WYOMING GAME AND FISH DEPARTMENT

FISH DIVISION

ADMINISTRATIVE REPORT

TITLE: LaBarge Creek Instream Flow Report

PROJECT: IF-4090-07-8805

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INTRODUCTION

Studies were conducted to obtain instream flow information from a segment of LaBarge Creek northwest of LaBarge, Wyoming. These studies were designed to provide the basis for determining instream flows which would maintain or improve the existing fishery in the candidate section of LaBarge Creek. Results of these studies apply to the stream segment extending upstream from the U.S. Forest Service boundary in Section 1, Range 116 West, Township 27 North, to the confluence of LaBarge Creek and Turkey Creek in Section 24, Range 116 West, Township 28 North. This stream section is 3.3 miles long.

This section of LaBarge Creek is designated by the Wyoming Game and Fish Department (WGFD) as a Class 3 trout stream. Class 3 streams generally support regionally important fisheries. The stream is managed under the basic yield concept for rainbow trout and is stocked with rainbow trout during spring and summer months. Some recruitment from tributary streams also contributes to the fishery during the same time period. Other species present include brook trout, brown trout, cutthroat trout and mountain whitefish. This section of LaBarge Creek provides significant recreational fisheries opportunities for both resident and non-resident anglers (R. Remmick, WGFD, personal communication), and is highly accessible through public lands. For these reasons, this segment of the stream is considered a critical segment.

The management goal of the WGFD is to maintain or improve the existing stream fishery in LaBarge Creek. Three time periods are considered critical for realizing this goal. October 1 to March 31 is considered critical because this is a time period when low flows can cause degradation of hydraulic characteristics necessary for trout survival, fish passage and aquatic insect production. April 1 to June 30 is a critical period for maintaining physical habitat for juvenile rainbow trout; and from July 1 to September 30 it is critical to maintain flows adequate for adult trout production.

To address the management goal, objectives of this study were to determine instream flows necessary to 1) maintain or improve winter hydraulic characteristics for trout survival, fish passage and aquatic insect production, 2) maintain physical habitat for juvenile rainbow trout, and 3) maintain or improve adult trout production during the late summer months.

METHODS

Data for these studies were collected from a site located approximately 1/4 mile below the confluence of LaBarge and Turkey Creeks, in Section 24, Range 116 West, Township 28 North (Figure 1). These studies were conducted between June and August 1988 within a 483 foot long study site that contained trout habitat typical of that found throughout the candidate section of LaBarge Creek. Data were collected after peak runoff from a range of discharge rates (Table 1).

Table 1. Dates and discharge rates when instream flow data were collected from LaBarge Creek during 1988.

Date	Discharge Cubic Feet Per Second (cfs)
06-10-88	142
07-02-88	54
08-28-88	22

The Habitat Retention method (Nehring 1979, Annear and Conder 1984) was used to identify a maintenance flow. A maintenance flow is defined as a continuous flow needed to maintain minimum hydraulic criteria at riffle areas in a stream segment. Based on the extensive research of Annear and Conder (1984), the maintenance flow is further defined as the discharge at which two of three hydraulic criteria are met for all riffles in the study area (Table 2). Meeting these criteria provides passage for all life stages of trout between different habitat types and maintains survival of trout and aquatic macroinvertebrates at all times of year.

Data were collected from transects placed across three riffles within the study area and analyzed using the IFG-1 computer program (Milhous 1978). Instream flow recommendations derived from this method are applicable throughout the year except when higher instream flows are required to meet other fishery management purposes.

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

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

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

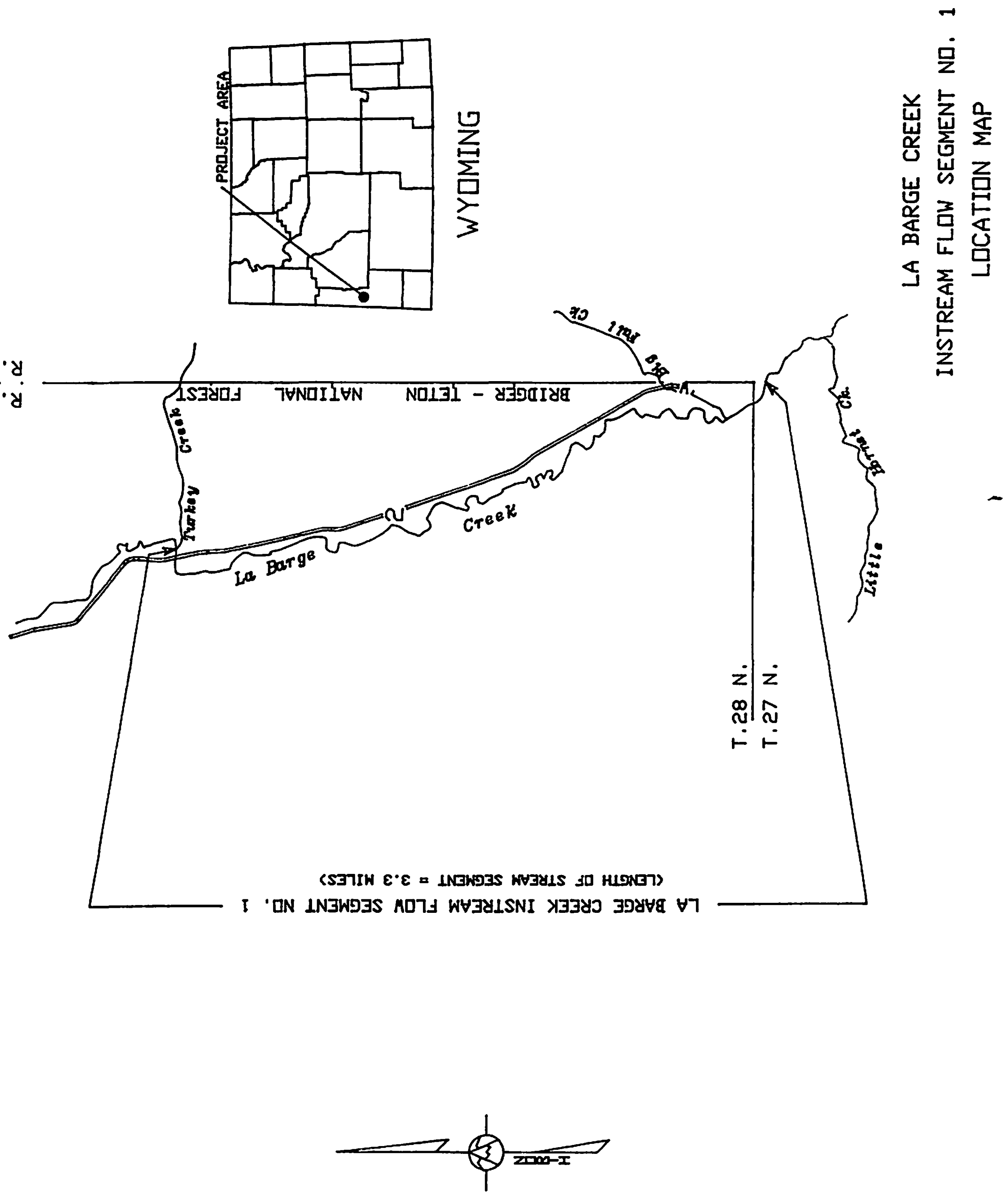

Figure 1. Location of Instream Flow filing reach on LaBarge Creek.

A physical habitat simulation model (PHABSIM) developed by the Instream Flow Service Group of the U.S. Fish and Wildlife Service (Bovee and Milhous 1978) was used to examine incremental changes in the amount of physical habitat available for rainbow trout juveniles at various discharge rates. This model is generally regarded as state-of-the-art technology and is the most commonly used method in North America for quantifying changes in physical habitat with changes in discharge (Reiser et al. 1989).

The amount of physical habitat available at a given discharge is expressed in terms of weighted usable area (WUA) and reflects the composite suitability of depth, velocity and substrate at a given flow. Depth, velocity and substrate data were collected from seven transects in accordance with guidelines given by Bovee and Milhous (1978).

In order to perpetuate this fishery, it is important to maintain suitable habitat for juveniles that are stocked into LaBarge Creek by the WGFD or that recruit naturally to LaBarge Creek as tributary flows drop during the summer. Maintenance of suitable physical habitat for this life stage is a critical part of ensuring adequate recruitment to this fishery. The WUA for rainbow trout juveniles was simulated for flows ranging from 5 to 200 cfs using calibration and modeling techniques outlined in Milhous (1984) and Milhous et al. (1984).

Physical habitat for adult rainbow trout was considered adequate for their survival at flows recommended for juveniles. Simulation of physical habitat for spawning was not done because very little spawning habitat was found within the instream flow segment.

The Habitat Quality Index (HQI) developed by the Wyoming Game and Fish Department (Binns and Eiserman 1979) was used to estimate potential changes in trout production over a range of late summer flow conditions. The model incorporates seven attributes that address chemical, physical and biological components of trout habitat. Results are expressed in habitat units (HU), with one HU defined as the amount of habitat quality which will support 1 pound of trout. This model was developed by the WGFD after several years of testing and model refinement. The HQI has been reliably used on many Wyoming streams to assess habitat unit gains or losses associated with projects that modify instream flow regimes.

By measuring habitat attributes at various flow events as if associated habitat features were typical of late summer flow conditions (Conder and Annear 1987), HU estimates were made for hypothetical summer flows ranging from 5 to 125 cfs. To better define the potential impact of these other late summer flow levels on trout production, some attributes were derived mathematically for flows other than those which were measured. Results of the HQI model apply to the time of year that determines trout production. For LaBarge Creek this period is from July 1 to September 30.

RESULTS AND DISCUSSION

The Habitat Retention method was developed to identify a flow that would maintain existing survival rates of trout, provide passage for trout between different habitat types in streams, and maintain survival rates of aquatic insects in riffle areas. Maintenance of these features is important year round except when higher flows are needed at specific times to meet other requirements.

Results from the Habitat Retention model showed that flows of 17, 3 and 15 cfs are necessary to maintain aquatic insect production and fish passage at riffles 1, 2 and 3 respectively (Table 3). The maintenance flow derived from this method is defined as the flow at which two of the three hydraulic criteria are met for all riffles in the study site. Based on this criteria, the maintenance flow for this segment of LaBarge Creek is 17 cfs.

Table 3. Results from IFG-1 modeling at the LaBarge Creek study site.

Discharge (cfs)	Average Depth (ft)	Average Velocity (ft/sec)	Wetted Perimeter
		Riffle 1	
3.6	0.19	1.00[1]	18.8
6.7	0.25	1.18	22.5
10.8	0.30	1.33	26.7
16.8[2]	0.36[1]	1.47	31.4
21.9	0.43	1.58	32.2
30.6	0.53	1.75	33.0
39.9	0.62	1.92	33.6
54.3	0.74	2.16	34.4
77.2	0.88	2.48	35.5
87.7	0.94	2.61	35.8
110.1	1.06	2.88	36.6
141.6	1.19	3.21	37.4
248.4	1.29	4.01	48.5[1]
567.4	1.44	4.86	80.8
		Riffle 2	
0.7	0.11	1.00[1]	5.1
2.6	0.22[1]	1.06	8.9
3.5	0.27	1.24	10.6
8.0	0.41	1.54	12.7
14.9	0.54	1.91	14.7
23.3	0.65	2.22	16.7
36.8	0.82	2.59	18.0
49.0	0.92	2.87	19.5
71.1	1.04	3.26	22.0
93.5	1.14	3.56	24.1
119.5	1.11	3.82	29.5
133.2	1.14	3.91	31.2[1]
201.6	1.32	4.25	37.5
310.1	1.50	4.59	47.1
567.4	2.21	5.17	52.0

Table 3. (continued)

Discharge (cfs)	Average Depth (ft)	Average Velocity (ft/sec)	Wetted Perimeter
		Riffle 3	
0.9	0.14	0.30	22.9
2.4	0.20	0.42	28.8
3.9	0.25	0.51	30.5[1]
5.1	0.28	0.58	31.8
9.2	0.37	0.77	33.2
15.3[2]	0.42	1.00[1]	37.3
17.4	0.44[1]	1.05	37.8
22.7	0.49	1.21	39.2
34.9	0.57	1.50	41.5
51.0	0.66	1.84	42.6
87.7	0.81	2.47	44.8
145 6	0.95	3.28	48.0
231.2	1.15	4.26	48.8
340.6	1.33	5.33	49.5
567.4	1.60	7.21	50.8

1 - Hydraulic criteria from Table 2 met
2 - Flow meets two of three criteria for individual transect

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

Causes of winter mortality discussed above are all greatly influenced by the quantity of winter flow in terms of its ability to minimize anchor ice formation (increased velocity and temperature loading) and dilute and prevent snow bank collapses and ice dam formation respectively. Because any reduction of natural winter stream flows would increase trout mortality and effectively reduce the number of fish that the stream could support, maintenance of natural flows is considered critical. As a consequence, the fishery management objective for the time period from October 1 to March 31 is to protect all available natural stream flows in the instream flow segment up to the maintenance flow. For LaBarge Creek, the maintenance flow is 17 cfs.

Stream flow data are unavailable for this section of LaBarge Creek and it is possible that the discharge of 17 cfs identified by the Habitat Retention method may not be present at times during the winter. Because the existing fishery is adapted to natural flow patterns, occasional periods of shortfall during the winter do not

imply the need for storage. Instead, they illustrate the need to maintain all natural winter streamflows, up to 17 cfs, in order to maintain existing survival rates of trout populations.

Results from the PHABSIM analysis show that a flow of 25 cfs will maintain 99% of the physical habitat for rainbow trout juveniles but at lower flows, physical habitat is reduced (Figure 2). A flow of 20 cfs will maintain 95% of the physical habitat and at 15 cfs about 90% of the physical habitat is maintained. Reductions in physical habitat are rapid below 15 cfs. Under natural conditions, flows are often in excess of 25 cfs from April 1 to July 31. When this occurs, physical habitat for juvenile rainbow trout will be less than optimum, especially when flows exceed 50 cfs.

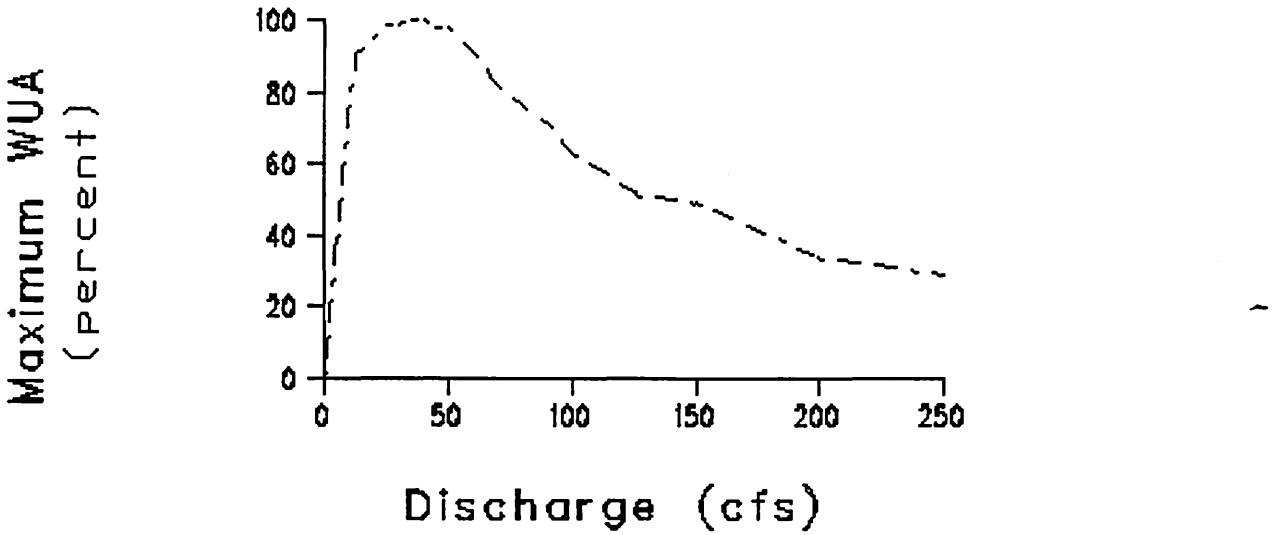

Figure 2. Percent of maximum weighted usable area (MUA) for rainbow trout juveniles at the LaBarge Creek study site as a function of discharge.

Because the existing fishery is maintained by juvenile trout stocked by the WGFD or that drift into LaBarge Creek from tributaries, it is important to maintain or improve physical habitat for juvenile rainbow. Instream flow recommendations were developed for the time of year when juveniles are stocked or recruit to the instream flow segment. This time period was defined as the period from April 1 to June 30. The current fishery management objectives for this section of LaBarge Creek are to maintain or improve physical habitat for juvenile rainbow trout and meet or exceed the hydraulic criteria addressed by the Habitat Retention method. In this situation, a flow of 25 cfs is the minimum amount necessary to accomplish these objectives.

Results from the HQI model indicate that under existing average late summer conditions, this segment of LaBarge Creek supports approximately 55 trout Habitat Units per acre (Figure 3). A flow of 25 cfs is the minimum flow that will maintain this existing level of HU's. At lower flows, trout habitat units would be reduced by approximately 15% or more. Fishery management objectives for the late summer are to

maintain the existing number of habitat units, and meet or exceed the hydraulic criteria addressed by the Habitat Retention method. A flow of 25 cfs is the minimum streamflow which will accomplish these objectives for the period from July 1 through September 30.

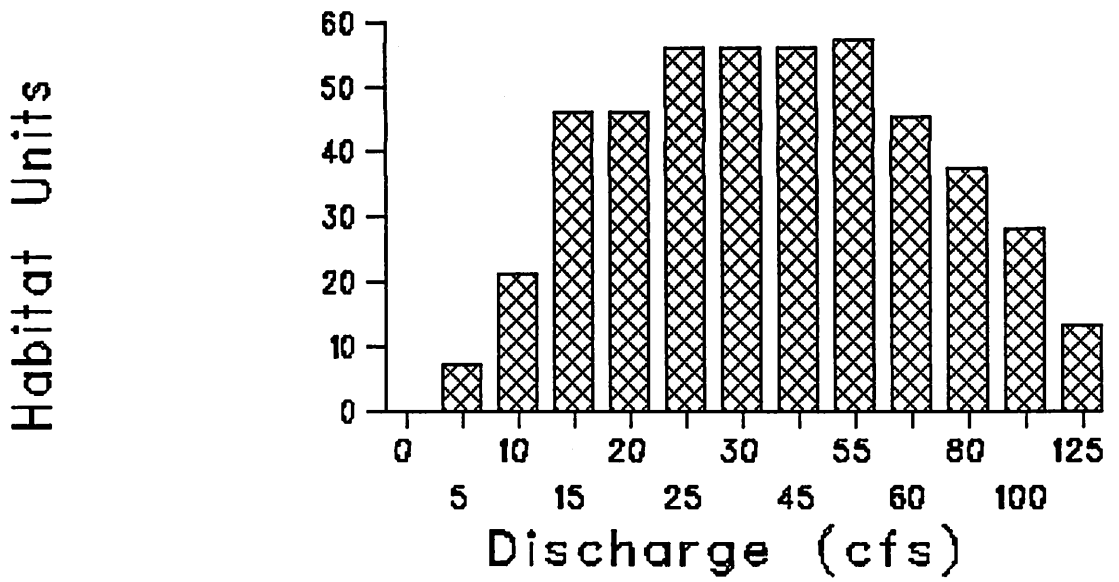

Figure 3. Adult trout habitat units (HU) as a function of discharge at the LaBarge Creek study site.

SUMMARY

The instream flow regime in Table 4 is based on results from the Habitat Retention, HQI and PHABSIM models, and displays the minimum stream flows needed to maintain or improve existing trout production levels in a section of LaBarge Creek at critical times of year. This stream section extends for a distance of 3.3 miles; from the U.S. Forest Service boundary in Section 1, Range 116 West, Township 27 North, upstream to the confluence of LaBarge Creek and Turkey Creek in Section 24, Range 116 West, Township 28 North.

Table 4. Summary of instream flow recommendations for LaBarge Creek northwest of LaBarge.

Time Period	Instream Flow Recommendation (cfs)
October 1 to March 31	17*
April 1 to June 30	25
July 1 to September 30	25

* - To maintain existing natural flows

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