2	0.19	0.23	1.01	9.24	8.67	1.13	0.37	0.3	1,346
1978	0.39	0.3	0.23	0.21	0.2	0.23	1.02	9.29	8.72	1.13	0.37	0.3	1,354
1983	0.39	0.3	0.24	0.21	0.2	0.23	1.02	9.38	8.8	1.14	0.37	0.31	1,367
1986	0.4	0.31	0.24	0.21	0.2	0.23	1.04	9.55	8.96	1.16	0.38	0.31	1,391
1984	0.4	0.31	0.24	0.21	0.2	0.24	1.06	9.68	9.08	1.18	0.39	0.32	1,411
1982	0.42	0.32	0.25	0.22	0.21	0.24	1.1	10.03	9.42	1.22	0.4	0.33	1,462
1971	0.43	0.33	0.26	0.23	0.22	0.25	1.14	10.42	9.77	1.27	0.41	0.34	1,518

LAKE CREEK
Ranked Monthly Flow Values in CFS

YEAR	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	ANNUAL (AF)
1977	0.63	0.49	0.39	0.34	0.32	0.37	1.68	15.38	14.44	1.87	0.62	0.5	2,242
1955	0.75	0.57	0.46	0.41	0.38	0.44	1.97	18.05	16.94	2.2	0.72	0.59	2,631
1953	0.76	0.59	0.46	0.41	0.38	0.44	2	18.31	17.18	2.23	0.73	0.61	2,669
1981	0.78	0.61	0.47	0.41	0.4	0.46	2.03	18.67	17.52	2.28	0.75	0.61	2,721
1987	0.83	0.64	0.49	0.44	0.41	0.49	2.15	19.71	18.49	2.41	0.78	0.64	2,873
1989	0.86	0.67	0.52	0.46	0.43	0.5	2.27	20.81	19.53	2.54	0.83	0.67	3,033
1963	0.89	0.69	0.54	0.47	0.45	0.52	2.35	21.5	20.17	2.62	0.86	0.71	3,132
1961	0.93	0.72	0.55	0.49	0.47	0.55	2.44	22.32	20.95	2.73	0.89	0.72	3,254
1952	0.93	0.72	0.57	0.49	0.47	0.55	2.44	22.36	20.98	2.73	0.89	0.72	3,258
1966	0.94	0.72	0.57	0.5	0.47	0.55	2.47	22.57	21.18	2.75	0.89	0.74	3,290
1990	0.99	0.76	0.6	0.52	0.5	0.59	2.59	23.76	22.29	2.89	0.94	0.77	3,463
1960	1.01	0.77	0.6	0.54	0.5	0.59	2.66	24.26	22.76	2.96	0.96	0.79	3,536
1972	1.06	0.82	0.63	0.57	0.54	0.62	2.79	25.51	23.94	3.11	1.01	0.82	3,718
1967	1.07	0.82	0.65	0.57	0.54	0.62	2.81	25.64	24.06	3.12	1.02	0.84	3,737
1947	1.14	0.87	0.68	0.6	0.58	0.67	2.98	27.17	25.48	3.32	1.09	0.89	3,959
1956	1.15	0.89	0.7	0.62	0.58	0.67	3.01	27.53	25.84	3.37	1.09	0.89	4,013
1959	1.17	0.89	0.7	0.62	0.59	0.68	3.06	27.93	26.21	3.41	1.11	0.91	4,071
1988	1.17	0.89	0.7	0.62	0.59	0.68	3.06	27.93	26.21	3.41	1.11	0.91	4,071
1973	1.19	0.92	0.72	0.63	0.59	0.7	3.13	28.55	26.8	3.48	1.14	0.92	4,162
1969	1.22	0.94	0.73	0.65	0.61	0.72	3.18	29.11	27.3	3.54	1.15	0.94	4,241
1976	1.22	0.94	0.73	0.65	0.61	0.72	3.18	29.14	27.35	3.56	1.15	0.94	4,247
1949	1.27	0.97	0.76	0.67	0.63	0.73	3.31	30.29	28.43	3.69	1.2	0.99	4,414
1964	1.3	0.99	0.78	0.68	0.65	0.76	3.4	31.12	29.2	3.8	1.24	1.01	4,536
1946	1.38	1.06	0.83	0.73	0.7	0.81	3.63	33.25	31.2	4.07	1.32	1.08	4,846
1985	1.4	1.08	0.85	0.75	0.7	0.83	3.68	33.71	31.64	4.11	1.35	1.09	4,913
1968	1.41	1.09	0.85	0.75	0.72	0.83	3.72	33.95	31.85	4.15	1.35	1.11	4,947
1950	1.43	1.09	0.86	0.76	0.72	0.83	3.73	34.13	32.02	4.16	1.37	1.11	4,973
1951	1.43	1.09	0.86	0.76	0.72	0.83	3.73	34.13	32.02	4.16	1.37	1.11	4,975
1965	1.43	1.11	0.86	0.76	0.72	0.85	3.75	34.32	32.21	4.2	1.37	1.13	5,001
1962	1.45	1.11	0.86	0.76	0.72	0.85	3.77	34.5	32.38	4.21	1.37	1.13	5,029
1948	1.45	1.11	0.86	0.76	0.72	0.85	3.78	34.6	32.48	4.23	1.38	1.13	5,044
1975	1.46	1.13	0.88	0.78	0.74	0.86	3.83	35.14	32.96	4.29	1.4	1.14	5,121
1980	1.5	1.16	0.91	0.8	0.76	0.88	3.93	36.05	33.82	4.41	1.43	1.18	5,254
1958	1.53	1.18	0.91	0.81	0.77	0.89	3.98	36.52	34.26	4.46	1.45	1.19	5,322
1974	1.53	1.18	0.93	0.81	0.77	0.89	4	36.68	34.41	4.47	1.46	1.19	5,345
1957	1.54	1.18	0.93	0.81	0.77	0.89	4.03	36.85	34.58	4.5	1.46	1.19	5,370
1970	1.64	1.26	0.99	0.88	0.83	0.96	4.32	39.48	37.05	4.81	1.58	1.29	5,754
1979	1.66	1.28	1.01	0.88	0.85	0.98	4.37	39.93	37.47	4.88	1.59	1.29	5,821
1978	1.67	1.29	1.01	0.89	0.85	0.98	4.39	40.16	37.69	4.89	1.59	1.31	5,853
1983	1.69	1.29	1.02	0.89	0.85	0.99	4.44	40.55	38.04	4.94	1.61	1.33	5,910
1986	1.72	1.33	1.04	0.91	0.86	1.01	4.51	41.27	38.73	5.04	1.64	1.34	6,015
1984	1.74	1.34	1.06	0.93	0.88	1.02	4.57	41.85	39.27	5.11	1.66	1.36	6,099
1982	1.8	1.4	1.09	0.96	0.92	1.06	4.74	43.38	40.71	5.3	1.72	1.41	6,323
1971	1.89	1.45	1.14	0.99	0.95	1.11	4.93	45.04	42.26	5.5	1.79	1.46	6,564

NUGGET GULCH
Ranked Monthly Flow Values in CFS

YEAR	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	ANNUAL (AF)
1977	0.03	0.02	0.02	0.01	0.01	0.01	0.07	0.61	0.57	0.07	0.02	0.02	89
1955	0.03	0.02	0.02	0.02	0.02	0.02	0.08	0.72	0.67	0.09	0.03	0.02	105
1953	0.03	0.02	0.02	0.02	0.02	0.02	0.08	0.73	0.68	0.09	0.03	0.02	106
1981	0.03	0.02	0.02	0.02	0.02	0.02	0.08	0.74	0.7	0.09	0.03	0.02	108
1987	0.03	0.03	0.02	0.02	0.02	0.02	0.09	0.78	0.74	0.1	0.03	0.03	114
1989	0.03	0.03	0.02	0.02	0.02	0.02	0.09	0.83	0.78	0.1	0.03	0.03	121
1963	0.04	0.03	0.02	0.02	0.02	0.02	0.09	0.86	0.8	0.1	0.03	0.03	125
1952	0.04	0.03	0.02	0.02	0.02	0.02	0.1	0.89	0.84	0.11	0.04	0.03	130
1961	0.04	0.03	0.02	0.02	0.02	0.02	0.1	0.89	0.83	0.11	0.04	0.03	130
1966	0.04	0.03	0.02	0.02	0.02	0.02	0.1	0.9	0.84	0.11	0.04	0.03	131
1990	0.04	0.03	0.02	0.02	0.02	0.02	0.1	0.95	0.89	0.12	0.04	0.03	138
1960	0.04	0.03	0.02	0.02	0.02	0.02	0.11	0.97	0.91	0.12	0.04	0.03	141
1972	0.04	0.03	0.03	0.02	0.02	0.02	0.11	1.02	0.95	0.12	0.04	0.03	148
1967	0.04	0.03	0.03	0.02	0.02	0.02	0.11	1.02	0.96	0.12	0.04	0.03	149
1947	0.05	0.03	0.03	0.02	0.02	0.03	0.12	1.08	1.01	0.13	0.04	0.04	158
1956	0.05	0.04	0.03	0.02	0.02	0.03	0.12	1.1	1.03	0.13	0.04	0.04	160
1959	0.05	0.04	0.03	0.02	0.02	0.03	0.12	1.11	1.04	0.14	0.04	0.04	162
1988	0.05	0.04	0.03	0.02	0.02	0.03	0.12	1.11	1.04	0.14	0.04	0.04	162
1973	0.05	0.04	0.03	0.03	0.02	0.03	0.12	1.14	1.07	0.14	0.05	0.04	166
1969	0.05	0.04	0.03	0.03	0.02	0.03	0.13	1.16	1.09	0.14	0.05	0.04	169
1976	0.05	0.04	0.03	0.03	0.02	0.03	0.13	1.16	1.09	0.14	0.05	0.04	169
1949	0.05	0.04	0.03	0.03	0.03	0.03	0.13	1.21	1.13	0.15	0.05	0.04	176
1964	0.05	0.04	0.03	0.03	0.03	0.03	0.14	1.24	1.16	0.15	0.05	0.04	181
1946	0.06	0.04	0.03	0.03	0.03	0.03	0.14	1.32	1.24	0.16	0.05	0.04	193
1985	0.06	0.04	0.03	0.03	0.03	0.03	0.15	1.34	1.26	0.16	0.05	0.04	196
1968	0.06	0.04	0.03	0.03	0.03	0.03	0.15	1.35	1.27	0.16	0.05	0.04	197
1950	0.06	0.04	0.03	0.03	0.03	0.03	0.15	1.36	1.27	0.17	0.05	0.04	198
1951	0.06	0.04	0.03	0.03	0.03	0.03	0.15	1.36	1.28	0.17	0.05	0.04	198
1965	0.06	0.04	0.03	0.03	0.03	0.03	0.15	1.37	1.28	0.17	0.05	0.04	199
1962	0.06	0.04	0.03	0.03	0.03	0.03	0.15	1.37	1.29	0.17	0.05	0.04	200
1948	0.06	0.04	0.03	0.03	0.03	0.03	0.15	1.38	1.29	0.17	0.05	0.04	201
1975	0.06	0.04	0.04	0.03	0.03	0.03	0.15	1.4	1.31	0.17	0.06	0.05	204
1980	0.06	0.05	0.04	0.03	0.03	0.04	0.16	1.44	1.35	0.18	0.06	0.05	209
1958	0.06	0.05	0.04	0.03	0.03	0.04	0.16	1.45	1.36	0.18	0.06	0.05	212
1974	0.06	0.05	0.04	0.03	0.03	0.04	0.16	1.46	1.37	0.18	0.06	0.05	213
1957	0.06	0.05	0.04	0.03	0.03	0.04	0.16	1.47	1.38	0.18	0.06	0.05	214
1970	0.07	0.05	0.04	0.03	0.03	0.04	0.17	1.57	1.47	0.19	0.06	0.05	229
1979	0.07	0.05	0.04	0.04	0.03	0.04	0.17	1.59	1.49	0.19	0.06	0.05	232
1978	0.07	0.05	0.04	0.04	0.03	0.04	0.17	1.6	1.5	0.2	0.06	0.05	233
1983	0.07	0.05	0.04	0.04	0.03	0.04	0.18	1.61	1.51	0.2	0.06	0.05	235
1986	0.07	0.05	0.04	0.04	0.03	0.04	0.18	1.64	1.54	0.2	0.07	0.05	239
1984	0.07	0.05	0.04	0.04	0.03	0.04	0.18	1.67	1.56	0.2	0.07	0.05	243
1982	0.07	0.06	0.04	0.04	0.04	0.04	0.19	1.73	1.62	0.21	0.07	0.06	252
1971	0.07	0.06	0.05	0.04	0.04	0.04	0.2	1.79	1.68	0.22	0.07	0.06	261

CAMP CREEK
Ranked Monthly Flow Values in CFS

YEAR	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	ANNUAL (AF)
1977	0.07	0.05	0.04	0.04	0.03	0.04	0.18	1.61	1.51	0.2	0.06	0.05	235
1955	0.08	0.06	0.05	0.04	0.04	0.05	0.21	1.89	1.78	0.23	0.08	0.06	276
1953	0.08	0.06	0.05	0.04	0.04	0.05	0.21	1.92	1.8	0.23	0.08	0.06	280
1981	0.08	0.06	0.05	0.04	0.04	0.05	0.21	1.96	1.84	0.24	0.08	0.06	286
1987	0.09	0.07	0.05	0.05	0.04	0.05	0.23	2.07	1.94	0.25	0.08	0.07	302
1989	0.09	0.07	0.05	0.05	0.05	0.05	0.24	2.18	2.05	0.27	0.09	0.07	318
1963	0.09	0.07	0.06	0.05	0.05	0.06	0.25	2.26	2.12	0.28	0.09	0.07	329
1961	0.1	0.08	0.06	0.05	0.05	0.06	0.26	2.34	2.2	0.29	0.09	0.08	342
1952	0.1	0.08	0.06	0.05	0.05	0.06	0.26	2.35	2.2	0.29	0.09	0.08	342
1966	0.1	0.08	0.06	0.05	0.05	0.06	0.26	2.37	2.22	0.29	0.09	0.08	345
1990	0.1	0.08	0.06	0.06	0.05	0.06	0.27	2.49	2.34	0.3	0.1	0.08	363
1960	0.11	0.08	0.06	0.06	0.05	0.06	0.28	2.55	2.39	0.31	0.1	0.08	371
1972	0.11	0.09	0.07	0.06	0.06	0.07	0.29	2.68	2.51	0.33	0.11	0.09	390
1967	0.11	0.09	0.07	0.06	0.06	0.07	0.29	2.69	2.53	0.33	0.11	0.09	392
1947	0.12	0.09	0.07	0.06	0.06	0.07	0.31	2.85	2.68	0.35	0.11	0.09	416
1956	0.12	0.09	0.07	0.06	0.06	0.07	0.32	2.89	2.71	0.35	0.12	0.09	421
1959	0.12	0.09	0.07	0.07	0.06	0.07	0.32	2.93	2.75	0.36	0.12	0.1	427
1988	0.12	0.09	0.07	0.07	0.06	0.07	0.32	2.93	2.75	0.36	0.12	0.1	427
1973	0.13	0.1	0.08	0.07	0.06	0.07	0.33	3	2.81	0.37	0.12	0.1	437
1969	0.13	0.1	0.08	0.07	0.06	0.07	0.33	3.05	2.87	0.37	0.12	0.1	445
1976	0.13	0.1	0.08	0.07	0.06	0.07	0.33	3.06	2.87	0.37	0.12	0.1	446
1949	0.13	0.1	0.08	0.07	0.07	0.08	0.35	3.18	2.98	0.39	0.13	0.1	463
1964	0.14	0.1	0.08	0.07	0.07	0.08	0.36	3.27	3.07	0.4	0.13	0.11	476
1946	0.15	0.11	0.09	0.08	0.07	0.09	0.38	3.49	3.28	0.43	0.14	0.11	509
1985	0.15	0.11	0.09	0.08	0.07	0.09	0.39	3.54	3.32	0.43	0.14	0.12	516
1968	0.15	0.11	0.09	0.08	0.07	0.09	0.39	3.56	3.34	0.43	0.14	0.12	519
1950	0.15	0.11	0.09	0.08	0.08	0.09	0.39	3.58	3.36	0.44	0.14	0.12	522
1951	0.15	0.12	0.09	0.08	0.08	0.09	0.39	3.58	3.36	0.44	0.14	0.12	522
1965	0.15	0.12	0.09	0.08	0.08	0.09	0.39	3.6	3.38	0.44	0.14	0.12	525
1962	0.15	0.12	0.09	0.08	0.08	0.09	0.4	3.62	3.4	0.44	0.14	0.12	528
1948	0.15	0.12	0.09	0.08	0.08	0.09	0.4	3.63	3.41	0.44	0.14	0.12	529
1975	0.15	0.12	0.09	0.08	0.08	0.09	0.4	3.69	3.46	0.45	0.15	0.12	538
1980	0.16	0.12	0.1	0.08	0.08	0.09	0.41	3.78	3.55	0.46	0.15	0.12	552
1958	0.16	0.12	0.1	0.09	0.08	0.09	0.42	3.83	3.6	0.47	0.15	0.12	559
1974	0.16	0.12	0.1	0.09	0.08	0.09	0.42	3.85	3.61	0.47	0.15	0.13	561
1957	0.16	0.12	0.1	0.09	0.08	0.09	0.42	3.87	3.63	0.47	0.15	0.13	564
1970	0.17	0.13	0.1	0.09	0.09	0.1	0.45	4.14	3.89	0.51	0.16	0.14	604
1979	0.17	0.13	0.11	0.09	0.09	0.1	0.46	4.19	3.93	0.51	0.17	0.14	611
1978	0.18	0.14	0.11	0.09	0.09	0.1	0.46	4.22	3.96	0.51	0.17	0.14	614
1983	0.18	0.14	0.11	0.09	0.09	0.1	0.47	4.26	3.99	0.52	0.17	0.14	620
1986	0.18	0.14	0.11	0.1	0.09	0.11	0.47	4.33	4.06	0.53	0.17	0.14	631
1984	0.18	0.14	0.11	0.1	0.09	0.11	0.48	4.39	4.12	0.54	0.17	0.14	640
1982	0.19	0.15	0.11	0.1	0.1	0.11	0.5	4.55	4.27	0.56	0.18	0.15	664
1971	0.2	0.15	0.12	0.1	0.1	0.12	0.52	4.73	4.44	0.58	0.19	0.15	689

APPENDIX F

FLOW DURATION ANALYSIS

DOUGLAS CREEK

STREAMFLOW CLASSIFICATIONS - EXCEEDANCE PROBABLITIES

		OCT-MARCH				APR-JUNE				JULY-SEPT			
	FLOW CLASS (cfs)	FREQ	CUMUL.	PERCENT	EXCEED	FREQ	CUMUL.	PERCENT	EXCEED	FREQ	CUMUL.	PERCENT	EXCEED
1	0.00 - 0.049	0	0	0.00	100.00	0	0	0.00	100.00	0	0	0.00	100.00
2	0.05 - 0.099	0	0	0.00	100.00	0	0	0.00	100.00	0	0	0.00	100.00
3	0.10 - 0.149	0	0	0.00	100.00	0	0	0.00	100.00	0	0	0.00	100.00
4	0.15 - 0.199	0	0	0.00	100.00	0	0	0.00	100.00	0	0	0.00	100.00
5	0.20 - 0.249	0	0	0.00	100.00	0	0	0.00	100.00	0	0	0.00	100.00
6	0.25 - 0.299	0	0	0.00	100.00	0	0	0.00	100.00	0	0	0.00	100.00
7	0.30 - 0.349	0	0	0.00	100.00	0	0	0.00	100.00	0	0	0.00	100.00
8	0.35 - 0.399	0	0	0.00	100.00	0	0	0.00	100.00	0	0	0.00	100.00
9	0.40 - 0.449	0	0	0.00	100.00	0	0	0.00	100.00	0	0	0.00	100.00
10	0.45 - 0.499	0	0	0.00	100.00	0	0	0.00	100.00	0	0	0.00	100.00
11	0.50 - 0.549	0	0	0.00	100.00	0	0	0.00	100.00	0	0	0.00	100.00
12	0.55 - 0.599	0	0	0.00	100.00	0	0	0.00	100.00	0	0	0.00	100.00
13	0.60 - 0.649	0	0	0.00	100.00	0	0	0.00	100.00	0	0	0.00	100.00
14	0.65 - 0.699	0	0	0.00	100.00	0	0	0.00	100.00	0	0	0.00	100.00
15	0.70 - 0.749	0	0	0.00	100.00	0	0	0.00	100.00	0	0	0.00	100.00
16	0.75 - 0.799	0	0	0.00	100.00	0	0	0.00	100.00	0	0	0.00	100.00
17	0.80 - 0.849	0	0	0.00	100.00	0	0	0.00	100.00	0	0	0.00	100.00
18	0.85 - 0.899	0	0	0.00	100.00	0	0	0.00	100.00	0	0	0.00	100.00
19	0.90 - 0.949	0	0	0.00	100.00	0	0	0.00	100.00	4	4	0.10	99.90
20	0.95 - 0.999	0	0	0.00	100.00	0	0	0.00	100.00	0	4	0.10	99.90
21	1.0 - 1.49	82	82	1.00	99.00	8	8	0.20	99.80	36	40	0.97	99.03
22	1.5 - 1.99	436	518	6.32	93.68	15	23	0.56	99.44	46	86	2.08	97.92
23	2.0 - 2.99	1895	2413	29.42	70.58	83	106	2.59	97.41	253	339	8.19	91.81
24	3.0 - 3.99	2831	5244	63.94	36.06	78	184	4.49	95.51	518	857	20.71	79.29
25	4.0 - 4.99	1189	6433	78.44	21.56	80	264	6.45	93.55	518	1375	33.22	66.78
26	5.0 - 7.49	1047	7480	91.21	8.79	350	614	14.99	85.01	981	2356	56.92	43.08
27	7.5 - 9.99	510	7990	97.43	2.57	194	808	19.73	80.27	528	2884	69.68	30.32
28	10.0 - 14.99	163	8153	99.41	0.59	236	1044	25.49	74.51	507	3391	81.93	18.07
29	15.0 - 19.99	37	8190	99.87	0.13	230	1274	31.10	68.90	254	3645	88.06	11.94
30	20.0 - 24.99	7	8197	99.95	0.05	116	1390	33.94	66.06	129	3774	91.18	8.82
31	25.0 - 29.99	2	8199	99.98	0.02	96	1486	36.28	63.72	73	3847	92.95	7.05
32	30.0 - 39.99	2	8201	100.00	0.00	180	1666	40.67	59.33	86	3933	95.02	4.98
33	40.0 - 49.99	0	8201	100.00	0.00	126	1792	43.75	56.25	67	4000	96.64	3.36
34	50.0 - 74.99	0	8201	100.00	0.00	297	2089	51.00	49.00	92	4092	98.86	1.14
35	75.0 - 99.99	0	8201	100.00	0.00	286	2375	57.98	42.02	38	4130	99.78	0.22
36	100.0 - 149.99	0	8201	100.00	0.00	429	2804	68.46	31.54	6	4136	99.93	0.07
37	150.0 - 199.99	0	8201	100.00	0.00	376	3180	77.64	22.36	1	4137	99.95	0.05
38	200.0 - 249.99	0	8201	100.00	0.00	368	3548	86.62	13.38	1	4138	99.98	0.02
39	250.0 - 299.99	0	8201	100.00	0.00	240	3788	92.48	7.52	0	4138	99.98	0.02
40	300.0 - 399.99	0	8201	100.00	0.00	212	4000	97.66	2.34	0	4138	99.98	0.02
41	400.0 - 499.99	0	8201	100.00	0.00	75	4075	99.49	0.51	1	4139	100.00	0.00
42	500.0 - 749.99	0	8201	100.00	0.00	21	4096	100.00	0.00	0	4139	100.00	0.00
43	750.0 - 999.99	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00
44	1000 - 1499.9	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00
45	1500 - 1999.9	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00
46	2000 - 2499.9	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00
47	2500 - 2999.9	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00
48	3000 - 3999.9	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00
49	4000 - 4999.9	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00

HORSE CREEK

STREAMFLOW CLASSIFICATIONS - EXCEEDANCE PROBABLITIES

		OCT-MARCH				APR-JUNE				JULY-SEPT			
	FLOW CLASS (cfs)	FREQ	CUMUL.	PERCENT	EXCEED	FREQ	CUMUL.	PERCENT	EXCEED	FREQ	CUMUL.	PERCENT	EXCEED
1	0.00 - 0.049	0	0	0.00	100.00	0	0	0.00	100.00	0	0	0.00	100.00
2	0.05 - 0.099	0	0	0.00	100.00	0	0	0.00	100.00	0	0	0.00	100.00
3	0.10 - 0.149	0	0	0.00	100.00	0	0	0.00	100.00	4	4	0.10	99.90
4	0.15 - 0.199	4	4	0.05	99.95	0	0	0.00	100.00	29	33	0.80	99.20
5	0.20 - 0.249	99	103	1.26	98.74	4	4	0.10	99.90	33	66	1.59	98.41
6	0.25 - 0.299	253	356	4.34	95.66	3	7	0.17	99.83	27	93	2.25	97.75
7	0.30 - 0.349	285	641	7.82	92.18	3	10	0.24	99.76	71	164	3.96	96.04
8	0.35 - 0.399	409	1050	12.80	87.20	11	21	0.51	99.49	71	235	5.68	94.32
9	0.40 - 0.449	609	1659	20.23	79.77	8	29	0.71	99.29	122	357	8.63	91.37
10	0.45 - 0.499	825	2484	30.29	69.71	36	65	1.59	98.41	227	584	14.11	85.89
11	0.50 - 0.549	969	3453	42.10.	57.90	9	74	1.81	98.19	164	748	18.07	81.93
12	0.55 - 0.599	772	4225	51.52	48.48	18	92	2.25	97.75	206	954	23.05	76.95
13	0.60 - 0.649	816	5041	61.47	38.53	15	107	2.61	97.39	189	1143	27.62	72.38
14	0.65 - 0.699	501	5542	67.58	32.42	8	115	2.81	97.19	176	1319	31.87	68.13
15	0.70 - 0.749	423	5965	72.74	27.26	17	132	3.22	96.78	112	1431	34.57	65.43
16	0.75 - 0.799	223	6188	75.45	24.55	16	148	3.61	96.39	192	1623	39.21	60.79
17	0.80 - 0.849	328	6516	79.45	20.55	39	187	4.57	95.43	176	1799	43.46	56.54
18	0.85 - 0.899	172	6688	81.55	18.45	13	200	4.88	95.12	173	1972	47.64	52.36
19	0.90 - 0.949	149	6837	83.37	16.63	19	219	5.35	94.65	111	2083	50.33	49.67
20	0.95 - 0.999	138	6975	85.05	14.95	10	229	5.59	94.41	138	2221	53.66	46.34
21	1.0 - 1.49	922	7897	96.29	3.71	340	569	13.89	86.11	721	2942	71.08	28.92
22	1.5 - 1.99	196	8093	98.68	1.32	218	787	19.21	80.79	387	3329	80.43	19.57
23	2.0 - 2.99	88	8181	99.76	0.24	267	1054	25.73	74.27	351	3680	88.91	11.09
24	3.0 - 3.99	16	8197	99.95	0.05	241	1295	31.62	68.38	145	3825	92.41	7.59
25	4.0 - 4.99	2	8199	99.98	0.02	188	1483	36.21	63.79	72	3897	94.15	5.85
26	5.0 - 7.49	2	8201	100.00	0.00	288	1771	43.24	56.76	118	4015	97.00	3.00
27	7.5 - 9.99	0	8201	100.00	0.00	225	1996	48.73	51.27	67	4082	98.62	1.38
28	10.0 - 14.99	0	8201	100.00	0.00	381	2377	58.03	41.97	51	4133	99.86	0.14
29	15.0 - 19.99	0	8201	100.00	0.00	328	2705	66.04	33.96	2	4135	99.90	0.10
30	20.0 - 24.99	0	8201	100.00	0.00	261	2966	72.41	27.59	1	4136	99.93	0.07
31	25.0 - 29.99	0	8201	100.00	0.00	216	3182	77.69	22.31	1	4137	99.95	0.05
32	30.0 - 39.99	0	8201	100.00	0.00	491	3673	89.67	10.33	1	4138	99.98	0.02
33	40.0 - 49.99	0	8201	100.00	0.00	214	3887	94.90	5.10	0	4138	99.98	0.02
34	50.0 - 74.99	0	8201	100.00	0.00	189	4076	99.51	0.49	1	4139	100.00	0.00
35	75.0 - 99.99	0	8201	100.00	0.00	20	4096	100.00	0.00	0	4139	100.00	0.00
36	100.0 - 149.99	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00
37	150.0 - 199.99	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00
38	200.0 -	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00

BEAVER CREEK

STREAMFLOW CLASSIFICATIONS - EXCEEDANCE PROBABLITIES

		OCT-MARCH				APR-JUNE				JULY-SEPT			
	.OW CLASS (cfs)	FREQ	CUMUL.	PERCENT	EXCEED	FREQ	CUMUL.	PERCENT	EXCEED	FREQ	CUMUL.	PERCENT	EXCEED
1	0.00 - 0.049	1	1	0.01	99.99	0	0	0.00	100.00	15	15	0.36	99.64
2	0.05 - 0.099	573	574	7.00	93.00	12	12	0.29	99.71	151	166	4.01	95.99
3	0.10 - 0.149	2160	2734	33.34	66.66	60	72	1.76	98.24	478	644	15.56	84.44
4	0.15 - 0.199	2718	5452	66.48	33.52	50	122	2.98	97.02	698	1342	32.42	67.58
5	0.20 - 0.249	1183	6635	80.90	19.10	71	193	4.71	95.29	585	1927	46.56	53.44
6	0.25 - 0.299	422	7057	86.05	13.95	68	261	6.37	93.63	379	2306	55.71	44.29
7	0.30 - 0.349	370	7427	90.56	9.44	142	403	9.84	90.16	334	2640	63.78	36.22
8	0.35 - 0.399	310	7737	94.34	5.66	91	494	12.06	87.94	232	2872	69.39	30.61
9	0.40 - 0.449	206	7943	96.85	3.15	115	609	14.87	85.13	159	3031	73.23	26.77
10	0.45 - 0.499	90	8033	97.95	2.05	101	710	17.33	82.67	139	3170	76.59	23.41
11	0.50 - 0.549	48	8081	98.54	1.46	46	756	18.46	81.54	131	3301	79.75	20.25
12	0.55 - 0.599	24	8105	98.83	1.17	62	818	19.97	80.03	85	3386	81.81	18.19
13	0.60 - 0.649	33	8138	99.23	0.77	45	863	21.07	78.93	81	3467	83.76	16.24
14	0.65 - 0.699	13	8151	99.39	0.61	88	951	23.22	76.78	63	3530	85.29	14.71
15	0.70 - 0.749	12	8163	99.54	0.46	43	994	24.27	75.73	64	3594	86.83	13.17
16	0.75 - 0.799	10	8173	99.66	0.34	25	1019	24.88	75.12	45	3639	87.92	12.08
17	0.80 - 0.849	5	8178	99.72	0.28	35	1054	25.73	74.27	40	3679	88.89	11.11
18	0.85 - 0.899	8	8186	99.82	0.18	65	1119	27.32	72.68	38	3717	89.80	10.20
19	0.90 - 0.949	5	8191	99.88	0.12	32	1151	28.10	71.90	30	3747	90.53	9.47
20	0.95 - 0.999	2	8193	99.90	0.10	33	1184	28.91	71.09	26	3773	91.16	8.84
21	1.0 - 1.49	6	8199	99.98	0.02	335	1519	37.08	62.92	138	3911	94.49	5.51
22	1.5 - 1.99	2	8201	100.00	0.00	200	1719	41.97	58.03	89	4000	96.64	3.36
23	2.0 - 2.99	0	8201	100.00	0.00	316	2035	49.68	50.32	92	4092	98.86	1.14
24	3.0 - 3.99	0	8201	100.00	0.00	283	2318	56.59	43.41	38	4130	99.78	0.22
25	4.0 - 4.99	0	8201	100.00	0.00	226	2544	62.11	37.89	4	4134	99.88	0.12
26	5.0 - 7.49	0	8201	100.00	0.00	492	3036	74.12	25.88	3	4137	99.95	0.05
27	7.5 - 9.99	0	8201	100.00	0.00	446	3482	85.01	14.99	1	4138	99.98	0.02
28	10.0 - 14.99	0	8201	100.00	0.00	439	3921	95.73	4.27	0	4138	99.98	0.02
29	15.0 - 19.99	0	8201	100.00	0.00	145	4066	99.27	0.73	1	4139	100.00	0.00
30	20.0 - 24.99	0	8201	100.00	0.00	27	4093	99.93	0.07	0	4139	100.00	0.00
31	25.0 - 29.99	0	8201	100.00	0.00	3	4096	100.00	0.00	0	4139	100.00	0.00
32	30.0 - 39.99	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00
33	40.0 - 49.99	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00
34	50.0 - 74.99	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00
35	75.0 - 99.99	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00
36	100.0 - 149.99	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00
37	150.0 - 199.99	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00
38	200.0 -	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00

NUGGET ~~CREEK~~ Gulch

STREAMFLOW CLASSIFICATIONS - EXCEEDANCE PROBABLITIES

		OCT-MARCH				APR-JUNE				JULY-SEPT			
	FLOW CLASS (cfs)	FREQ	CUMUL.	PERCENT	EXCEED	FREQ	CUMUL.	PERCENT	EXCEED	FREQ	CUMUL.	PERCENT	EXCEED
1	0.00 - 0.049	6928	6928	84.48	15.52	285	285	6.96	93.04	2279	2279	55.06	44.94
2	0.05 - 0.099	1171	8099	98.76	1.24	540	825	20.14	79.86	1076	3355	81.06	18.94
3	0.10 - 0.149	81	8180	99.74	0.26	283	1108	27.05	72.95	338	3693	89.22	10.78
4	0.15 - 0.199	17	8197	99.95	0.05	250	1358	33.15	66.85	137	3830	92.53	7.47
5	0.20 - 0.249	2	8199	99.98	0.02	142	1500	36.62	63.38	72	3902	94.27	5.73
6	0.25 - 0.299	2	8201	100.00	0.00	107	1607	39.23	60.77	54	3956	95.58	4.42
7	0.30 - 0.349	0	8201	100.00	0.00	123	1730	42.24	57.76	44	4000	96.64	3.36
8	0.35 - 0.399	0	8201	100.00	0.00	85	1815	44.31	55.69	41	4041	97.63	2.37
9	0.40 - 0.449	0	8201	100.00	0.00	83	1898	46.34	53.66	23	4064	98.19	1.81
10	0.45 - 0.499	0	8201	100.00	0.00	90	1988	48.54	51.46	19	4083	98.65	1.35
11	0.50 - 0.549	0	8201	100.00	0.00	72	2060	50.29	49.71	17	4100	99.06	0.94
12	0.55 - 0.599	0	8201	100.00	0.00	67	2127	51.93	48.07	14	4114	99.40	0.60
13	0.60 - 0.649	0	8201	100.00	0.00	88	2215	54.08	45.92	9	4123	99.61	0.39
14	0.65 - 0.699	0	8201	100.00	0.00	83	2298	56.10	43.90	7	4130	99.78	0.22
15	0.70 - 0.749	0	8201	100.00	0.00	66	2364	57.71	42.29	3	4133	99.86	0.14
16	0.75 - 0.799	0	8201	100.00	0.00	64	2428	59.28	40.72	1	4134	99.88	0.12
17	0.80 - 0.849	0	8201	100.00	0.00	63	2491	60.82	39.18	0	4134	99.88	0.12
18	0.85 - 0.899	0	8201	100.00	0.00	68	2559	62.48	37.52	0	4134	99.88	0.12
19	0.90 - 0.949	0	8201	100.00	0.00	79	2638	64.40	35.60	1	4135	99.90	0.10
20	0.95 - 0.999	0	8201	100.00	0.00	50	2688	65.63	34.38	0	4135	99.90	0.10
21	1.0 - 1.49	0	8201	100.00	0.00	479	3167	77.32	22.68	2	4137	99.95	0.05
22	1.5 - 1.99	0	8201	100.00	0.00	491	3658	89.31	10.69	1	4138	99.98	0.02
23	2.0 - 2.99	0	8201	100.00	0.00	344	4002	97.71	2.29	0	4138	99.98	0.02
24	3.0 - 3.99	0	8201	100.00	0.00	80	4082	99.66	0.34	1	4139	100.00	0.00
25	4.0 - 4.99	0	8201	100.00	0.00	14	4096	100.00	0.00	0	4139	100.00	0.00
26	5.0 - 7.49	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00
27	7.5 - 9.99	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00
28	10.0 - 14.99	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00
29	15.0 - 19.99	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00
30	20.0 - 24.99	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00
31	25.0 - 29.99	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00
32	30.0 - 39.99	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00
33	40.0 - 49.99	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00
34	50.0 - 74.99	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00
35	75.0 - 99.99	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00
36	100.0 - 149.99	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00
37	150.0 - 199.99	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00
38	200.0 -	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00

LAKE CREEK

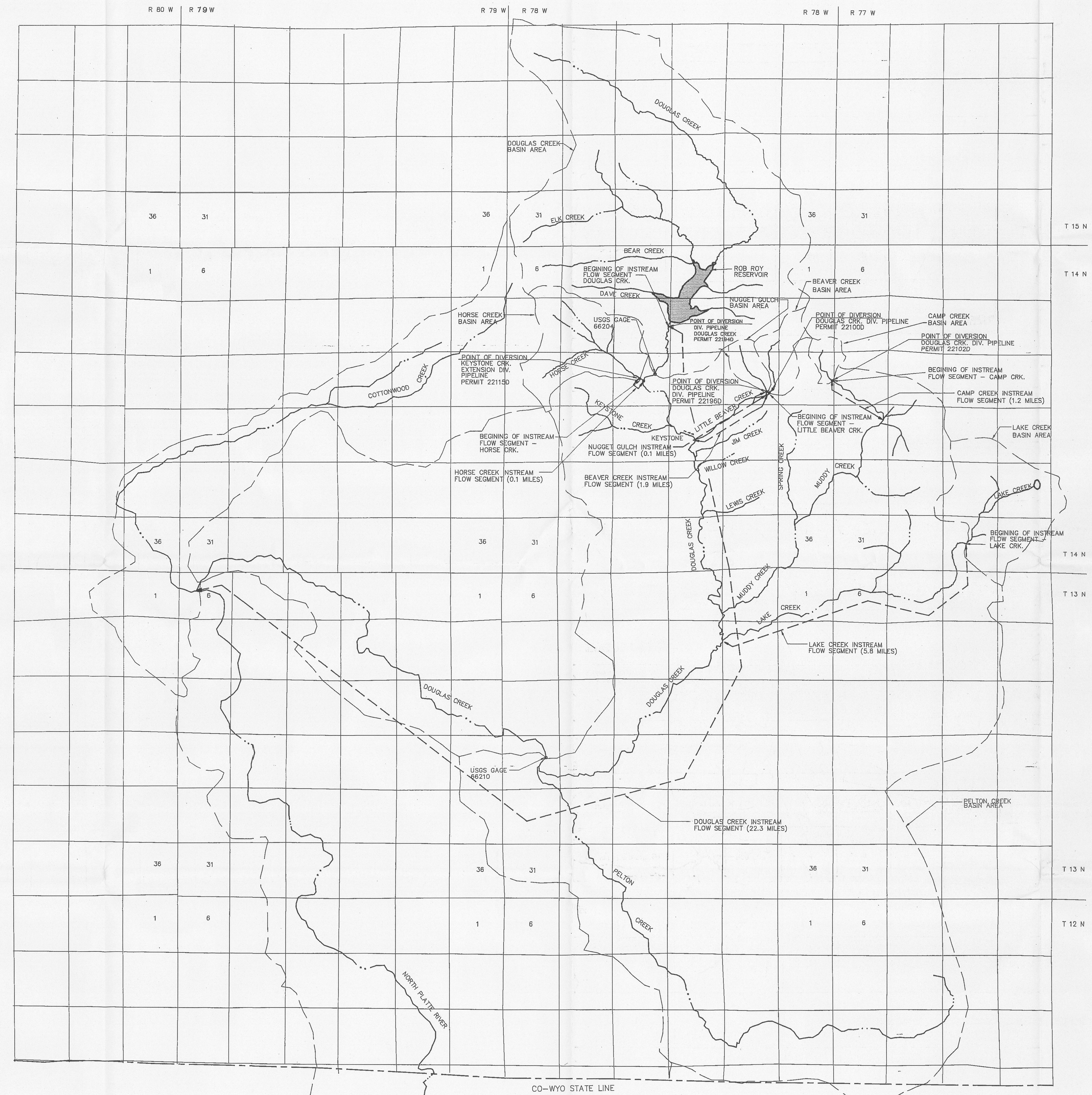
STREAMFLOW CLASSIFICATIONS - EXCEEDANCE PROBABLITIES

		OCT-MARCH				APR-JUNE				JULY-SEPT			
	FLOW CLASS (cfs)	FREQ	CUMUL.	PERCENT	EXCEED	FREQ	CUMUL.	PERCENT	EXCEED	FREQ	CUMUL.	PERCENT	EXCEED
	0.00 - 0.049	0	0	0.00	100.00	0	0	0.00	100.00	0	0	0.00	100.00
2	0.05 - 0.099	0	0	0.00	100.00	0	0	0.00	100.00	0	0	0.00	100.00
3	0.10 - 0.149	0	0	0.00	100.00	0	0	0.00	100.00	0	0	0.00	100.00
4	0.15 - 0.199	1	1	0.01	99.99	0	0	0.00	100.00	7	7	0.17	99.83
5	0.20 - 0.249	3	4	0.05	99.95	0	0	0.00	100.00	26	33	0.80	99.20
6	0.25 - 0.299	68	72	0.88	99.12	4	4	0.10	99.90	33	66	1.59	98.41
7	0.30 - 0.349	192	264	3.22	96.78	3	7	0.17	99.83	20	86	2.08	97.92
8	0.35 - 0.399	178	442	5.39	94.61	1	8	0.20	99.80	30	116	2.80	97.20
9	0.40 - 0.449	264	706	8.61	91.39	4	12	0.29	99.71	59	175	4.23	95.77
10	0.45 - 0.499	465	1171	14.28	85.72	9	21	0.51	99.49	91	266	6.43	93.57
11	0.50 - 0.549	331	1502	18.31	81.69	8	29	0.71	99.29	91	357	8.63	91.37
12	0.55 - 0.599	738	2240	27.31	72.69	36	65	1.59	98.41	171	528	12.76	87.24
13	0.60 - 0.649	600	2840	34.63	65.37	7	72	1.76	98.24	163	691	16.69	83.31
14	0.65 - 0.699	805	3645	44.45	55.55	6	78	1.90	98.10	151	842	20.34	79.66
15	0.70 - 0.749	659	4304	52.48	47.52	15	93	2.27	97.73	148	990	23.92	76.08
16	0.75 - 0.799	736	5040	61.46	38.54	14	107	2.61	97.39	153	1143	27.62	72.38
17	0.80 - 0.849	335	5375	65.54	34.46	8	115	2.81	97.19	99	1242	30.01	69.99
18	0.85 - 0.899	389	5764	70.28	29.72	9	124	3.03	96.97	164	1406	33.97	66.03
19	0.90 - 0.949	285	6049	73.76	26.24	14	138	3.37	96.63	185	1591	38.44	61.56
20	0.95 - 0.999	329	6378	77.77	22.23	11	149	3.64	96.36	84	1675	40.47	59.53
21	1.0 - 1.49	1062	7440	90.72	9.28	189	338	8.25	91.75	948	2623	63.37	36.63
22	1.5 - 1.99	538	7978	97.28	2.72	283	621	15.16	84.84	449	3072	74.22	25.78
23	2.0 - 2.99	176	8154	99.43	0.57	279	900	21.97	78.03	453	3525	85.17	14.83
24	3.0 - 3.99	36	8190	99.87	0.13	233	1133	27.66	72.34	205	3730	90.12	9.88
25	4.0 - 4.99	7	8197	99.95	0.05	179	1312	32.03	67.97	99	3829	92.51	7.49
26	5.0 - 7.49	4	8201	100.00	0.00	304	1616	39.45	60.55	127	3956	95.58	4.42
27	7.5 - 9.99	0	8201	100.00	0.00	209	1825	44.56	55.44	85	4041	97.63	2.37
28	10.0 - 14.99	0	8201	100.00	0.00	326	2151	52.51	47.49	73	4114	99.40	0.60
29	15.0 - 19.99	0	8201	100.00	0.00	313	2464	60.16	39.84	20	4134	99.88	0.12
30	20.0 - 24.99	0	8201	100.00	0.00	260	2724	66.50	33.50	1	4135	99.90	0.10
31	25.0 - 29.99	0	8201	100.00	0.00	214	2938	71.73	28.27	1	4136	99.93	0.07
32	30.0 - 39.99	0	8201	100.00	0.00	408	3346	81.69	18.31	2	4138	99.98	0.02
33	40.0 - 49.99	0	8201	100.00	0.00	353	3699	90.31	9.69	0	4138	99.98	0.02
34	50.0 - 74.99	0	8201	100.00	0.00	320	4019	98.12	1.88	0	4138	99.98	0.02
35	75.0 - 99.99	0	8201	100.00	0.00	66	4085	99.73	0.27	1	4139	100.00	0.00
36	100.0 - 149.99	0	8201	100.00	0.00	11	4096	100.00	0.00	0	4139	100.00	0.00
37	150.0 - 199.99	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00
38	200.0 -	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00

CAMP CREEK

STREAMFLOW CLASSIFICATIONS - EXCEEDANCE PROBABLITIES

		OCT-MARCH				APR-JUNE				JULY-SEPT			
	FLOW CLASS (cfs)	FREQ	CUMUL.	PERCENT	EXCEED	FREQ	CUMUL.	PERCENT	EXCEED	FREQ	CUMUL.	PERCENT	EXCEED
1	0.00 - 0.049	811	811	9.89	90.11	17	17	0.42	99.58	168	168	4.06	95.94
2	0.05 - 0.099	5320	6131	74.76	25.24	121	138	3.37	96.63	1255	1423	34.38	65.62
3	0.10 - 0.149	1275	7406	90.31	9.69	196	334	8.15	91.85	1028	2451	59.22	40.78
4	0.15 - 0.199	569	7975	97.24	2.76	272	606	14.79	85.21	501	2952	71.32	28.68
5	0.20 - 0.249	124	8099	98.76	1.24	168	774	18.90	81.10	329	3281	79.27	20.73
6	0.25 - 0.299	54	8153	99.41	0.59	109	883	21.56	78.44	199	3480	84.08	15.92
7	0.30 - 0.349	24	8177	99.71	0.29	123	1006	24.56	75.44	124	3604	87.07	12.93
8	0.35 - 0.399	13	8190	99.87	0.13	104	1110	27.10	72.90	98	3702	89.44	10.56
9	0.40 - 0.449	4	8194	99.91	0.09	68	1178	28.76	71.24	68	3770	91.08	8.92
10	0.45 - 0.499	3	8197	99.95	0.05	95	1273	31.08	68.92	48	3818	92.24	7.76
11	0.50 - 0.549	0	8197	99.95	0.05	118	1391	33.96	66.04	30	3848	92.97	7.03
12	0.55 - 0.599	2	8199	99.98	0.02	47	1438	35.11	64.89	25	3873	93.57	6.43
13	0.60 - 0.649	1	8200	99.99	0.01	57	1495	36.50	63.50	30	3903	94.30	5.70
14	0.65 - 0.699	0	8200	99.99	0.01	45	1540	37.60	62.40	21	3924	94.81	5.19
15	0.70 - 0.749	1	8201	100.00	0.00	38	1578	38.53	61.47	21	3945	95.31	4.69
16	0.75 - 0.799	0	8201	100.00	0.00	56	1634	39.89	60.11	17	3962	95.72	4.28
17	0.80 - 0.849	0	8201	100.00	0.00	44	1678	40.97	59.03	17	3979	96.13	3.87
18	0.85 - 0.899	0	8201	100.00	0.00	36	1714	41.85	58.15	20	3999	96.62	3.38
19	0.90 - 0.949	0	8201	100.00	0.00	46	1760	42.97	57.03	16	4015	97.00	3.00
20	0.95 - 0.999	0	8201	100.00	0.00	35	1795	43.82	56.18	17	4032	97.41	2.59
21	1.0 - 1.49	0	8201	100.00	0.00	315	2110	51.51	48.49	78	4110	99.30	0.70
22	1.5 - 1.99	0	8201	100.00	0.00	307	2417	59.01	40.99	24	4134	99.88	0.12
23	2.0 - 2.99	0	8201	100.00	0.00	464	2881	70.34	29.66	2	4136	99.93	0.07
24	3.0 - 3.99	0	8201	100.00	0.00	362	3243	79.17	20.83	2	4138	99.98	0.02
25	4.0 - 4.99	0	8201	100.00	0.00	393	3636	88.77	11.23	0	4138	99.98	0.02
26	5.0 - 7.49	0	8201	100.00	0.00	357	3993	97.49	2.51	0	4138	99.98	0.02
27	7.5 - 9.99	0	8201	100.00	0.00	88	4081	99.63	0.37	1	4139	100.00	0.00
28	10.0 - 14.99	0	8201	100.00	0.00	15	4096	100.00	0.00	0	4139	100.00	0.00
29	15.0 - 19.99	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00
30	20.0 - 24.99	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00
31	25.0 - 29.99	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00
32	30.0 - 39.99	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00
33	40.0 - 49.99	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00
34	50.0 - 74.99	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00
35	75.0 - 99.99	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00
36	100.0 - 149.99	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00
37	150.0 - 199.99	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00
38	200.0 -	0	8201	100.00	0.00	0	4096	100.00	0.00	0	4139	100.00	0.00



LEGEND

- INSTREAM FLOW SEGMENT
- CHANNEL
- DRAINAGE BASIN BOUNDARY
- STATE LINE

LIDSTONE & ANDERSON, INC.
Water Resources and Environmental Consultants

DETAILED LOCATION MAP
DOUGLAS CREEK
INSTREAM FLOW SEGMENTS

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SCALE: 1"=5000'

Project No. WY-WDC-04
Date: 9-24-92
Design: CMJ
Drawn: JHF
Checked:
Revisions:

EXHIBIT 1

SHEET 1 OF 1