Evaluation of Newlan Creek Reservoir Water Purchase to Augment Stream Flows in the Smith River, Montana

by

Fred Nelson and Frank Culver

Montana Department of Fish, Wildlife & Parks
Helena, MT 59620

November 1992

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION AND METHODS

During the drought of 1992, DFWP purchased 1,000 acre-feet of stored water in Newlan Creek Reservoir, at $5 per acre-foot, to augment instream flows in the Smith River, one of Montana's outstanding recreational rivers. Dam releases began on August 28 and ended on October 4, 1992. DFWP established flow monitoring sites on Newlan Creek and on the Smith River to evaluate the effectiveness of the experimental flow releases. This report discusses the study results and provides recommendations regarding future water purchases.

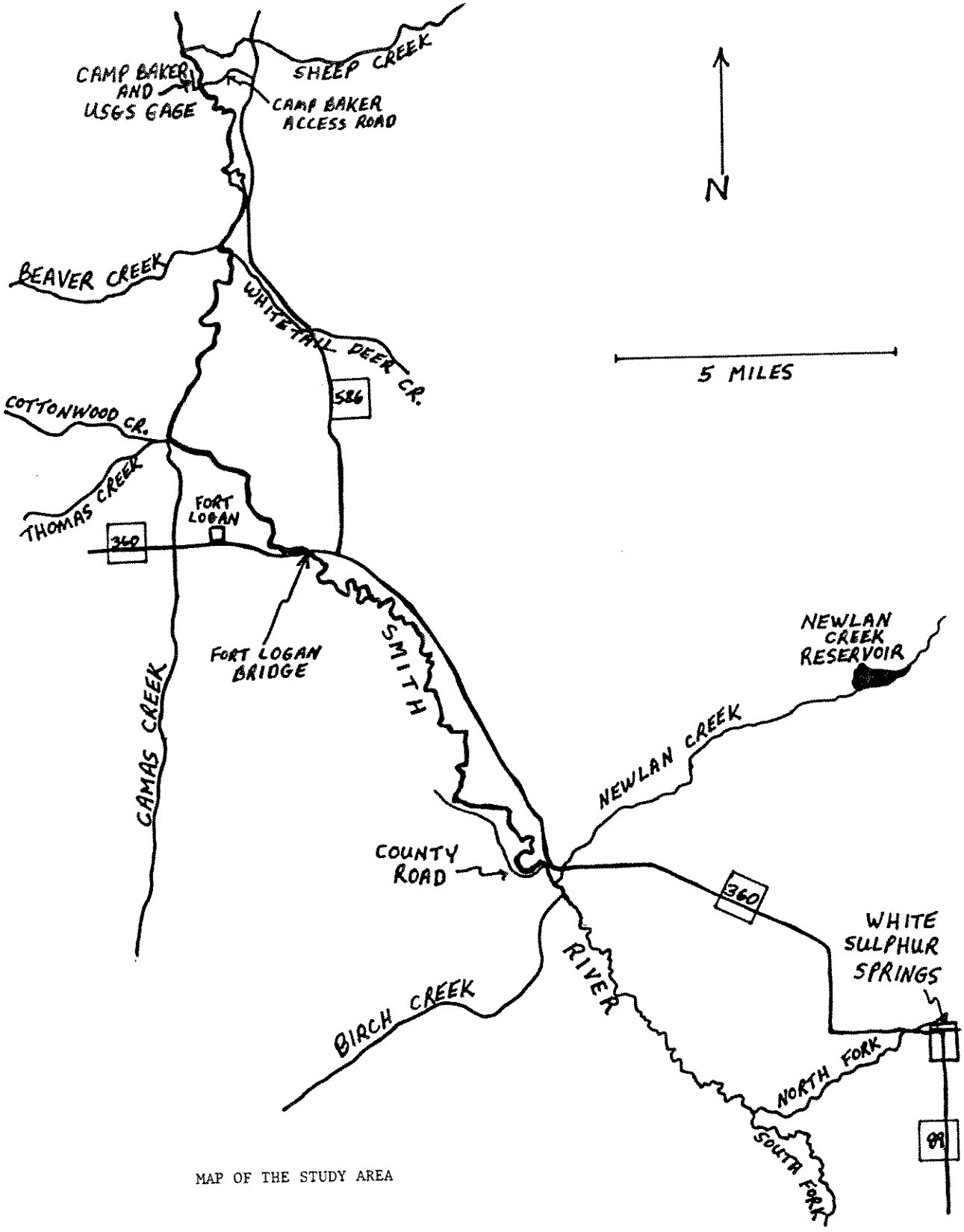
STUDY AREA

The Smith River originates at the juncture of its North and South forks near White Sulphur Springs and flows 125 miles before discharging into the Missouri River near Great Falls. Newlan Creek enters the Smith River at river mile 112 (see map). Newlan Creek Reservoir, a 250-acre, SCS-built, irrigation storage project completed in 1977, is located at stream mile 9.2 of Newlan Creek. The project is now owned and operated by the Meagher County Newlan Creek Water District, from which the stored water was purchased.

The study area encompasses the 29-mile-section of the upper Smith River between the mouth of Newlan Creek and Camp Baker. Camp Baker, at river mile 84, is the major launch site for Smith River float trips and is also the site of an active USGS gauge (No. 06076690).

Fourteen river miles downstream from the Newlan Creek mouth, at river mile 98, Highway 360 crosses the Smith River at Fort Logan. This bridge is the upstream boundary of DFWP's "Murphy Right" section and is near the beginning of the river's better trout fishing. DFWP's Smith River Wildlife Management Area, located between Fort Logan and Camp Baker, provides the public with over two miles of river access.

Numerous tributaries feed the Smith River above Camp Baker. In addition to Newlan Creek, these include: Beaver, Whitetail Deer, Cottonwood, Thomas, Camas, and Birch creeks.



MAP OF THE STUDY AREA

RESULTS

The flows measured for Newlan Creek and the Smith River during the study period are listed in Tables 1-10. A discussion by monitoring site follows:

Smith River above Newlan Creek

Flows for the Smith River above the mouth of Newlan Creek were derived by subtracting the flows for Newlan Creek at its mouth from the six corresponding measurements for the Smith River below Newlan Creek (Tables 1 and 3). The flows of the Smith River above the mouth of Newlan Creek ranged from 26 to 37 cfs from August 27-September 29 (Figure 1). Flows entering the study area were not constant during the study period.

Newlan Creek at Mouth

Daily flows in Newlan Creek at its mouth from August 24-October 5 are shown in Figure 2. Seven actual measurements (Table 1) were used in conjunction with the timing of flow releases at Newlan Creek Dam, coupled with a 24-hour lag to adjust for travel time to the mouth, to generate the daily flows in Figure 2 for Newlan Creek at its mouth.

Before DFWP's water was initially released at the dam on August 28, Newlan Creek was delivering a flow of 2.8 cfs to the Smith River. After water was released, a maximum of 18.3 cfs, which flowed for 15 days, was achieved at the mouth. Releases were then terminated for six days, causing flows at the mouth to decrease to 1.8 cfs. When water was again released, flows recovered to 18.3-19.0 cfs for 10 days. Flows returned to a base level of 2-3 cfs on October 5 at approximately 3:30 p.m.

Smith River below Newlan Creek

Flows of the Smith River at the county road bridge ¼ mile downstream from Newlan Creek were measured six times from August 27-September 29 (Table 3). Flows ranged from 32 to 52 cfs.

Figure 2 compares the flows at this site to those for Newlan Creek at its mouth. Increased flows in Newlan Creek generally led to increases in the Smith River. Likewise, a cut-back to 1.8 cfs decreased the river flow. However, the magnitude of the flow increases and decreases was not the same as that for Newlan Creek because the river flow entering the study area was not constant, but varied from 26 to 37 cfs (Figure 1).

When Newlan Creek was flowing at its maximum (18.3-19.0 cfs), it accounted for 35-41% of the Smith River's flow. At a base flow of 1.8-2.8 cfs, Newlan Creek contributed 6-7% of the river's flow.

Clearly, purchased water measurably increased the flows of the Smith River immediately below the creek's confluence.

Smith River at Fort Logan

Flows of the Smith River at the Fort Logan bridge, located 14 river miles below the mouth of Newlan Creek, were measured six times from August 27-September 29 (Table 3). Flows ranged from 43 to 59 cfs.

Figure 3 compares the flows at this site to those for Newlan Creek at its mouth. For the comparison in Figure 3, flow measurements at Fort Logan were moved back one day to account for an approximate 24-hour travel time between Newlan Creek and Fort Logan. An adjustment of one day is needed to correctly assess the influence of flow variations in Newlan Creek on the flows in the Smith River at Fort Logan.

Flows at Fort Logan did not mirror flow increases/decreases in Newlan Creek. During the period that Newlan Creek increased from 2.8 to 18.3 cfs, flows at Fort Logan remained relatively stable at 47-54 cfs. When Newlan Creek was stable at 18.3 cfs, flows at Fort Logan decreased from 54 to 43 cfs. Flows at Fort Logan remained stable at 43-45 cfs when Newlan Creek dropped from 18.3 to 1.8 cfs. An increase of 16.5 cfs in Newlan Creek (from 1.8 to 18.3 cfs) corresponded to a 13.5 cfs increase at Fort Logan, from 45.2 to 58.7 cfs. While releases might have influenced flows at Fort Logan, a consistent relationship was not detected throughout the study period.

Smith River at Camp Baker

Flows at the USGS gauge at Camp Baker, located 29 river miles below Newlan Creek, ranged from 38 to 68 cfs during the period of August 24 - October 5.

Figure 4 compares the Camp Baker flows to those for Newlan Creek. For this comparison, flows at Camp Baker were moved back two days to account for an approximate 48-hour travel time between Newlan Creek and Camp Baker.

Flows at Camp Baker did not mirror the flow trend for Newlan Creek. During the period when Newlan Creek increased from 2.8 to 18.3 cfs, flows at Camp Baker were fairly stable at approximately 60-68 cfs. The greatest flow decrease at Camp Baker, from 66 to 38 cfs, occurred when Newlan Creek was flowing a constant 18.3 cfs. An increase from 1.8 cfs to 18.3-19.0 cfs in Newlan Creek corresponded to an increase at Camp Baker, from 41-42 cfs to 52-58 cfs. Given the fact that the correlation with Newlan Creek flows was weak at Fort Logan, located 15 miles upstream from Camp Baker, a strong correlation at Camp Baker is unexpected and none was found.

DISCUSSION

This study brought to light a number of problems that will be encountered when attempting to use Newlan Creek water to augment instream flows in the Smith River. A discussion of these problems follows:

Irrigation Diversions - Smith River

According to Otto Ohlson, SCS District Conservationist at White Sulphur Springs, there are seven irrigation diversions on the Smith River between Newlan Creek and the Fort Logan bridge. Three of these consist of dams that span the river channel (see Figure 5). Between Fort Logan and Camp Baker, there are an additional three diversions, one of which is a permanent dam spanning the river.

The DNRC lists 14 SB76 irrigation claims, totalling 96.9 cfs, for the Smith River between Newlan Creek and Camp Baker. Three water use permits for irrigation, totalling 6.5 cfs, are also listed. One of these permits, for 2.2 cfs, is within DFWP's "Murphy Right" section (Sheep Creek-Fort Logan bridge) and is junior to DFWP's instream right.

To successfully move purchased water downstream to Camp Baker, a distance of 29 miles, the water must bypass ten diversions. During this study, some late summer irrigation was occurring in the Smith River Valley. Consequently, released water, along with the normal river flow, was subject to diversion as it passed downstream. The majority of flow fluctuations at the Fort Logan and Camp Baker monitoring sites is primarily attributable to this irrigation usage. Had diversions not operated during the study, flow improvements due to Newlan Creek releases might have been detected at Fort Logan and Camp Baker throughout the study period.

Administration

To successfully pass purchased water downstream for instream use, a water commissioner is needed to protect DFWP's interests. To accomplish this task, the commissioner has to administer water rights by amount and priority to ensure that each user is within the limits of his right and that sufficient water, including the purchased amount, is continuously passed downstream to serve the next users in-line and to also meet the instream need.

To administer water rights, a commissioner relies on a decree that lists the amount, priority and point of diversion of each right. Unfortunately, the Smith River has not been decreed and has never had a water commissioner. Under Montana's water adjudication process, a temporary preliminary decree will not be issued for the Smith River for 3-5 years. The lack of a decree greatly hinders the ability of DFWP to protect purchased water instream.

Another issue concerns the amount of water that DFWP is entitled to protect at the various monitoring points. If DFWP purchases 15 cfs, is 15 cfs the minimum flow that must pass the monitoring points or is the 15 cfs in addition to a base river flow? If the latter is the correct approach, how is the base river flow quantified?

USGS gauge records for the Smith River at Camp Baker (Table 11) show that the monthly percentile flows routinely exceed any reasonable augmentation flow that DFWP is likely to purchase. For example, a 15 cfs purchase is far less than the 90th percentile flows for July, August and September. Since the gauge was installed in 1977, the lowest recorded flow was 16 cfs, in Aug./Sept., 1988. Clearly, if water purchases are to benefit instream flows, a method for quantifying the river's base flow is needed. To be accurate, the method must account for daily variations in tributary inflows, other sources of accretion, and irrigation usage. This, by itself, is a difficult task, but necessary if released water is to be successfully passed through the system.

Irrigation Diversions - Newlan Creek

Under SB76 (Montana's Water Adjudication Act), 10 irrigation claims, totalling 24.4 cfs, were filed for Newlan Creek below Newlan Creek Dam. According to Otto Ohlson, SCS, there are seven irrigation diversions, serving three users, below the dam (Figure 5). Newlan Creek below the dam is a decreed stream and a water commissioner administers water rights each year.

Cool, wet weather eliminated the need for late summer irrigation along Newlan Creek in 1992. Aside from a 1.2-1.6 cfs leakage at the Weitz Ditch (the major diversion on Newlan Creek) and some minor use near the mouth, nearly all of DFWP's purchased water reached the Newlan Creek mouth, 9.2 miles downstream. Had the irrigation demand been high and the ditches opened, successfully passing water to the mouth would have been more difficult. (Passing water in Newlan Creek under the condition of high irrigation demand was untested in this study). However, unlike the Smith River, a water commissioner is available on Newlan Creek to administer water rights and to ensure that water purchased for instream use is delivered to the creek's mouth.

Newlan Creek Channel Capacity

Since the completion of Newlan Creek Dam in 1977, the year-long flow of the lower creek near its mouth has been fairly stable at 2-3 cfs. As a result, the lower creek channel has become constricted and vegetated with grass and woody plants. Beavers have also constructed a network of dams throughout much of the creek. Consequently, high flows can lead to flooding along portions of Newlan Creek.

Based on our observations while monitoring streamflows along Newlan Creek, a flow of 20 cfs is about the upper limit before flooding occurs. At 20 cfs, the creek flow below the road crossing one mile below the dam was backed up - a result of beaver activity - and approached the road level. Attempting to pass more than about 20 cfs by this point could lead to road flooding. Flooding along the lower creek, where the channel has constricted, was also visible. (Proposed road reconstruction, including a new culvert at the road crossing, could minimize this local flooding problem but would not alter flooding problems in the lower creek.)

Newlan Creek has the capacity to deliver a maximum instream flow of about 20 cfs to the Smith River. Above approximately 20 cfs, flooding becomes a threat.

The amount of water that can be delivered to the Newlan Creek mouth when all diversions are operating is unknown. It is doubtful that the channel capacity of Newlan Creek is sufficient to supply the irrigation rights of all users (a total of 24.4 cfs, according to SB76 claims) and still provide room to deliver instream flows of 10-20 cfs to the Smith River.

Monitoring Releases

About 100 yds. below the dam is an SCS-constructed flume on Newlan Creek. Dam releases are gauged at this site.

At the beginning of this study, our flow measurements were substantially less than the flows predicted by the flume's rating table. Additional measuring sites were subsequently established to verify the flume's accuracy (Table 1). Following our findings, the SCS surveyed the flume and found that it was not level. The rating table was subsequently adjusted by - 0.08 ft to compensate.

Other problems also existed. A massive weed bed plugged the flume's entrance, causing an uneven flow of water through the flume. A flume will not measure correctly under this condition. The weed bed was partially removed. Leakage of water under the flume - a common problem with flumes - was also suspected, although our measurements were inconclusive in demonstrating leakage.

Once the above problems were addressed, agreement between the flume readings and our flow measurements improved. The flume ultimately provided a fairly reliable measure of the amount of water released at the dam. Until all flume problems are corrected, an auxiliary monitoring system will be needed to verify the accuracy of future flume readings.

SUMMARY

The lack of a water right decree for the Smith River will hamper DFWP's future efforts to augment river flows using purchased water from Newlan Creek Reservoir. This study showed that, under minimal irrigation in Newlan Creek, instream flow augmentation is achievable in the Smith River immediately below the mouth of Newlan Creek. However, the distance that augmentation can be sustained is relatively short; far short of reaching Fort Logan and Camp Baker where instream benefits are highest. Purchased water can be protected to the mouth of Newlan Creek because a water commissioner administers water under a decree. However, once the purchased water passes the mouth of Newlan Creek, it is subject to diversion and will likely disappear, particularly in water short years, even before reaching Fort Logan 14 miles downstream. Without the ability to administer water past these diversions, the purchased water is unlikely to reach those distant points where it is most desired. Therefore, the benefits to fish, wildlife and recreation are limited.

Very little irrigation occurred from Newlan Creek during this study. When peak irrigation is occurring, there may be limited physical ability to deliver adequate water to the mouth of Newlan Creek without causing flooding problems.

RECOMMENDATIONS

1. DFWP should limit purchases of water from Newlan Creek Reservoir until mechanisms are in place to allow protection of the purchased water in the desired reach of the Smith River.

2. Follow-up flow measurements on Newlan Creek should be undertaken during the peak irrigation season to further document the physical ability to transport purchased water to the Smith River for instream flow augmentation.

drg
993.7

TABLE 1. Newlan Creek Flow Measurements

NEWLAN CREEK	FLOW (cfs)						
	8-27	8-31	9-3	9-9	9-17	9-22	9-29
Flume Below Dam (Rating Table)	3.1	15.5	15.5	20.3	19.7	3.3	18.8
Flume Below Dam (measured)	-	12.8	12.8	16.5	17.1	2.1	16.5
45 - 100 ft. Below Flume (measured)	-	-	15.2	-	16.1	2.8	16.6
1 mi. Below Dam - Above Weitz Ditch (measured)	-	-	15.6[2]	20.2[3]	18.0	2.7	17.4
Highway Crossing Near Mouth (Measured)	2.8[1]	10.2	12.2	18.3[4]	18.3	1.8[5]	19.0

Notes:

1 2.8 cfs at the Highway Crossing on 8-27-92 is an average of two measurements (2.7 and 2.9).
2 15.6 cfs at 1 mi. below dam on 9-3-93 is a combined measurement of 14.4 cfs at Newlan C. and 1.2 cfs at Weitz Ditch.
3 18.68 cfs at Newlan Cr. and 1.55 cfs at Weitz Ditch are flume readings taken by SCS.
4 Measurement taken at best site; poor site reading was 17.3 cfs.
5 Max Buckingham was diverting approximately 2.5 cfs above this measurement site.

TABLE 2. Weitz Ditch Flow Measurements

WEITZ DITCH	FLOWS (cfs)			
	8-27	8-31	9-3	9-9
30 ft. Below Ditch Flume	-	-	1.2	1.6[1]

Note:

1 Measurement is flume reading taken by Otto Ohlson, SCS.

TABLE 3. Smith River Flow Measurements

SMITH RIVER	FLOWS (cfs)						
	8-27	8-31	9-3	9-9	9-17	9-22,23	9-29
County Road Bridge[1]	39.4	38.3	-	51.6	44.5	31.8	47.7
Fort Logan Bridge	47.4	49.4	-	53.7	43.3	45.2	58.7

Note:

1 County road bridge is located about 1/4 mile below the mouth of Newlan Creek.

TABLE 4. Flow Measurements - August 27, 1992

Measurements by Fred Nelson and Frank Culver Flume Gauge = .39 ft. adjusted to .31 ft. (3.12 cfs.)			
Time	Flows	Stream	Location
1:55 PM	2.9	Newlan Creek	30 ft. below hwy. crossing, near mouth
3:00 PM	2.7	Newlan Creek	1/8 mi. below Hwy. crossing, near mouth
4:00 PM	39.4	Smith River	About 90 ft. upstream from county road bridge, about 1/4 mi. below mouth of Newlan C.
1:00 PM	47.4	Smith R.	At Fort Logan Bridge

TABLE 5. Flow Measurements - August 31, 1992

Measurements by Fred Nelson and Frank Culver Flume Gauge = .93 ft. adjusted to .85 ft. (15.5 cfs.) (Dam flow was increased on Aug. 28 at 5:00 PM)			
Time	Flows	Stream	Location
02:00 PM	12.8	Newlan Creek	Below dam at staff gauge in flume (staff gauge = 0.90 - 0.93)
12:45 PM	10.2	Newlan Creek	About 50 yds above hwy. crossing, near mouth
03:25 PM	38.3	Smith River	About 30 ft. below County Road Bridge, about 1/4 mi. below mouth of Newlan C.
04:30 PM	49.4	Smith R.	At Fort Logan Bridge

TABLE 6. Flow Measurements - September 3, 1992

Measurements by Fred Nelson and Frank Culver Flume Gauge = 93 ft. adjusted to .85 ft. (15.5 cfs.) (Dam flow was increased on Aug. 28 at 5:00 PM)			
Time	Flows	Stream	Location
12:45 PM	12.8	Newlan C.	Below dam at staff gauge in flume (staff gauge = 0.92 - 0.93)
04:05 PM	15.2	Newlan C.	About 45 ft. below staff gauge in flume and about 10 ft. above road culvert
02:30 PM	1.2	Weitz Ditch	About 30 ft. below flume in ditch (flume = 0.34 ft.)
02:00 PM	14.4	Newlan C.	About 60 ft. upstream from road crossing 1 mile below dam, and below Weitz diversion
05:25 PM	12.2	Newlan C.	About 1/8 mi. below hwy. crossing near mouth

TABLE 7. **Flow Measurements - September 9, 1992**

Measurements by Liter Spence and Frank Culver, and SCS Flume Gauge = 1.09 ft. adjusted to 1.01 ft (20.3 cfs) (Dam flow was increased on Sept. 4 at 8:30 AM)			
Time	Flows	Stream	Location
10:45 AM	16.5	Newlan C.	Below dam at staff gauge in flume (staff gauge = 1.09 or 20.3 cfs w/ -.08 adjustment in staff gauge)
about 11:30 PM	18.7	Newlan C.	One mile below dam at Weitz Ditch Headgate - measurement taken by Otto Ohlson of SCS using contracted flume measurement
about 12:00 PM	1.6	Weitz Ditch	In ditch at metal Parshall flume - measurement taken by Otto Ohlson of SCS using Parshall flume measurement in ditch (flume = 0.34 ft.)
02:45 PM	17.3	Newlan C.	About 50 yds. above hwy crossing near mouth - below old concrete bridge. Poor site.
03:35 PM	18.3	Newlan C.	About 1/8 mi. below hwy. crossing near mouth
05:05 PM	51.6	Smith R.	100 yds. above County Bridge
06:30 PM	53.7	Smith R.	At Fort Logan Bridge

TABLE 8. Flow Measurements - September 17, 1992

Measurements by Fred Nelson and Frank Culver Flume Gauge = 1.07 ft. adjusted to .99 ft. (19.7 cfs) (Dam flow was increased on Sept. 4 at 8:30 AM)			
Time	Flows	Stream	Location
12:00 PM	17.1	Newlan C.	Below dam at staff gauge in flume (staff gauge = 1.07 or 19.7 cfs w/ -.08 adjustment in staff gauge)
12:40 PM	16.1	Newlan C.	Below dam, 50 ft. below road culvert
2:25 PM	18.0	Newlan C.	One mile below dam, 100 ft. above Weitz Ditch Headgate
3:15 PM	18.3	Newlan C.	Near mouth, 100 yds. below hwy. crossing
4:10 PM	44.5	Smith R.	100 yds. above County Bridge
5:25 PM	43.3	Smith R.	At Fort Logan Bridge

TABLE 9. Flow Measurements - September 22 and 23, 1992

Measurements by Fred Nelson and Frank Culver Flume Gauge = 0.40 ft. adjusted to 0.32 ft. (3.28 cfs) (Dam flow was reduced on Sept. 18 at 3:15 PM)			
Time	Flows	Stream	Location
11:40 AM 9-22	2.1	Newlan C.	Below dam at staff gauge in flume (staff gauge = 0.40 or 3.28 cfs w/ -.08 adjustment in staff gauge)
12:15 PM 9-22	2.8	Newlan C.	Below dam, at lower end of road culvert
1:00 PM 9-22	2.7	Newlan C.	One mile below dam, 50 yds. above Weitz Ditch Headgate
2:10 PM 9-22	1.8	Newlan C.	Near mouth, 1/8 mi. below hwy. crossing
3:35 PM 9-22	31.8	Smith R.	100 yds. above County Road Bridge
10:55 AM 9-23	45.2	Smith R.	At Fort Logan Bridge

TABLE 10. Flow Measurements - September 29, 1992

Measurements by Fred Nelson and Frank Culver Flume Gauge = 1.04 ft. adjusted to 0.96 ft. (18.8 cfs) (Dam flow was increased on Sept. 24 at 5:20 PM and was reduced on Oct. 4 at 3:30 PM)			
Time	Flows	Stream	Location
11:35 AM	16.5	Newlan C.	Below dam at staff gauge in flume (staff gauge = 1.4' or 18.8 cfs w/ -0.08 adjustment in staff gauge)
12:15 PM	16.6	Newlan C.	Below dam, 50' below road culvert
1:05 PM	17.4	Newlan C.	One mile below dam, 50 yds. above Weitz Ditch Headgate
2:10 PM	19.0	Newlan C.	Near mouth, 1/8 mi. below hwy. crossing
3:15 PM	47.7	Smith R.	100 yds. above County Road Bridge
4:30 PM	58.7	Smith R.	At Fort Logan Bridge

TABLE 11. Monthly Percentile Flows for the Smith River at Camp Baker, USGS Gage Number 06076690

MONTH	PERCENTILE FLOWS (cfs)[1]			
	90th	80th	50th	20th
July	81	100	170	230
August	41	55	100	130
September	90	98	110	120

Note:

1 Source: Parrett, C., Johnson, D. and J. Hull. 1989. Estimates of monthly streamflow characteristics at selected sites in the upper Missouri Basin, Montana, base period water years 1937-86. U.S. Geological Survey Water Resources Investigations Report 89-4082. Helena, MT. pp. 69,77.

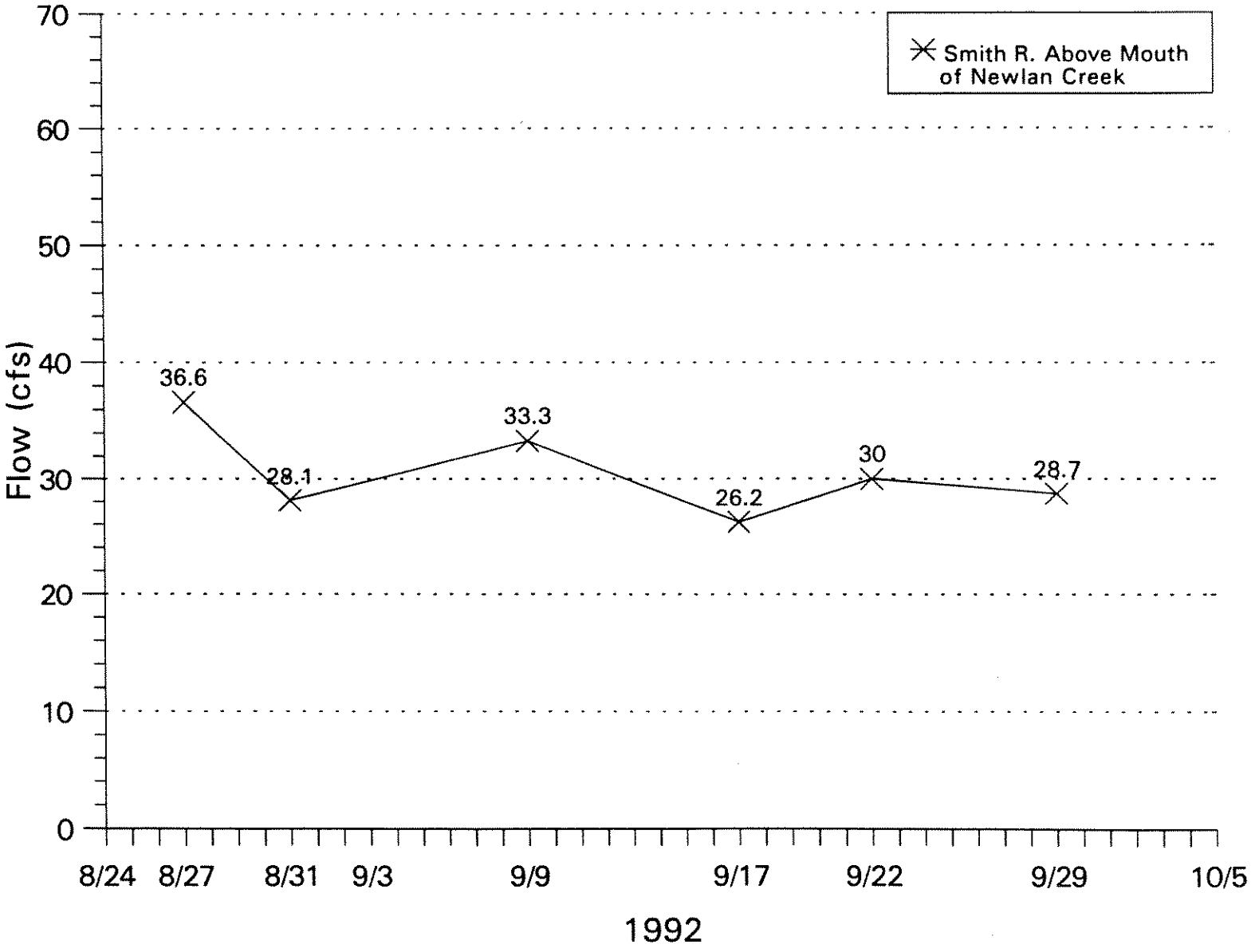


Figure 1. Flows in the Smith River above the mouth of Newlan Creek.

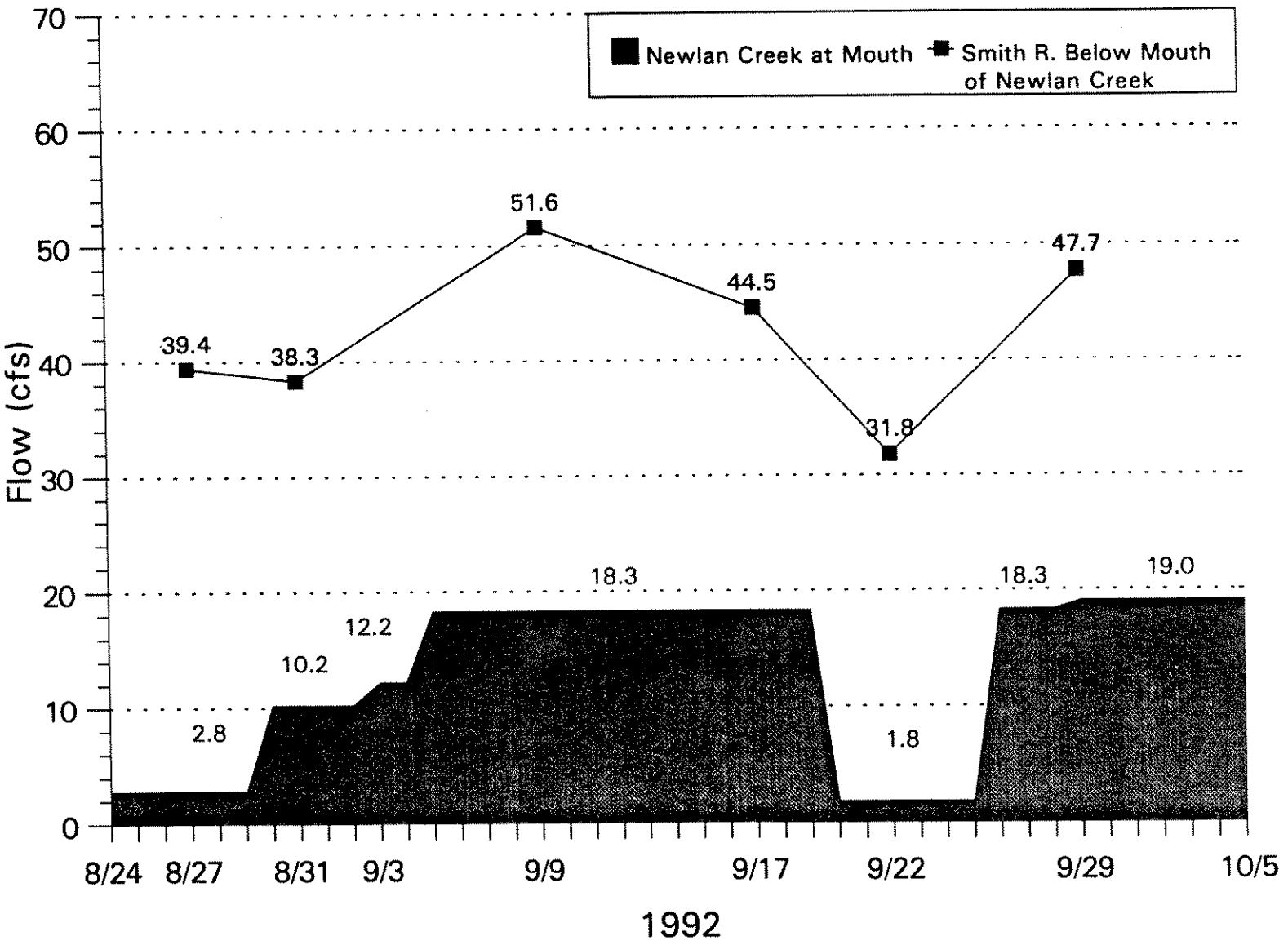


Figure 2. Flows in the Smith River below the mouth of Newlan Creek compared to the flows in Newlan Creek at its mouth.

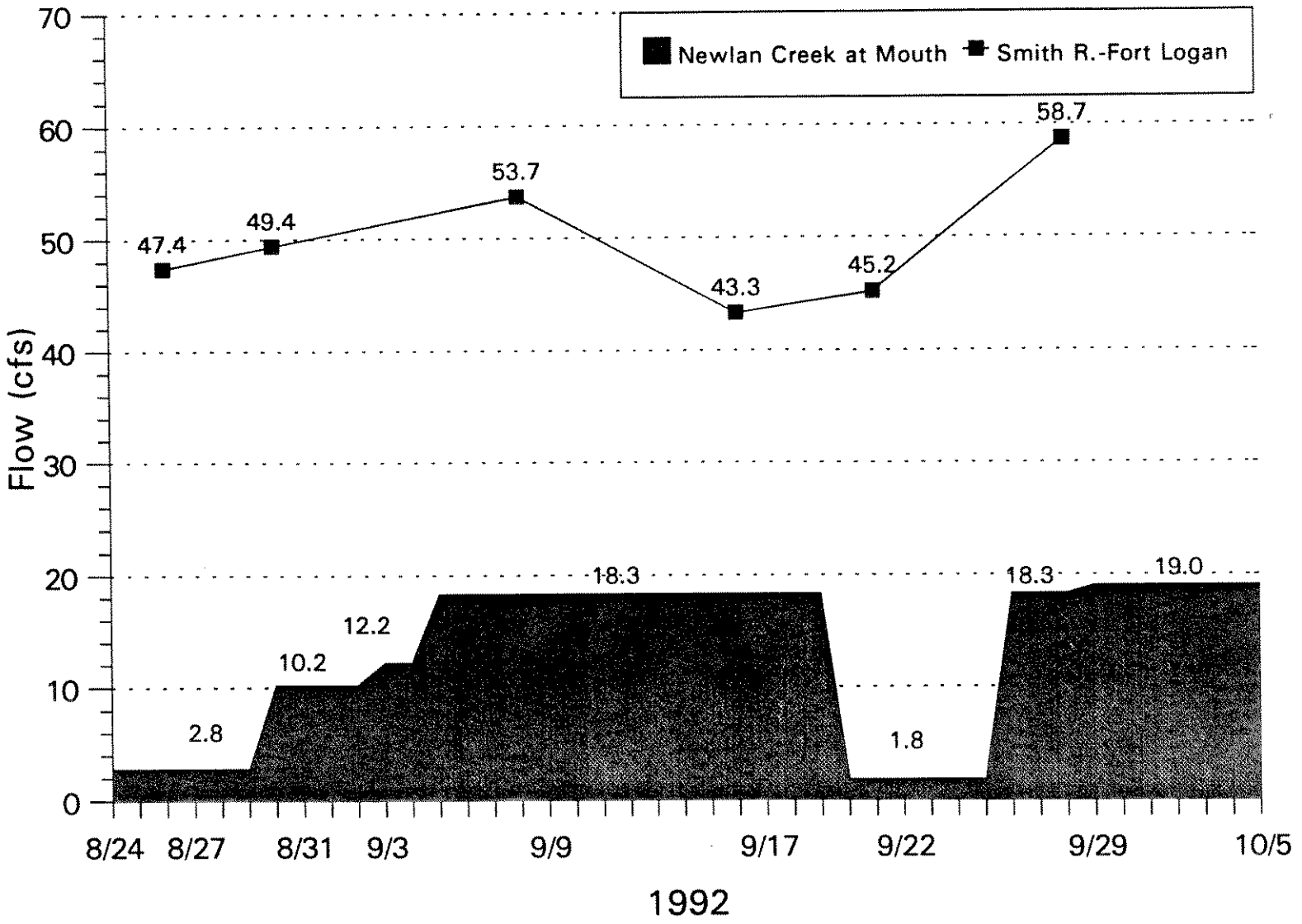


Figure 3. Flows in the Smith River at the Fort Logan Bridge compared to the flows in Newlan Creek at its mouth. For this comparison, Smith River flows were moved back in time by one day.

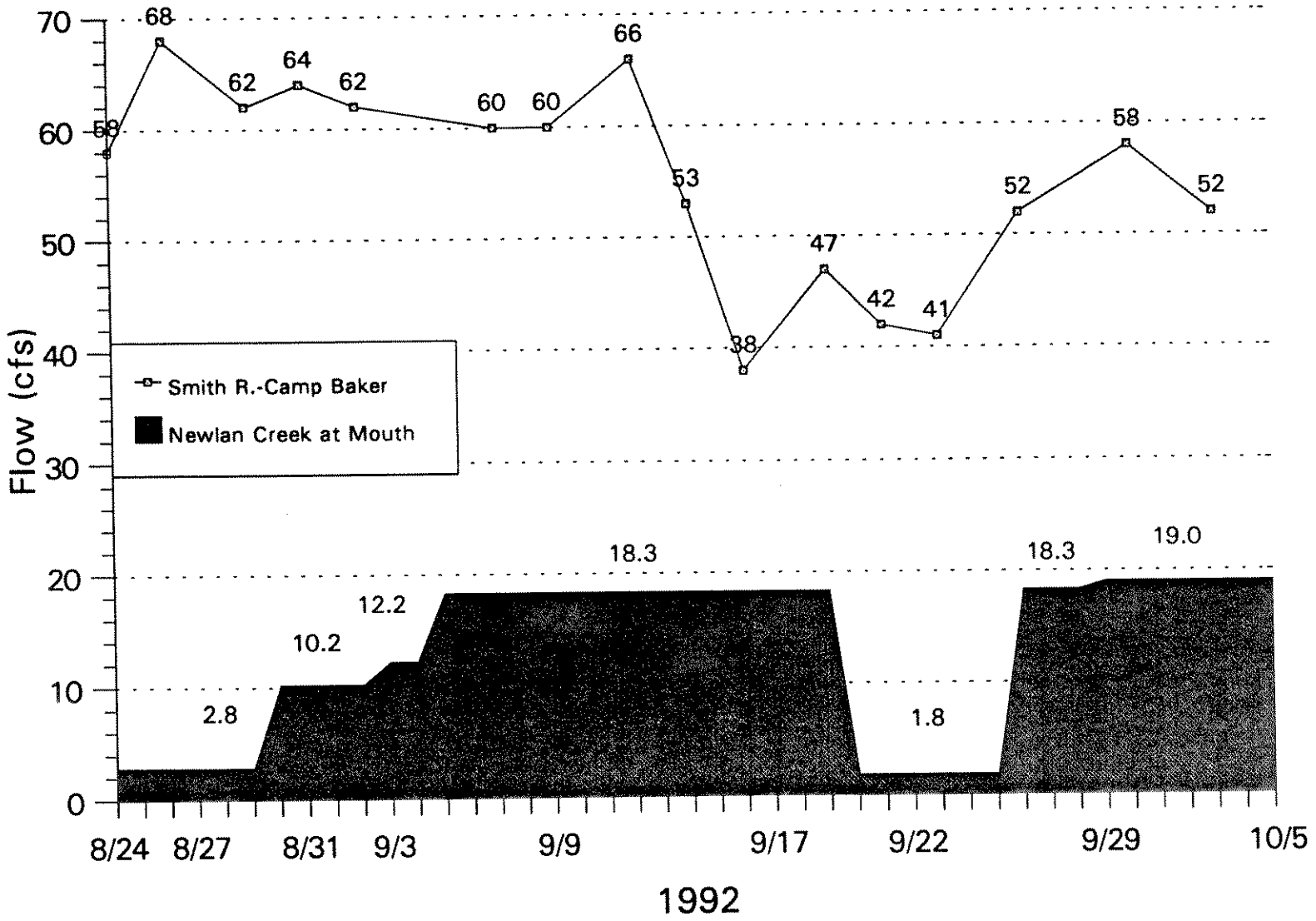


Figure 4. Flows in the Smith River at Camp Baker compared to the flows in Newlan Creek at its mouth. For this comparison, Smith River flows were moved back in time by two days.

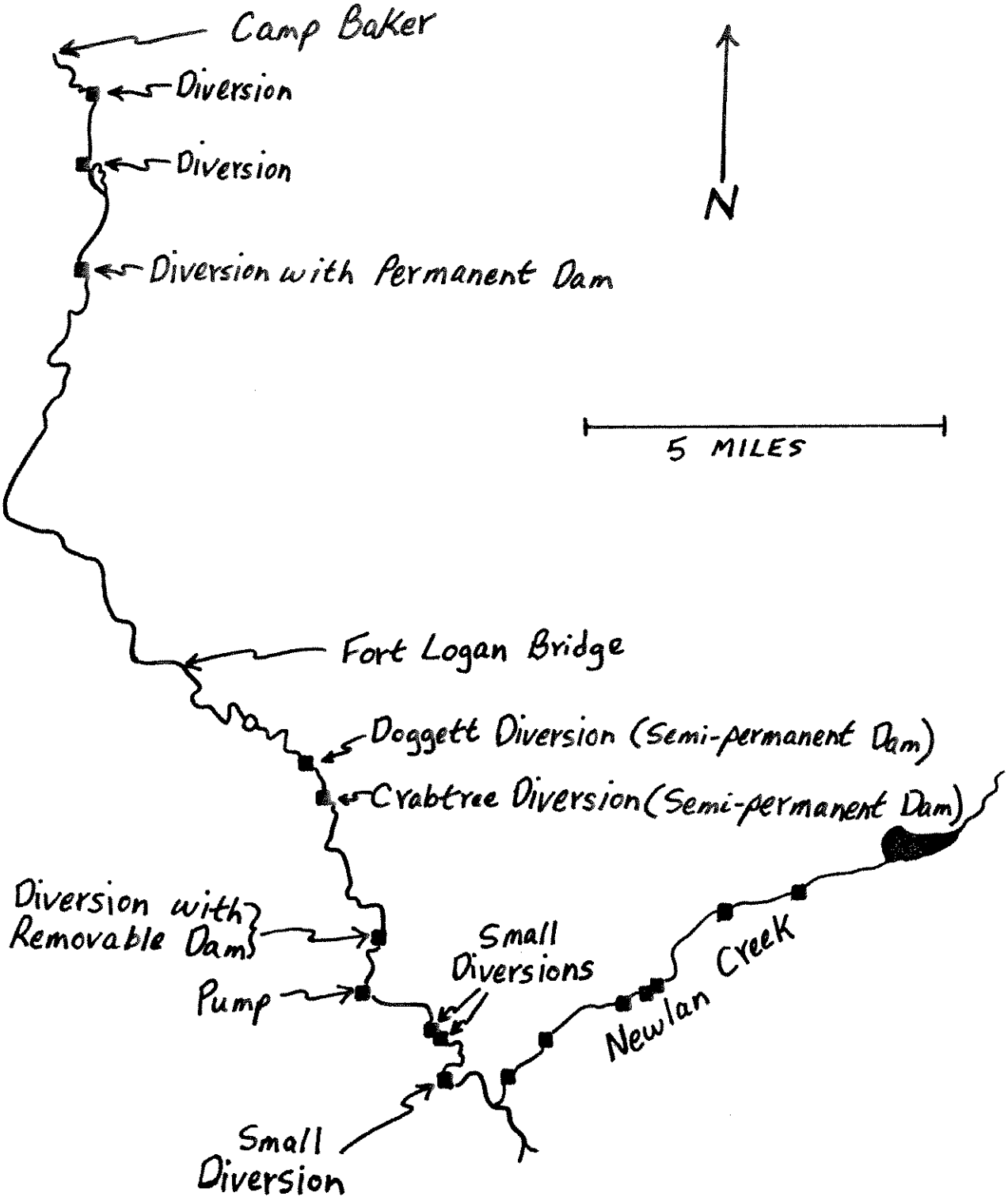


Figure 5. Map of Smith River (Camp Baker-Newlan Creek mouth) and Newlan Creek showing locations of irrigation diversions.