Methow River Basin Fish Habitat analysis Using the Instream Flow Incremental Methodology

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Department of Ecology

Methow River Basin
Fish Habitat Analysis Using the
Instream Flow Incremental Methodology

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ABSTRACT

The Washington State Department of Ecology (Ecology), Water Resources Program studied the relationship between fish habitat and stream flow in the Methow River basin using the Instream Flow Incremental Methodology (IFIM).

Measurement sites included four sites on the Methow River, involving 32 transects, to represent 60 miles of the Methow River. Three study sites, involving 20 transects, were chosen to represent the lower miles of the Twisp River, Chewuch River, and Early Winters Creek.

Fish habitat is defined in this study as water depth, velocity, substrate, and cover. Habitat measurements encompassed three to four different flows for each of the seven study sites.

At the Walsh Site on the Methow River (River Mile (RM) 31.5) the highest quantity of fish habitat occurs at a flow of 1000 cubic feet per second (cfs) for spawning steelhead, at 1050 cfs for spawning chinook, at 1050 cfs for juvenile steelhead rearing, at 600 cfs for juvenile chinook rearing, at 1400 cfs for juvenile bull trout rearing, and at 2000 cfs for adult holding chinook.

At the KOA Site on the Methow River (RM 49) the highest quantity of fish habitat occurs at a flow of 800 cfs for spawning steelhead, at 650 cfs for spawning chinook, at 650 cfs for juvenile steelhead rearing, at 200 cfs for juvenile chinook rearing, at 1000 cfs for juvenile bull trout rearing, and at 1300 cfs for adult holding chinook.

At the Weeman Site on the Methow River (RM 59) the highest quantity of fish habitat occurs at a flow of 650 cfs for spawning steelhead, at 600 cfs for spawning chinook, at 350 cfs for spawning bull trout, at 425 cfs for juvenile steelhead rearing, at 85 cfs for juvenile chinook rearing, at 700 cfs for juvenile bull trout rearing, and at 800 cfs for adult holding chinook.

At the Chokecherry Site on the Methow River (RM 66.5) the highest quantity of fish habitat occurs at a flow of 500 cfs for spawning steelhead, at a flow of 400 cfs for spawning chinook, at 75 cfs for spawning bull trout, at 500 cfs for juvenile steelhead rearing, at 250 cfs for juvenile chinook rearing, at 600 cfs for juvenile bull trout rearing, and at 850 cfs for adult holding chinook.

At the Twisp River (RM 1.8) the highest quantity of fish habitat occurs at a flow of 250 cfs for spawning steelhead, at 150 cfs for spawning chinook, at 50 cfs for spawning bull trout, at 200 cfs for juvenile steelhead rearing, at 80 cfs for juvenile chinook rearing, and at 225 cfs for juvenile bull trout rearing.

At the Chewuch River (RM 1.3) the highest quantity of fish habitat occurs at a flow of 425 cfs for spawning steelhead, at 275 cfs for spawning chinook, at 175 cfs for spawning bull trout, at 400 cfs for juvenile steelhead rearing, at 150 cfs for juvenile chinook rearing, and at 400 cfs for juvenile bull trout rearing.

At Early Winters Creek (RM 1-0) the highest quantity of fish habitat occurs at a flow of 475 cfs for spawning steelhead, at 325 cfs for spawning chinook, at 575+ cfs for spawning bull trout, at 150 cfs for juvenile steelhead rearing, at 50 cfs for juvenile chinook rearing, and at 175 cfs for juvenile bull trout rearing.

Future determination of a satisfactory minimum instream flow for a stream in the Methow River basin will employ choices as to the relative importance of the river reaches, fish species, and lifestages, and the peak weighted-usable- area (WUA) flows listed above. Different fish species and lifestages exist simultaneously in the river and each has a different flow requirement. Providing an optimum flow for one lifestage will usually result in habitat degradation for another lifestage.

In addition, minimum instream flows must include flows necessary for incubation of fish eggs, smolt out-migration, fish passage to spawning grounds, and prevention of stranding of fry and juveniles. Other variables which have to be considered include water temperature, water quality, and sediment load. The flows needed for these variables were not calculated in this study, but must be determined by knowledgable biologists.

No attempt was made in this report to derive a final optimum flow regime for the Methow River since a consensus on the effect of the environmental variables listed above on the river and fishery management objectives is needed from the state and federal resource agencies and the tribes.

ACKNOWLEDGEMENTS

We are very grateful for the enthusiastic, hard field work provided b Ann Butler, Maryrose Livingston, and Steve Hirschey of the Department of Ecology and from Ernie Buchanna of the Okanogan County Public Works Department.

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LIST OF ACRONYMS

Cfs	cubic feet per second
Ecology	Washington Department of Ecology
Fps	feet per second
HABTAT	Computer program that combines
IFG4	with habitat-use curves
IFG4	Instream Flow Group's hydraulic model
IFIM	Instream Flow Incremental Methodology
IRPP	Instream Resources Protection Program
PHABSIM	Physical Habitat Simulation computer model
RM	river mile
VAF	Velocity Adjustment Factor
WAC	Washington Administrative Code
WDF	Washington Department of Fisheries
WDW	Washington Department of Wildlife
WUA	Weighted Usable Area
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
YIN	Yakima Indian Nation
CCT	Colville Confederated Tribes

PROJECT BACKGROUND

Study Objectives

Since 1983, the Washington State Department of Ecology (Ecology) has conducted Instream Flow Incremental Methodology (IFIM) studies throughout Washington for use in determining minimum instream flows. This study serves two objectives:

1. To provide Ecology with instream flow information that can be used to review the minimum instream flows for the Methow basin adopted by Ecology in 1976 (See Appendix Q, and

2. To provide Ecology with instream flow information to determine the impact of new water right appropriations on fish habitat.

Participants

Project participants included the Washington State Department of Fisheries (WDF), Washington State Department of Wildlife (WDW), the Yakima Indian Nation (YIN), Colville Confederated Tribes (CCT), Okanogan County, and U.S. Fish and Wildlife Service (USFWS).

River Basin Description

The Methow River is located in north central Washington and drains southward for more than 80 miles through western Okanogan county before emptying into the Columbia River near the town of Pateros. Mean annual runoff per unit of watershed area decreases dramatically from 60 inches at the headwaters (elevation 6000 feet) to only one inch near Pateros (elevation 779 feet; Richardson, 1976).

About 85% of the Methow basin is national forest or wilderness and 15% is under private ownership.

From Pateros to Carlton (River Mile (RM) 0.0 to 27.2) most of the irrigated land is in fruit production. Between Carlton and Twisp (RM 27.2 to 40), land use is half orchards and half field crops. From Twisp to Early Winters Creek (RM 40 to 67.3), most of the irrigated lands are in alfalfa with some grain. See Table 1 for an index to the river miles.

Hydrology

The Methow River is fed by snow melt, rain, and ground water. High flows are mostly snowmelt and occur from mid-April until the end of July with a peak around the first of June. The Methow River experiences low streamflow from the end of August until the end of March. Upstream of Winthrop, low flows during winter can freeze solid down to the river bed in certain reaches, although substantial volumes of water continue to flow down valley underground.

Table 1. River Mile Index for the-Methow River

Methow River	River Mile
Mouth of Methow	0.0
Head of pool from Well's Dam	2.0
USGS gage at Pateros	6.7
Town of Methow	12.4
Gold Creek confluence	21.8
Carlton highway bridge	27.2
Walsh IFIM site	31.5
Twisp highway bridge	39.4
USGS gage at Twisp	40.0
Town of Twisp	40.0
Twisp River confluence	40.2
KOA IFIM site	49.0
Winthrop highway bridge	49.8
USGS gage at Winthrop	49.8
Town of Winthrop	50.0
Chewuch River confluence	50.1
Winthrop National Fish Hatchery	50.4
Wolf Creek confluence	52.8
Weeman IFIM site	59.0
Weeman bridge	59.7
USGS gage near Mazama	63.8
Mazama bridge	65.4
Chokecherry IFIM site	66.5
Early Winters Creek confluence	67.3
Gate Creek Campground	69.8
Lost River confluence	73.0
Robinson Creek confluence	74.0

Flows have been gaged by the United States Geological Survey (USGS) in the Methow basin for the last 33 years at Pateros (RM 6.7), for 43 years ending in 1962 at Twisp (RM 40), for 2 years (1912 and 1972) at Winthrop (RM 49.8), and for 4 years ending in 1979 on the Twisp River (RM 1.6). Sixteen years ago, Milhous, Sorlie, and Richardson (1976) recognized that the streamflow data available for Methow River upstream of Twisp (RM 40) were not adequate for standard statistical measures (means, statistical frequencies).

Ecology and USGS reactivated three gages, and installed two new gages in the basin. Flows have been measured daily by USGS on the Methow River at Pateros (RM 6.7) since April, 1959; at Twisp (RM 40) since April, 1991; at Winthrop (RM 49.8) since November, 1989; near Mazama (RM 63.8) since April, 1991; on the Twisp River (RM 1.6) since October, 1989; and on the Chewuch River since November 1991.

The hydrographs in figures 1 to 5 portray the exceedence-frequencies for 10- day intervals for USGS gages with adequate data. The plotted numbers are in tables in Appendix K5. Unfortunately, not enough data yet exists to synthesize hydrographs with any degree of reliability for Early Winters Creek or for the Methow River at Mazama.

The 50-percent-exceedence flow is the median flow and gives the closest approximation to the "normal" expected flow. The 90 percent exceedence flow is equaled or exceeded 90 percent of the time. This can be thought of as a 1- in-10-year low flow. These hydrographs are based on 10-day averages to eliminate some of the variation from using daily flows.

These hydrographs do not include water diverted for irrigation and used consumptively. The consumptive amount of the diversions would have to be added in to arrive at what was the original or natural flow. Most of the diversion quantities are discussed later in this document. Ten of the largest irrigation diversions were built between 1898 to 1914 and pre-date any flow measurements.

<u>Hydraulic Continuity Between Ground Water and Surface Water</u>

The following background information on the relationships between ground water and surface water was added to assist in reviewing the minimum instream flows in the Methow basin. These water relationships are complex because the surface water in the Methow River can disappear and reappear in different reaches as it flows downstream; the ground water can reverse its direction of flow as the water level drops in the Methow River; and it is uncertain as to where all the water goes when the irrigation diversions cease. Surface water measurements and well levels are discussed in the following paragraphs to provide up-to-date information as to how a minimum instream flow at a USGS gage relates to surface water upstream and downstream of the gage.

Sands and gravels deposited by past melted glaciers are the principal Methow Valley aquifer. Along the Methow River and its tributaries, these sands and gravels are so porous and permeable that a high degree of hydraulic continuity is virtually guaranteed as the ground water and surface water exchange rapidly under certain conditions (Peterson and Larson, 1991).

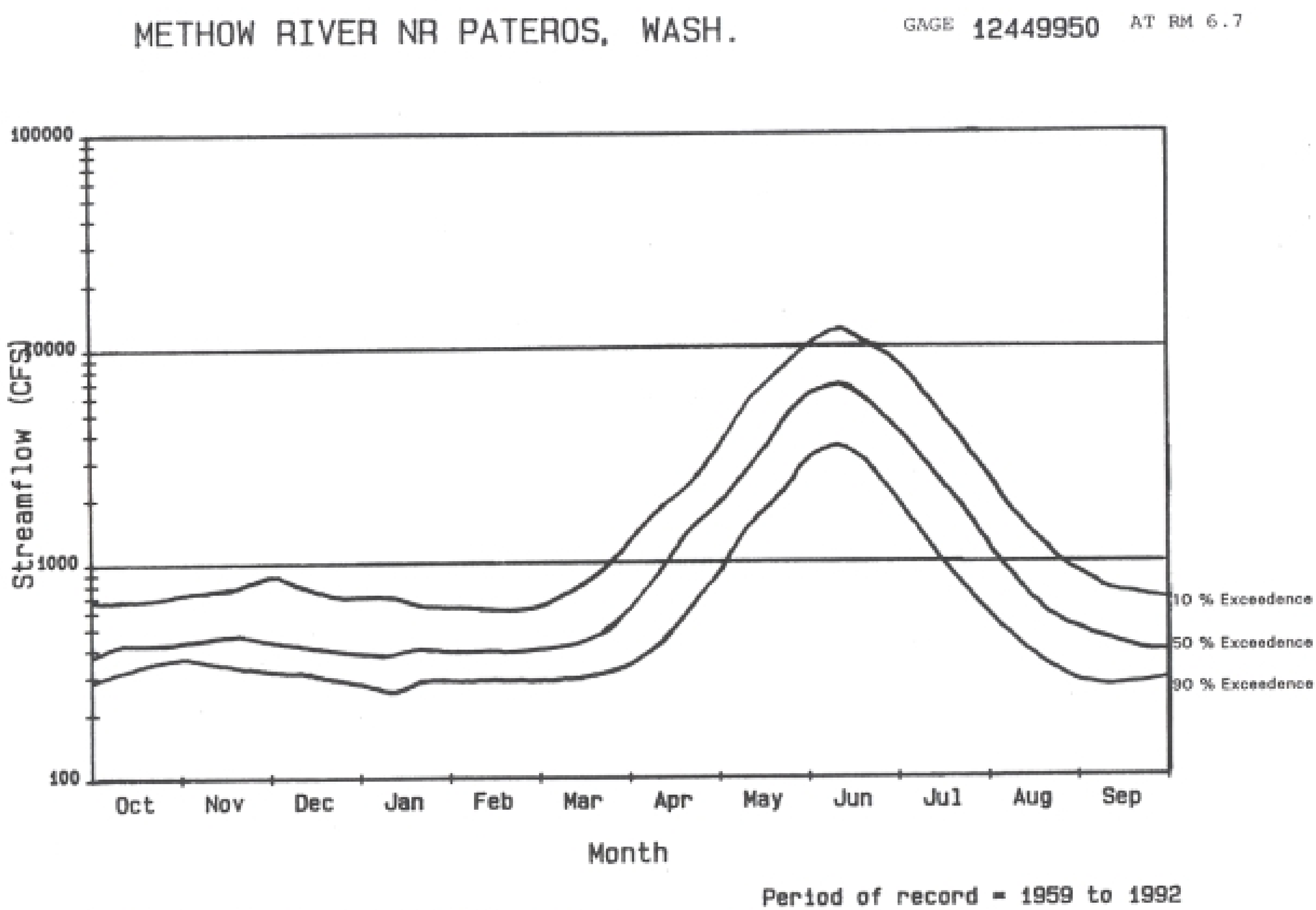


Figure 1. Exceedence-frequency hydrograph of the Methow River at Pateros.

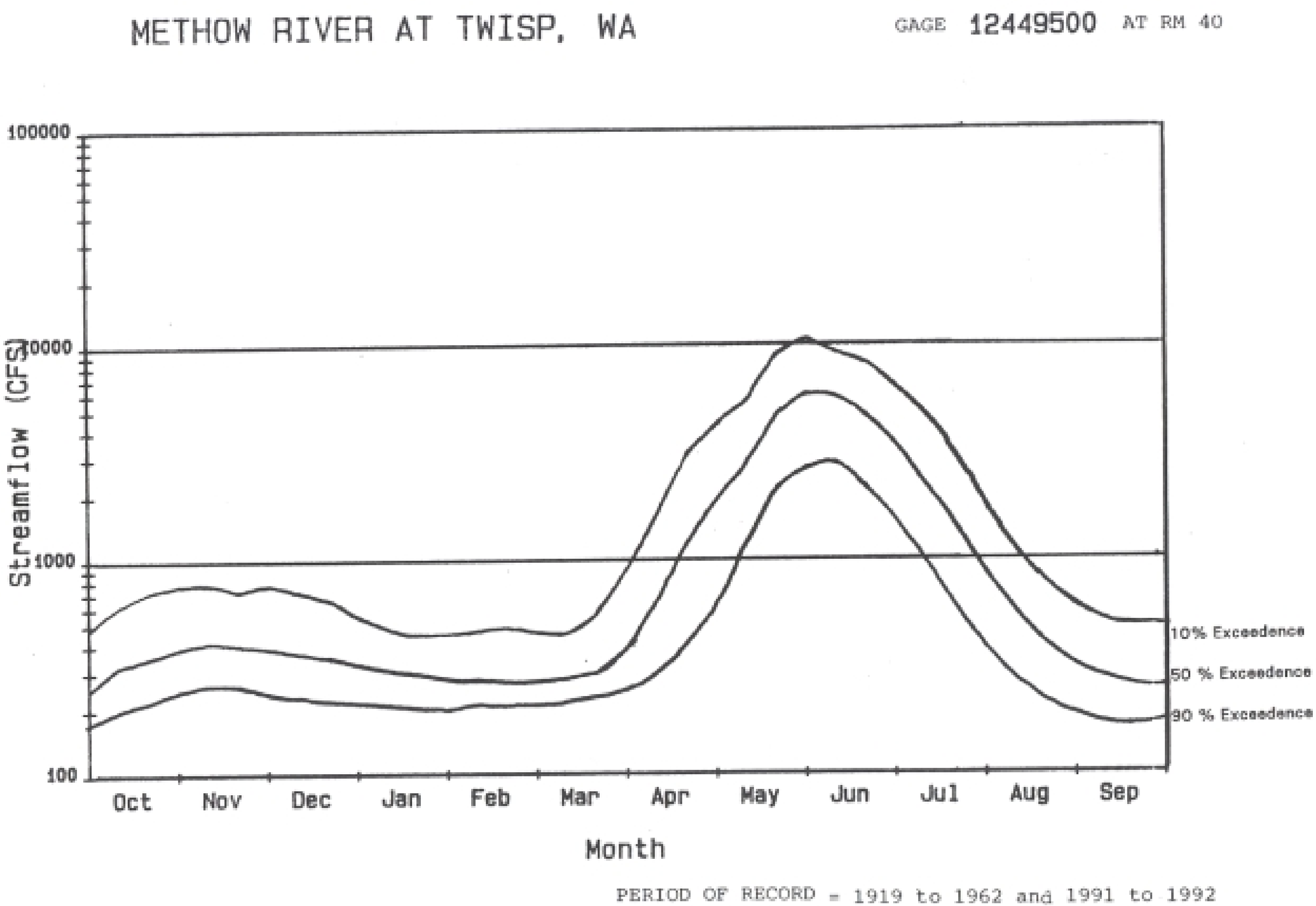
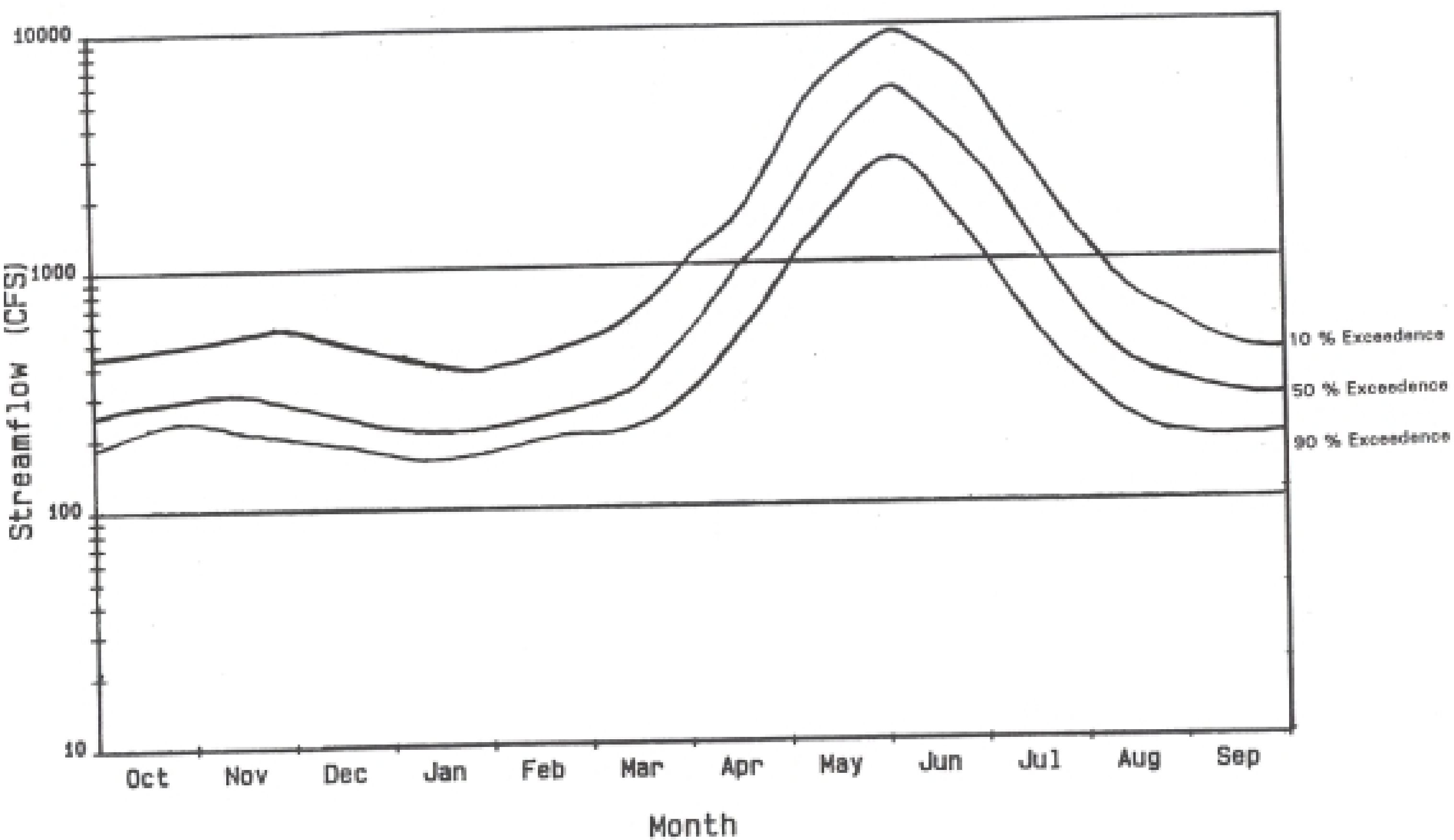


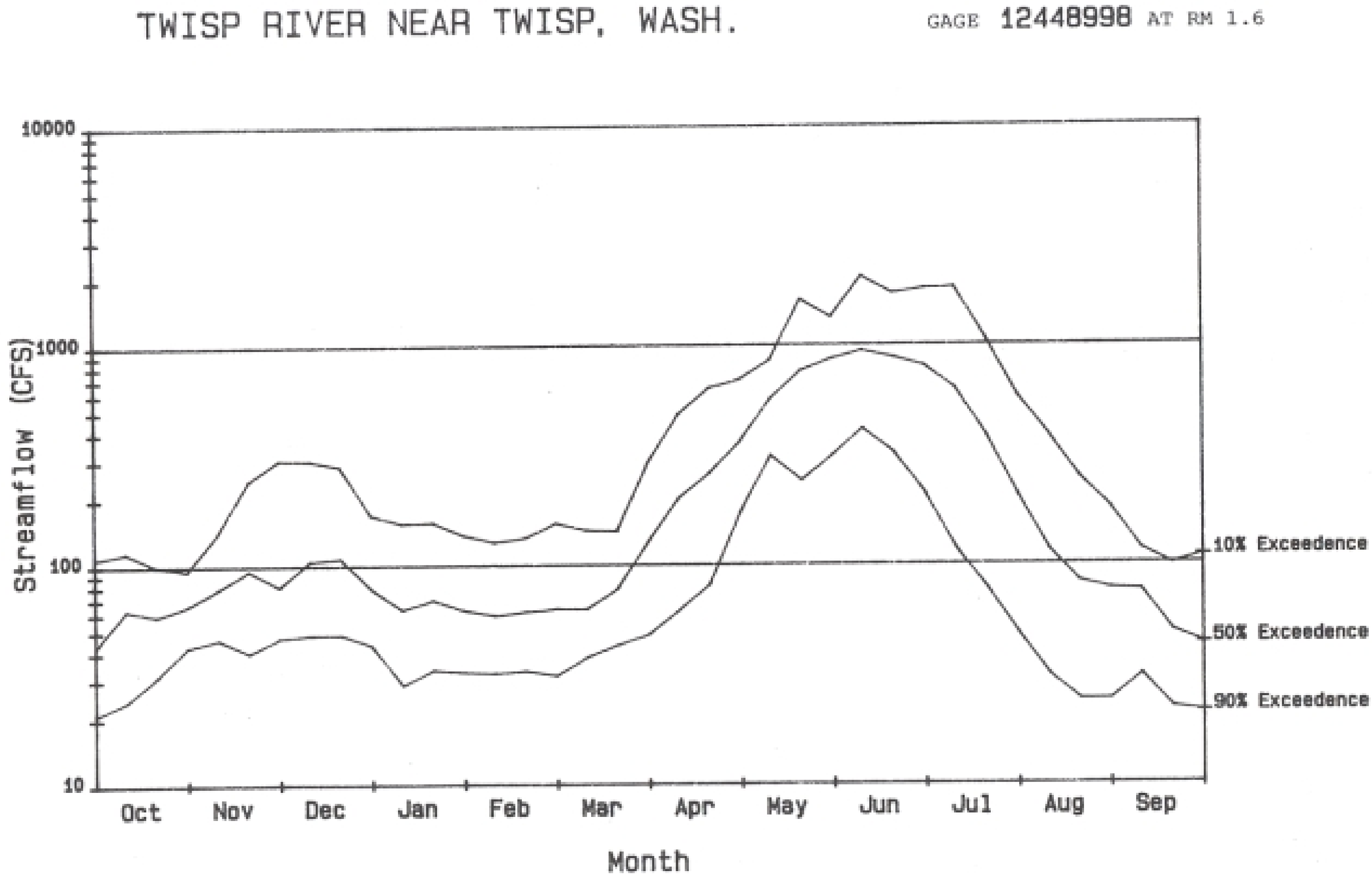
Figure 2. Exceedence-frequency hydrograph of the Methow River at Twisp.

METHOW RIVER AT WINTHROP, WASH. GAGE 12448500 AT RM 49.8



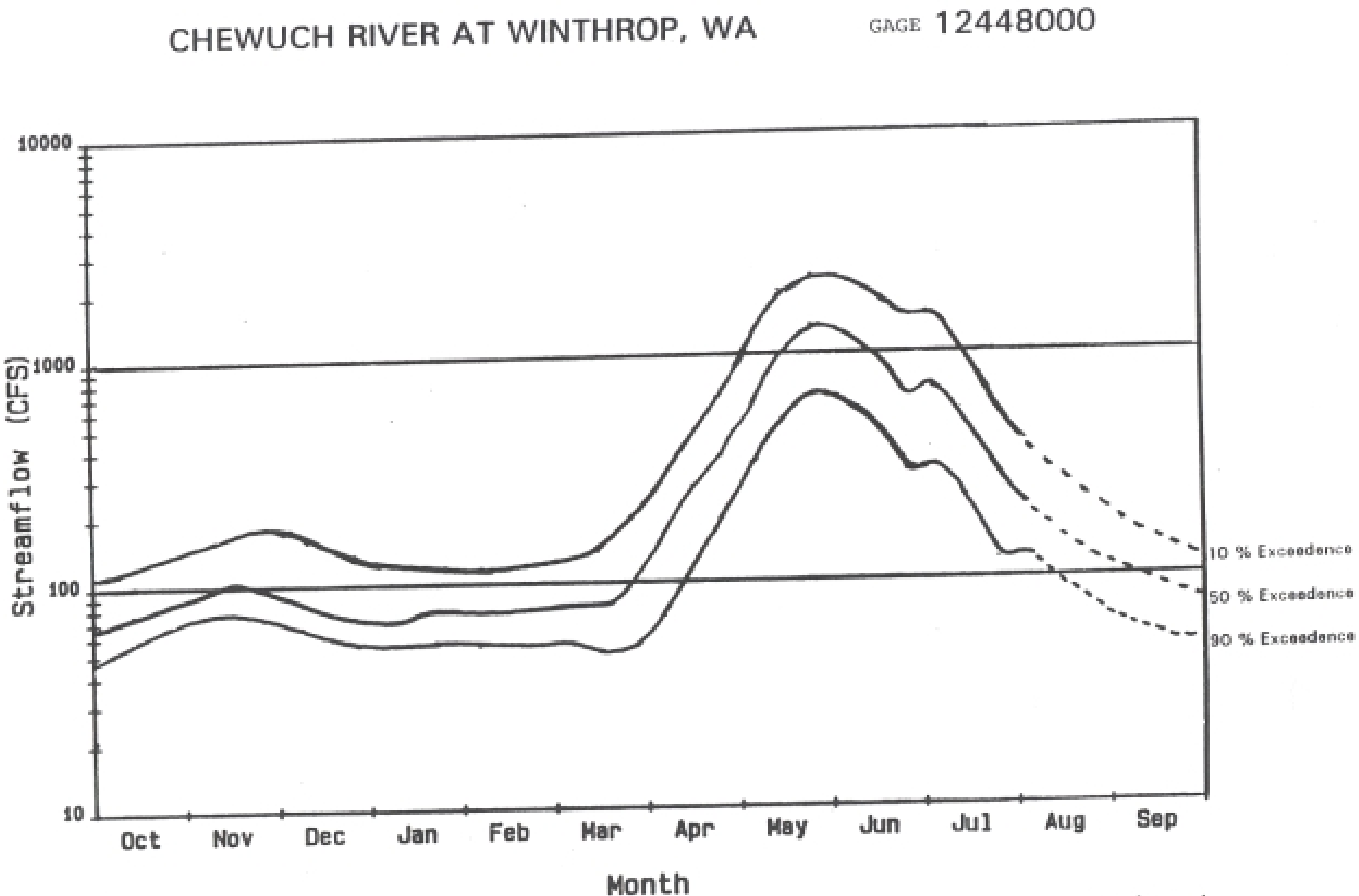
PERIOD OF RECORD = Synthesized from 33years of Pateros gage with Winthrop gage flows from 1991.

Figure 3. Exceedence-frequency hydrograph of the Methow River at Winthrop.



PERIOD OF RECORD = 1975 to 1979 and 1989 to 1992

Figure 4. Exceedence-frequency hydrograph of the Twisp River.



PERIOD OF RECORD = Synthesized from 33 years at Pateros gage with Chewuch gage flows from 1991 and 1992.

Figure 5. Exceedence-frequency hydrograph of the Chewuch River.

Snowmelt in the spring creates high flow levels in the Methow River which causes water levels in wells in the Early Winters area to rise 10 to 25 feet in a one to two week period (colder Associates, 1991).

This high degree of hydraulic continuity is also demonstrated when certain reaches of the mainstem Methow River upstream of the Weeman bridge (RM 59.7) go dry during drought years from August through October and freeze solid from December through February. This is because the upper level of the ground water aquifer is the same as the surface water level in the Methow River. If the water depth of the Methow River is one foot and the ground water aquifer drops one foot due to ',pumping of wells, then the Methow River is dry even though a large quantity of water is flowing downstream through the gravels under the bed of the Methow River.

A significant amount of Methow River surface flow goes into the ground water around the Lost River confluence (RM 73). However, this underground flow is channeled back onto the surface downstream between the Weeman and Winthrop bridges (RM 59.7 to 49.8). On August 25, 1988, the flow in the Methow River was 213 cfs at the Manama bridge (RM 65.4) and 218 cfs at the Winthrop bridge (RM 49.8): an increase of only 5 cfs. But 41 days later, the flow was 13 cfs at the Manama bridge and 190 cfs at the Winthrop bridge: an increase of 177 cfs (Kohn, 1988). This clearly showed how the surface flow at Manama could drop 200 cfs with a corresponding drop of only 28 cfs at Winthrop. ' The ground water at Manama became surface water by the time it reached Winthrop.

Dry River Reaches During the Fall in Drought Years

Identifying specific reaches that go dry is important in establishing minimum instream flows to ensure that fish eggs and juveniles are not dried up unknowingly. Dry reaches have been identified in the Methow Subbasin Plan, the tribal spawning surveys, and by Ecology.

Three reaches of the Methow River where the surface flow dries up during droughts have been identified in the Methow and Okanogan Rivers Subbasin Salmon and Steelhead Production Plan (WDF, YIN, CCT, and WDF, 1989). These dry riverbeds in the Methow Rive total 8 miles and include:

1) 1.5 miles from RM 60.7 to 62.2 (in between the Weeman bridge and the Manama bridge),
2) 5.5 miles from RM 67.5 to 73.0 (just upstream of Early Winters Creek up to the Lost River confluence),
3) 1.0 mile from RM 73.0 to 74.0 (from the confluence of the Lost River to the confluence of Robinson Creek).

Salmon spawning surveys by Kohn in 1987 for the YIN found dry riverbeds occurred in:

1) the Lost River from RM 7.1 to 11.7 (Monument Creek to Drake Creek),
2) the Twisp River at Poplar Flats campground (RM 23.4),
3) the mouth of Wolf Creek.

These reaches that go dry during low flow years in the Methow River basin expand in length during extreme drought years such as in 1987 and 1988. The Methow River was dry October 27, 1987, for 7.5 miles from the Manama bridge up to the Lost River confluence (RM 65.4 to 72.9) (Kohn, 1987). Only a hundred-yard reach below Early Winters Creek confluence had any water. Normally, fall rains cause the river to start rising around mid-October. However, when the Methow was surveyed downstream of the Manama bridge on November 12 Kohn found the river dry until about RM 62.6. In summary, the spawning surveys done in 1987 and 1988 indicted that the total dry reach on the Methow River in 1987 was from RM 62.6 to around RM 77.0 (assuming the four-mile reach upstream of Lost River confluence was dry as found 'in 1988) for a total of 14.4 miles with only a pool at RM 73 (Lost River confluence) and RM 67.3 (Early Winters Creek confluence).

During the drought of 1988 many parts of the Methow River in September went dry from RM 62.7 to RM 77.0 (Kohn, 1988). It is surprising that the Methow River only went dry downstream to RM 62.6 during the extreme droughts in 1987 and 1988 since the Methow River Subbasin Plan stated that the river goes dry down to RM 60.7 during low flow years.

No dry reaches in the Methow River and its tributaries were noted during the same extensive salmon spawning surveys in 1989 through 1991 (Kohn, 1989; Edson, 1990; Langness, 1990; and Meekin, 1991). However, these surveys failed to note the one reach on the Methow River that dried up: RM 69.8 to 68.3 (Gate Creek reach). This reach went dry in 1990 and 1991 contained some of the highest densities of spring Chinook juveniles and redds in the basin (See snorkeling observations in Appendix M). In 1990, Methow River flow measured at six gages from the Lost River confluence down to USGS' gage near Manama by Hosey and Associates showed that only downstream of Gate Creek from RM 69.8 to' 68.3 went dry from September 20 until October 5 in 1990. At the same time, flows at RM 63.8 (next to USGS gage) were as high as 34 cfs while the Gate Creek reach was dry. These flows by Hosey and Associates are in Appendix K1. Ecology's flow measurements in 1991 (Appendix K2) and Hosey's data in 1990 found that a reach of about 1.5 miles below Gate Creek was the only reach to go dry in the Methow River in the fall of 1990 and 1991.

The following Ecology and USGS numbers show how the flows upstream and downstream corresponded to the Gate Creek reach flows in the Methow River in 1991:

REACH		SEPTEMBER 26	OCTOBER 23
Lost River confluence	RM 73	60 cfs	40 cfs
Below Gate Creek	RM 69.7	5.5 cfs	0 cfs
USGS gage near Manama	RM 63.8	29 cfs	7.1cfs

The flows by Ecology are in Appendix K2 and the flows measured by USGS are in Appendix K3. 'If you assume the flow at the USGS gage near Manama would drop 5.5 cfs when the flow below Gate Creek drops 5.5 cfs, then the USGS gage near Manama would have read about 24 cfs when the Gate Creek reach went dry. This would have occurred on September 30 in 1991.

These Hosey and Ecology flow observations indicate that the Methow River reach downstream of Gate Creek at RM 69.7 will be dry when the USGS gage near Mazama at RM 63.8 reads around 24 to 34 cfs.

Dry Reaches and Icing During Winter in Drought Years

During 1991, the Methow River received no rain from mid-summer until November 12 except for a very light amount on October 14th and 28th. Because of sustained cold temperatures, precipitation fell only as snow after mid-November in the area upstream of Winthrop.

The USGS gage on the Methow River near Mazama at RM 63.8 indicated zero flow for the period from December 12, 1991 until February 15, 1992 (Appendix K3). To investigate whether the river was truly dry as indicated by the gage, we surveyed the Methow River on January 30, 1992. Two to three feet of snow covered the ground upstream of Winthrop. At the gage, we confirmed that the flow was indeed zero but also noted one foot of ice covering the streambed for at least 0.5 miles upstream and downstream. Also, we estimated flows at other locations on January 30, 1992, as follows:

REACH	FLOW
Weeman IFIM site RM 59.0	16 cfs with no ice
Weeman bridge RM 59.7	16 cfs with no ice
USGS gage near Mazama RM 63.8	0 cfs with one foot of ice
Mazama bridge RM 65.4	17 cfs with no ice
Gate Creek reach RM 69.7	0 cfs with ice
Lost River confluence RM 72.9	12 cfs with no ice
Lost River bridge RM 0.5	40 cfs with no ice

Summary of Timing and Location of River Reaches That Go Dry

During drought years, several reaches on the Methow River go dry in September/October and ice over in December/January/February. The reaches go dry in the following order: 1) downstream of Gate Creek (RM 69.7), 2) the Mazama gage reach (RM 63.8), 3) the reach upstream of the Lost River confluence (RM 73.1), and 4) the reach upstream of Gate Creek (RM 70.8).

Quantifying Total Irrigation Diversions

The number of diversions and quantity of water diverted in the Methow basin is not known for certain. However, three estimates of irrigation diversions have been compiled and are similar: 248, 201, and 215 cfs.

The Pacific Northwest River Basin Commission (1977) estimated that in 1971 irrigators diverted 5.8 cfs from Gold and Libby Creeks, an unknown amount from Beaver Creek, 61.5 cfs from four ditches from the Twisp River and from one ditch from the nearby Methow River (around RM 40), 93.8 cfs from six ditches on the Methow River above Winthrop (RM 50), and 87.1 cfs from the Chewuch

River. These diversions from the Methow River and its tributaries total 248.2 cfs.

Willms and Kendra (1990) estimated that recorded surface water rights for diversions from the Methow River along the reach from Pateros to Carlton (RM 0 to 27.2) amount to 67 cfs. Between Carlton and Twisp (RM 27.2 to 40) water rights for diversions total 11 cfs with an additional 60 cfs diverted by the Methow Valley Irrigation District (MVID) from the Methow and Twisp Rivers above Twisp. From Twisp to Winthrop (RM 40 to 50) water rights for irrigation diversions (excluding MVID) amount to 63 cfs. These diversions from the Methow River total 201 cfs.

Larson and Peterson (1991) measured flows in 18 of the largest irrigation ditches in the Methow basin (Appendix K4). These flows were measured downstream of the fish screens and did not include excess ditch water diverted back to the river. These ditches probably contained at least 90$ of the total quantity of water diverted by irrigation diversions in the Methow River basin. Miscellaneous information gathered on another 26 irrigation diversions in the basin revealed that their total cfs diverted was small compared to the 18 diversions measured in 1991. These measurements revealed that from July through October irrigation diversions from ditches decreased as the river levels decreased except for the MVID canal. Irrigation diversions on August 27-29 were: 68 cfs from the MVID (30 cfs from the Twisp River and 38 cfs from the Methow River at RM 44.8), 12.2 cfs from three ditches on the Twisp River, 44.3 cfs from five ditches on the Methow River from RM 48.3 to 61.4, 75.6 cfs from four ditches on the Chewuch River, and 15.1 cfs from two ditches on Early Winters Creek. Two other ditches were dry. These diversions total 215.2 cfs.

The following list shows how total irrigation diversions in 1991 changed month-by-month in the Methow River basin in the 18 measured ditches:

DATE	TOTAL OF IRRIGATION DIVERSIONS
July 18-19	222 cfs
August 27-29	215 cfs
September 24-27	174 cfs
October 22-24	12 cfs

Relationship of Irrigation Canal Flows to the Methow River

These flow relationships are unknown, but the 1991 USGS daily flow measurements and Larson and Peterson ditch measurements give indications. See Appendices K3 and K4 for full dates and flows.

Larson and Peterson (1991) measured 174 cfs in irrigation diversions upstream from the USGS gage on the Methow river at Twisp on September 24-27, 1991. The gage was reading about 272 cfs at this time and slowly, but steadily dropping. According to the exceedence reports presented earlier in this report, 272 cfs was the median flow for that time of year. If all the measured diverted irrigation water was used consumptively, then the historic median flow would have been 446 cfs (174 plus 272 cfs) at the end of September at Twisp.

The flow at Twisp went from 258 cfs on September 30, 1991, to 325 cfs on October 2, 1991. The flow increased 67 cfs because diversions ended; no rain occurred. The flow did not increase 174 cfs (total of the upstream irrigation diversions). It was most likely that the missing flow went into the streambanks as bank storage. The sudden rise in water level in the river would have caused the river level to be higher than the nearby ground water level in the streambanks. The high degree of hydraulic continuity in the area would allow the river water to rapidly .go into the ground water. Once the bank storage is filled (the ground water level in the streambanks equals the level of the water in the river), then the river flow would begin to steadily drop again if no rain occurred. This bank storage could be verified by monitoring the water level in the wells along the river.

Evidence for reversal of the direction of ground water flow is in a report that investigated ground water in 1989 for a possible hatchery near Winthrop (GeoEngineers, 1990). The well was 650 feet south of the Methow River. The ground water was flowing northeast toward the river. They found near Winthrop that, "Site measurements during September and October, 1989 indicated that the Methow River was gaining water from the aquifer beneath the site. Site measurements during August 1988 indicated that the Methow River was losing water into the aquifer beneath the site." The Methow River flow was still high in August, but dropped to a low level in September and October. With a high river flow and high water level in August the river was flowing into the ground water at Winthrop in a southerly direction, but during the low river flow and low water level in September and October the ground water reversed its direction and flowed northeast .into the Methow river since the ground water level was now higher than river level. This rise in the ground water level can occur very rapidly. Golder Associates (1991) found well levels rose 10 to 25 feet in a one to two week period from an increase in river flow.

At other sites (besides Twisp) in the Methow basin on the same dates (September 30 and October 2) the flow upstream at Winthrop went from 228 to 229 cfs for an increase of 1 cfs. Only six days earlier the Chewuch canals were diverting 64.2 cfs. It is unknown when the canals stopped diverting, except that the canals were all dry on October 22. The highest reading at Winthrop in October before the 22nd was 245 cfs on October 12 which was an increase of 17 cfs. The lack of a large increase in river flow in October is puzzling. Monitoring well levels along the river would provide the answer..

On the same dates (September 30 and October 2) the flow in the Twisp River at the USGS gage went from 37 to 58 cfs for an increase of 21 cfs. Five days earlier the irrigation canals were diverting 37 cfs out of the Twisp River upstream of the gage.

Significantly, when most irrigation diversion ended October 1 upstream of Twisp, a minimum of 39 percent of the previously diverted water showed up immediately at the gage on the Methow at Twisp. In the Twisp River a minimum of 57 percent of previously diverted water showed up immediately at the Twisp River gage.

Fish Runs. Hatcheries. Fish Management Plans and Timing of Spawning

The following background information on fish is provided to assist when interpreting the fish habitat versus flow relationships at the end of this document. This requires knowledge of what and when fish species are present.

Most of the following fish information comes from the Methow and Okanogan Rivers Subbasin Salmon and Steelhead Production Plan done by WDW, WDF, Yakima Indian Nation, and Colville Indian Reservation in 1989. Details on timing and location of spawning salmon are from the spring and summer Chinook spawning ground survey reports done by M. Kohn, S. Edson, T. Meekin, and 0. Langness for the Yakima and Colville Indian Reservations from 1987 until 1991. Observations of actual fish use and distribution in 1991 are in Appendix M.

History and Status of Fish Production

The natural (not spawned and reared in a hatchery) anadromous fish populations are at depressed levels. The largest of many factors limiting restoration of the salmonid runs is poor fish passage caused by the nine mainstem Columbia River dams the fish have to pass on their way to and returning from the ocean. Fish passage into the Methow River was completely blocked from 1912 until the 1930's by a hydroelectric dam built across the river at Pateros. This dam was removed in the 1930's, but the coho salmon run became extinct and perhaps the other original salmonid runs. Some salmonids were trucked above the dam but it is doubted that any survived. After the dam was removed, hatchery salmonids were planted into the river and strays from downriver entered the river. Over the past decades, many different trap-and-release and hatchery projects have resulted in significant runs of hatchery fish with some restoration of natural runs. In addition, fish runs suffer from miles of the upper Methow River being dewatered naturally and from irrigation withdrawals during the low flow times in the fall and winter.

Existing Fish Runs

The Methow River has anadromous fish runs of summer steelhead, spring Chinook, summer Chinook, fall Chinook, and sockeye salmon. The Methow River has resident fish populations of rainbow, cutthroat, brook, and dolly warden or bull trout along with whitefish, suckers, and squawfish. A recreational fishery exists for summer steelhead, whitefish, and resident rainbow and cutthroat trout. Recreational fishing is closed for salmon, and all dolly warden or bull trout and natural steelhead must be released. The only commercial fishery is a small tribal fishery on steelhead.

Hatchery Information

The Winthrop National Fish Hatchery at Winthrop is operated by the United States Fish and Wildlife Service and raises spring Chinook for stocking the Methow River. An average of 986,187 spring Chinook smolts were planted into the Methow River each year from 1980-1987.

The Wells Salmon and Steelhead Hatchery is at Wells Dam on the Columbia River and has raised summer steelhead and summer Chinook for stocking into the

Methow River since 1967. An average of 370,664 steelhead smolts were stocked each year into the Methow, Twisp, and Chewuch Rivers from 1981-87. Additionally, the hatchery goal is to plant 400,000 summer Chinook subyearlings in the Methow River each year. However, this summer Chinook stocking has only occurred in 1987 when 212,732 were stocked.

Expected Hatchery Development and Production

The Wells Dam Settlement Agreement will try to promote natural spawners by stocking 450,000 spring Chinook smolts each year in acclimation ponds along the Chewuch and Methow Rivers. In addition, 150,000 summer Chinook yearlings and 260,000 subyearlings will be stocked each year into the Methow River.

The Rock Island Settlement Agreement will supplement natural spawners by stocking 100,000 spring Chinook smolts each year in an acclimation pond along the Twisp River and stocking 400,000 summer Chinook yearlings each year into the Methow River. The Methow River subbasin production plan proposes to increase spring Chinook smolt production to 1.4 million per year from the Winthrop National Fish Hatchery.

Natural Summer Steelhead

POPULATION SIZE- The natural summer steelhead run size from 1982-1986 averaged 201 with a sport catch of 103 and a tribal catch of 5 leaving 93 to escape to spawn in the Methow watershed. The natural steelhead run makes up only 3 percent of the total steelhead run in the Methow watershed.

FISH PRODUCTION LIMITATIONS- The lack of natural adults for spawning is caused primarily by over-harvest of adults before they can return to the Methow River and poor fish passage through nine dams on the Columbia River. Significant mortalities are believed to occur from winter icing in the Methow watershed.

MANAGEMENT GOAL- The goal of fish agencies in the Methow watershed for natural steelhead is to maintain genetic integrity and rebuild the natural run of steelhead to achieve a spawning escapement of 3,200 adults. The recent Methow River salmon and steelhead production plan proposes no harvest of natural steelhead, but allows harvest of 10,000 hatchery steelhead along with inventoring and restoring fish habitat.

LIFE HISTORY- Adults enter the Methow River in mid-July with the numbers peaking by mid-September and October. However, during winter the adults will leave the Methow river and return to the warmer Columbia River. The adults will return to Methow River and beginning spawning in the lower mainstem in mid-March and continue through May. Spawning in the upper mainstem and tributaries occurs from April 1 to May 31. The fry emerge in summer with the juveniles rearing from two to three years before outmigration during the spring.

Hatchery Summer Steelhead

POPULATION SIZE- The hatchery summer steelhead run size from 1983-1986 averaged 15,015 with a sport catch of 7,804 and a tribal catch of 388 leaving

6,823 to escape to spawn in the Methow watershed. Hatchery steelhead make up 97 percent of the total steelhead run in Methow watershed.

FISH PRODUCTION LIMITATIONS- The primary limitation to production are the mortalities caused by having to pass upstream and downstream through the nine dams on the Columbia River.

MANAGEMENT GOAL- The goal of the fish agencies is to achieve 10,000 hatchery steelhead for sport and tribal harvest. Since this goal has been met in recent years, enhancement of the hatchery stock is not desired.

LIFE HISTORY- Hatchery steelhead spawn naturally in the lower mainstem from March 1 to May 15, and in the upper mainstem and tributaries from March 15 until May 31. After nearly 14 months of rearing in a hatchery, the smolts are stocked for outmigration beginning around April 20 until mid-May. Almost 10 percent of these hatchery smolts spend an additional year in fresh water before migrating out to salt water.

Spring Chinook

POPULATION SIZE- The natural spring Chinook escapement for spawning in the watershed averaged 2,161 from 1982-1985. No sport or tribal fishing for salmon is allowed in the Methow River. No one knows how many hatchery fish spawn naturally in the Methow River.

FISH PRODUCTION LIMITATIONS- The greatest limitation is from smolt and adult mortalities due to passing the nine Columbia River dams. Fish losses are also due to 1) unscreened diversion structures, 2) loss of instream flows from irrigation diversions, 3) natural low flows, 4) loss of riparian habitat from streamside development, 5) and possible loss of juvenile fish during winter icing. Dewatering causes fish mortalities in the Methow River from Weeman Bridge on upstream past Mazama, past Early Winters confluence, and even past the Lost River confluence. Dewatering also occurs in the Lost River and the Chewack River.

MANAGEMENT GOAL- An escapement goal has not been set, but the goal of the fish agencies is to achieve 2,000 spring Chinook for sport and tribal harvest. A higher priority is to increase the productivity while maintaining the unique biological characteristics of the stock, including the existing balance of spawners in the tributaries.

LIFE HISTORY- The adult spring Chinook migrate into the Methow River in May and June. Overall, spawning begins at the end of July, peaks August 20 until September 1, and ends by September 11. In the Methow River in 1987 spawning started August 7, peaked August 28-September 4, and ended September 11. In the Chewuch River spawning in the lower reach started August 18, peaked September 1, and ended September 8. But in the upper Chewuch River spawning peaked August 1. In the Twisp River spawning started late July and peaked August 19-26. In the Lost River spawning peaked August 20-27 and, ended September 3. In Early Winters Creek spawning started in late July, peaked August 9, and ended August 13.

The largest densities of redds occur in the Methow River from Winthrop to Lost River (especially from RM 57.7 until 65.4), the lower Lost River, the middle and upper Twisp River, and the middle and upper Chewuch River (See Figure 6). They have been seen since 1987 spawning in Early Winters Creek, Lake Creek, and Gold Creek. However, the fish and redd counts have dropped dramatically and steadily from 1987 to 1991.. In 1991, no spring Chinook redds were counted in Early Winters Creek, Gold Creek, or Lake Creek and the count of spring Chinook that migrate over Wells Dam (their last dam obstacle) was the lowest on record (since 1967). Almost no spring Chinook spawning occurs in the Methow River downstream of the town of Winthrop.

Juvenile spring Chinook rear for a year in the river. Snorkelling observations by Ecology and Hosey and Assoc. in 1990 and 1991 found high densities of juveniles in the deep pools by the Gate Creek area in the upper Methow. Unfortunately, that reach dried up completely in 1990 and 1991 in October and all juveniles are believed to have been killed in that area. High densities of juvenile spring Chinook were also found by Ecology in 1991 in the large pools fed by springs that emerge one mile downstream of Weeman bridge (Appendix M). These springs and pools remained cold (48 degrees F) and flowing even when the Methow River dropped to a low flow and air temperatures were in the high 90's. We also found high densities of juveniles in 1991 in the lower Twisp River in August, but they were not visible in September. Juvenile salmonids begin disappearing under cobble out of view around mid-September in drainages along the eastern Cascade Mountains.

Summer Chinook

POPULATION SIZE- The natural summer Chinook escapement for spawning in the watershed averaged 674 from 1982-1985. No sport or tribal fishing for salmon is allowed in the Methow River. No one knows how many hatchery ,fish spawn naturally in the Methow River.

FISH PRODUCTION LIMITATIONS- The greatest limitation is from smolt and adult mortalities due to passing the nine Columbia River dams. Fish losses are also due to 1) unscreened diversion structures, 2) loss of instream flows from irrigation diversions, 3) natural low flows, and 4) loss of riparian habitat from streamside development.

MANAGEMENT GOAL- An escapement goal has not been set, but the goal of the fish agencies is to achieve 3,000 summer Chinook for sport and tribal harvest. A higher priority is to increase the productivity while maintaining the unique biological characteristics of the stock, including the existing balance of spawners in the tributaries.

LIFE HISTORY- The adult summer Chinook migrate into the Methow River in late August. Spawning usually begins September 16, peaks October 13-20, and is complete by October 31. Chinook that spawn after October 31 are considered to be fall Chinook. No summer Chinook spawning occurs in the tributaries. Summer Chinook spawn in the Methow River from Winthrop downstream to just below Methow (See Figures 7 and 8). Emergence timing is unknown, but is likely January until April. Juveniles may rear from a few months to a year before migrating out.

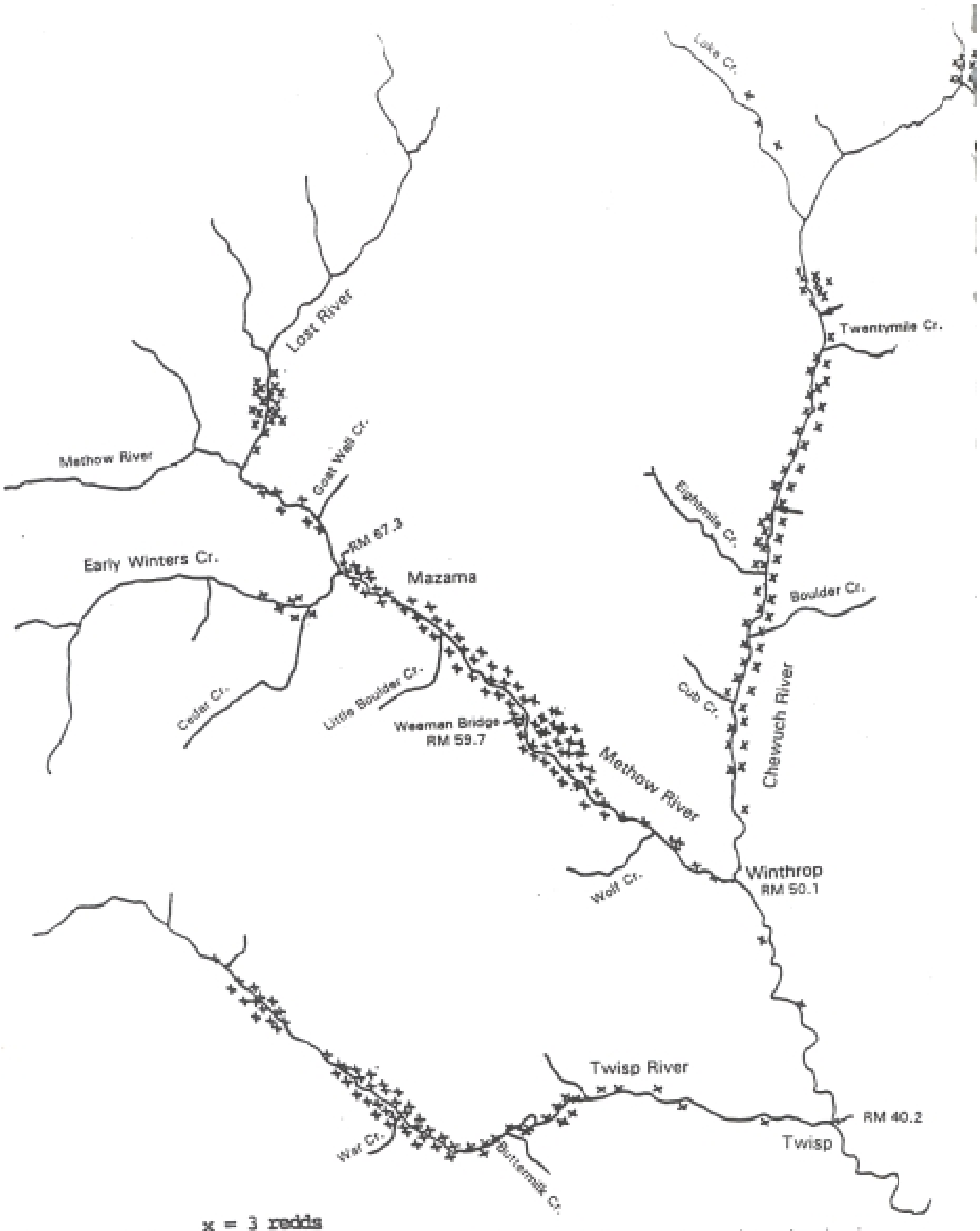


Figure 6. Location of spring chinook redds in the Methow River basin in 1986. Adapted from M. Kohn, 1988.

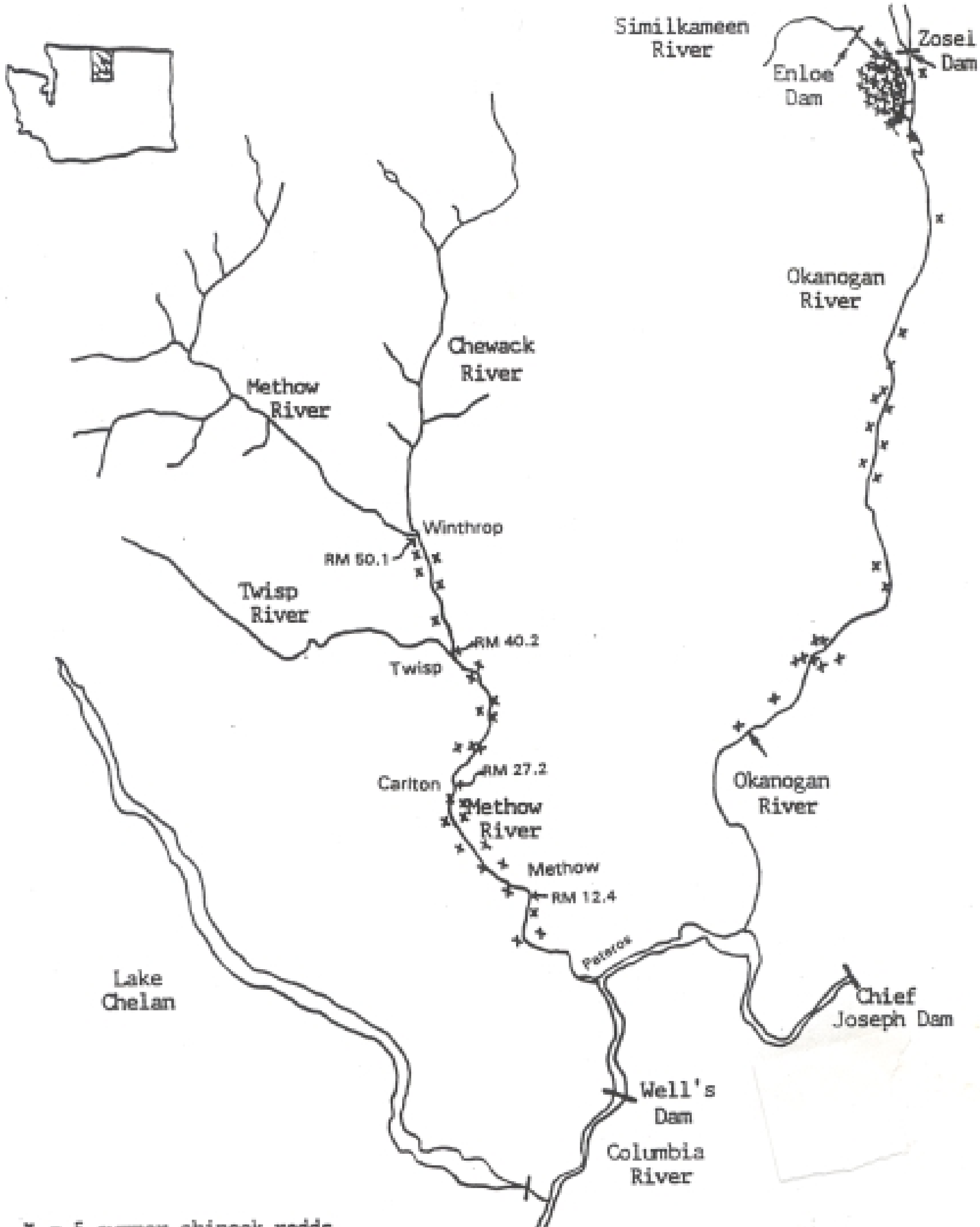


Figure 7. Location of summer chinook redds in the Methow River basin in 1988. Adapted from M. Kohn, 1988.

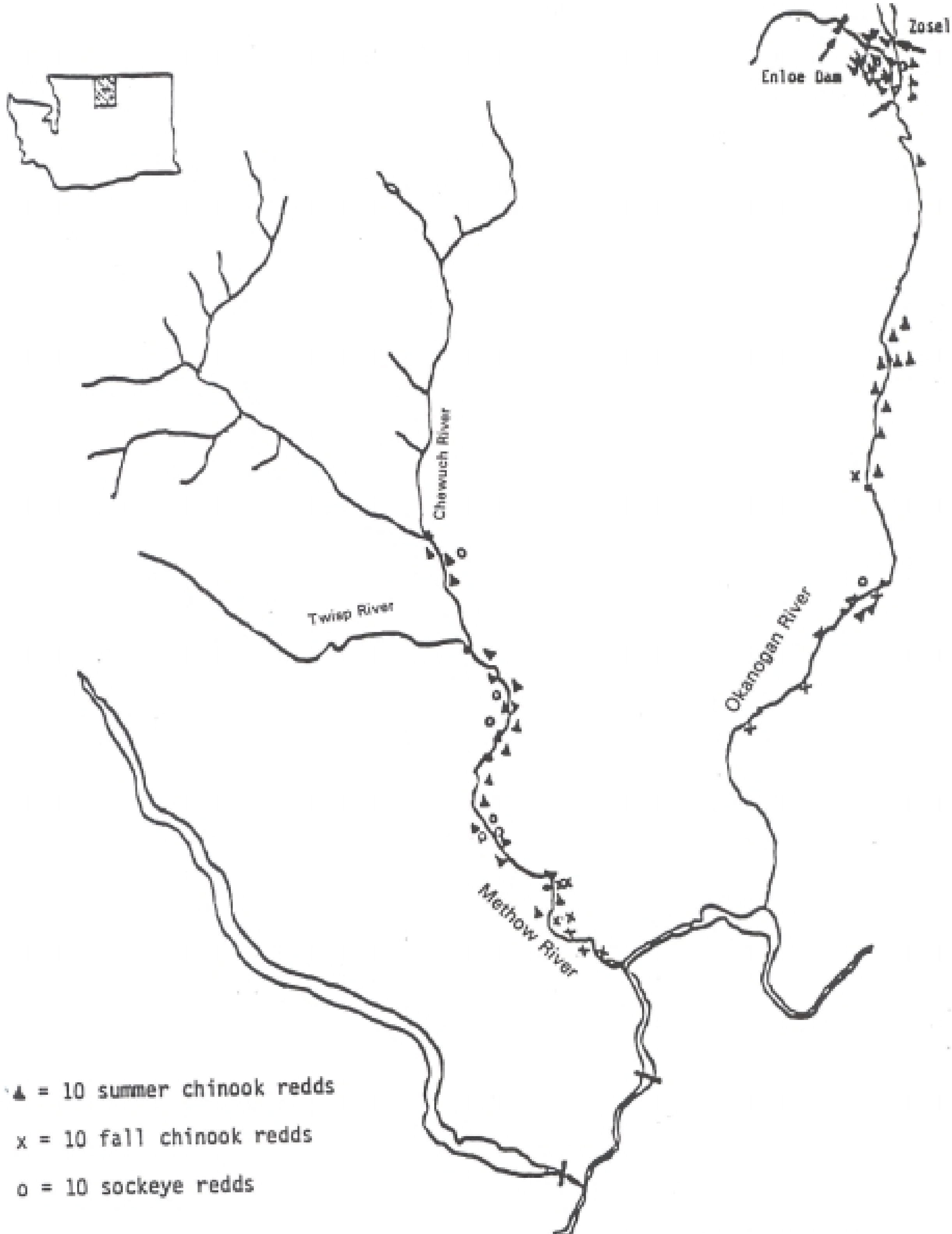


Figure 8. Location of sockeye, summer chinook, and fall chinook redds in the Methow River basin in 1987. Adapted from M. Kohn, 1987.

Fall Chinook

POPULATION SIZE- The fall chinook escapement for spawning in the watershed is unknown A redd count in 1987 found 160 redds on November 13. Fall chinook counts It Wells Dam (the nearest dam on the Columbia River downstream from the Methow River) have increased from 477 in 1980 to 2,822 in 1987. This increase in fall chinook at Wells Dam may be from increased straying from the increased production in the Hanford Reach on the Columbia River or from the same improved river conditions that helped the Hanford Reach fish. No sport or tribal fishing for salmon is allowed in the Methow River.

FISH PRODUCTION LIMITATIONS- The greatest limitation is from smolt and adult mortalities due to passing the nine Columbia River dams.

MANAGEMENT GOAL- There is. no management plan for this run due to a lack of information.

LIFE HISTORY- Little is known of the life history of fall chinook in the Methow River. The adult fall chinook migrate into the Methow River in late October. Spawning begins November 1, peaks from November 7-13, and ends at an unknown time. No fall chinook spawning occurs in the tributaries (See Figure 8). In 1988, fall chinook spawned in the lower 5 miles of the Methow River from the town of Methow downstream to the mouth of the Methow River, but in later years have spawned up to RM 10.4. Emergence in unknown, but fall chinook in other watersheds usually emerge in early spring and migrate out in 90 days',,

Sockeye

I POPULATION SIZE- The sockeye escapement for spawning in the watershed is unknown. A redd count in 1987 found a total of 56 redds.

FISH PRODUCTION LIMITATIONS- The greatest limitation is from smolt and adult mortalities due to passing the nine Columbia River dams.

MANAGEMT GOAL- There is no management plan for this run due to a lack of informal ion.

LIFE HISTORY- Little is known of the life history of sockeye in the Methow River. The adult sockeye migrate into the Methow River in early September. The spawning reaches are about the same as summer chinook with redds found only in the mainstem Methow River downstream from Winthrop, at Twisp, and downstream to Gold Creek (See Figure 8). Some, have spawned in the Twisp River, some were seen spawning just upstream of Winthrop in 1990, and Ecology found six spawning one mile downstream of Weeman bridge in September, 1991. Spawning begins in early September, peaking in mid-September in the upper reach and peaking in the first week in October in the middle reach. Fry emergence and juvenile rearing areas and timing is unknown.

The Methow Subbasin Salmon and Steelhead Production Plan

The following goals and proposals are in the final 1990 proposal plan given to the Northwest Power Planning Council. These goals are from the WDF, WDW, Yakima Indian Reservation, and the Colville Indian Reservation. The Council will decide whether to fund the proposals in 1992.

Methow Summer Steelhead- The goal is for a harvest of no natural steelhead but allows a harvest of 10,000 hatchery steelhead. The plan proposes to supplement natural production using natural brood stock for their hatchery programs. Unscreened diversions should be inventoried and corrected with screens. Water temperatures and riparian zones should be measured. Improve water quality and stream habitat by seeking legislation to eliminate additional water withdrawals and replace existing withdrawals.

Methow Spring Chinook- The goal is to provide a harvest of 2,000 spring chinook. The plan proposes that unscreened diversions should be inventoried and corrected with screens. Water temperatures and riparian zones should be measured. Improve water quality and stream habitat by seeking legislation to eliminate additional water withdrawals and replace existing withdrawals. Increase streamflows in fall and winter by converting to sprinkler irrigation, lining earthen ditches, and converting from surface water ditches to wells for irrigation conveyance. Build ten groundwater spawning channels in the upper Methow River. Use natural broodstock to supplement natural production and construct the hatcheries in the Rock Island and Wells Dam settlement agreements to grow 550,000 smolts. Improve survival at the Winthrop National Fish Hatchery and increase production to 1.4 million smolts.

Methow Summer Chinook- The goal is to provide a harvest of 3,000 fish. The plan proposes to improve water quality by reducing sedimentation. Inventory and correct unscreened diversions and diversion structures that are causing mortalities. Supplement natural production with 400,000 yearlings and 400,000 fingerlings as per the Rock Island and Wells Dam settlement agreements.

Northwest Power Planning Council Protected Areas

The Northwest Power Planning Council (NWPPC) has the Methow River basin designated as an area to be protected from future hydroelectric development. This designation is used to protect streams used by anadromous fish and to protect high quality habitat in streams used by resident fish and wildlife. Any hydroelectric power generated by a new facility in the Methow basin would be unable to sell its power to Bonneville Power Authority and the NWPPC would argue that no new facility should be licensed by Federal Energy Regulatory Commission.

II. METHODS OF STUDY

IFIM was selected by the local, state, and federal agencies and the tribes for this study as the best available methodology for predicting how fish habitat responds to incremental changes in streamflow.

Description of the Instream Flow Incremental Methodology

IFIM, as described by Bovee (1982),was developed by the U.S. Fish and Wildlife Service's Instream Flow Group in the late 1970's. Their main achievement was advancing the state-of-the-art in calculating fish- habitat-versus-flow relationships for multiple flows. Previous methods often used only a single transect to describe depths and velocities along a cross section of a river and lacked the ability to extrapolate the results to higher or lower flows of interest.

PHABSIM (Physical Habitat Simulation) is a collection of computer models used in IFIM (Milhous et al, 1989). The most commonly used hydraulic model in PHABSIM is IFG4. IFG4 uses multiple transects to predict the depths and velocities in a river over a range of flows (Figure S). IFG4 creates a cell for each measured point along the transect or cross section. Each cell has an average water depth and water velocity associated with a type of substrate or cover for a particular flow. The cell's area is measured in square feet. Fish habitat is defined in the computer model by the variables of velocity, depth, substrate, and/or cover. These are important habitat variables that can be measured, quantified, and predicted.

The IFIM is used nationwide and is accepted by most resource managers as the best available tool for determining fish habitat versus flow relationships. However, the methodology only uses four variables in hydraulic simulation, and at certain flows, such as extreme low flows, other variables such as fish passage, food supply (aquatic insects), competition between fish species, and predation (birds, larger fish, etc.) may be of overriding importance. The IFIM approach encompasses more than just the PHABSIM model, it includes reviewing water quality, sediment, channel stability, temperature, hydrology, and other variables that affect a river's fish production. These additional variables are not analyzed in this report.

After the hydraulic model (IFG4) is calibrated and run, a computer model called HABTAT combines IFG4 output with a biological model. The biological model is composed of fish preference curves describing the preference each fish species has for each of the four variables (depth, velocity, substrate, and cover). The fish species are defined further by particular lifestages: adult spawning, juvenile rearing, and adult holding.

Weighted Usable Area (WUA) is an index of fish habitat. The preference factor for each variable at a cell is multiplied by the other variables to arrive at a composite, weighted preference factor for that cell. For example, a velocity preference of 1.0 multiplied by a depth preference of 0.9 multiplied by a substrate preference of 0.8 equals a composite-preference factor of 0.72 for that cell. This composite-preference factor is multiplied by the number of square feet of area in that cell. This gives the number of square feet of habitat in that cell. A summation of all the transects' cell areas gives the total number of square feet of preferred habitat at a specified flow. This total square feet of habitat is normalized to 1,000 feet of stream. The final model result is a listing of fish habitat values called WUA in units of square feet per 1,000 feet of stream. WUA is listed with its corresponding flow or discharge in cfs.

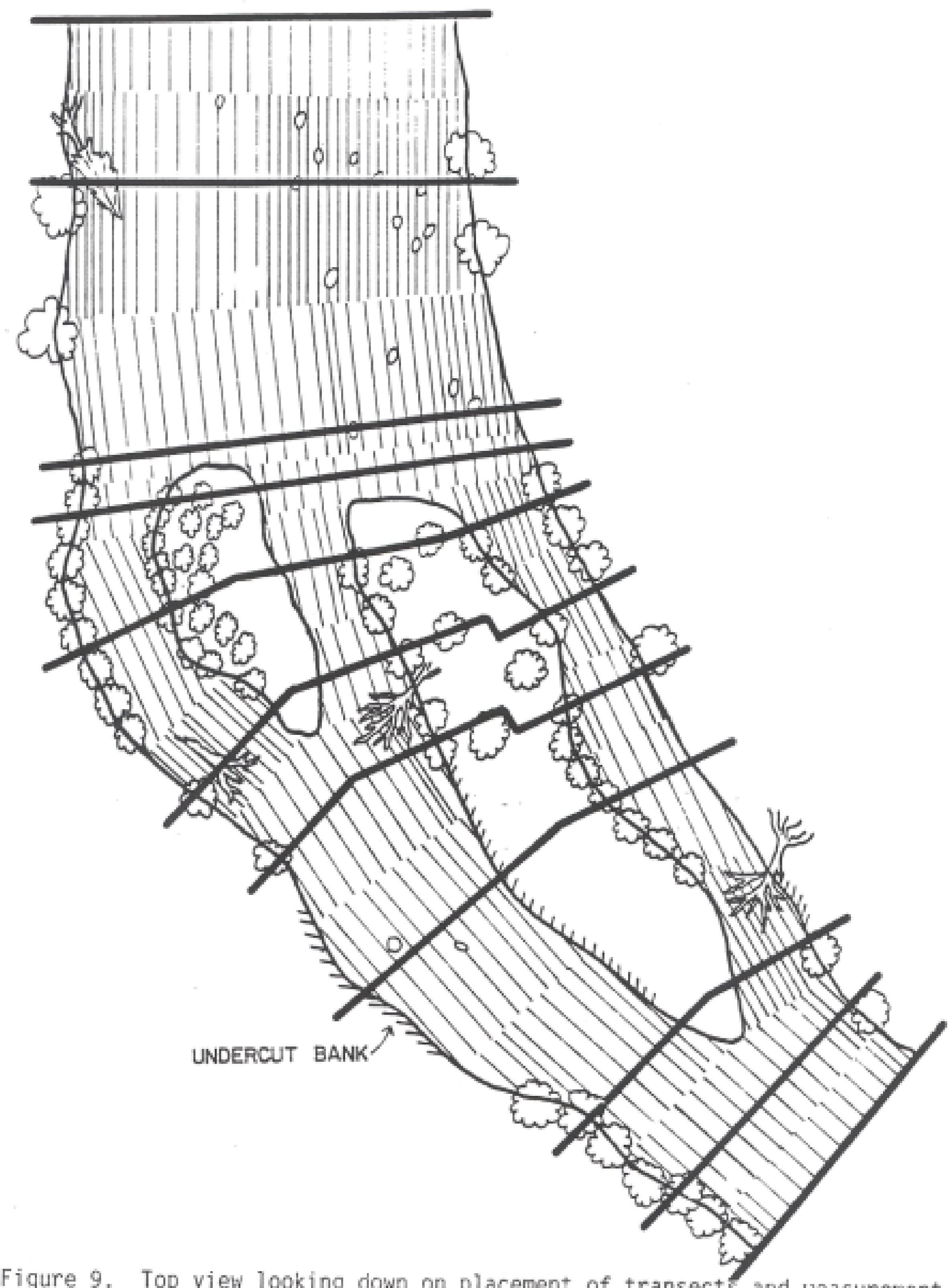


Figure 9. Top view looking down on placement of transects and measurement verticals used to define the distribution of aquatic habitat in an IFIM site (from Bovee, 1982).

Interagency Participation in Scope-of-Work

On February 7, 1991, representatives from Okanogan County, the Yakima and Colville tribes, and the Departments of Ecology and Wildlife met to discuss what studies would be needed to review Ecology's 1977 Methow basin plan. Those present at the Yakima Indian Nation council chambers in Toppenish were: Mary Meloy (Okanogan County), Gerritt Rosenthal (Sweet-Edwards consultant representing Okanogan County), Jack Fiander (Yakima Nation), Lynn Hatcher (Yakima Nation), David Lind (Yakima Nation), Mike Kohn (Yakima Nation), Olaf Langness (Colville Tribe), Hal Beecher (Wildlife), Darlene Frye (Ecology), Art Larson (Ecology), and Brad Caldwell (Ecology).

Everyone present agreed that an IFIM study was needed for the purpose of reviewing the minimum instream flows in the Methow basin. They also agreed that an IFIM scoping meeting on picking IFIM measurement sites should be held immediately at the end of the meeting.

Those present at the technical IFIM scoping meeting later in the day (everyone was invited from the earlier meeting) discussed their knowledge about fish habitat, fish distribution, and flows in the Methow basin. Those with technical knowledge included Gerritt Rosenthal, Olaf Langness, Hal Beecher, and Mike Kohn.

Brad Caldwell agreed that he would seek out those throughout the agencies, tribes, and consultants who could provide additional technical expertise on fish habitat, fish distribution, and flows in the Methow basin. On February 27 and 28, 1991, he met and discussed these subjects with Jim Mullen (USFWS), Ken Williams (WDW), Bob Steele (WDW), Bill Zook (WDF), Charles Gowan (Harza Inc.), Richard Grost (Harza Inc.), Max Judd, and Lee Bernheisel. On March 14, 1991, he met with Mike Kohn (YIN) and Larry Wasserman (YIN). On March 27, 1991, Mike Kohn (YIN) accompanied him throughout the Methow basin pointing out specific chinook salmon spawning areas, the river reaches he has seen dry up, and problem areas for upriver migration. The YIN has done detailed spawning ground surveys in the Methow basin for the last five years.

Okanogan County Public Works Department volunteered Ernie Buchanan from their office to be a member of the IFIM field crew. Additionally, Ecology's Brad Caldwell, Dave Catterson, Ann Butler, Maryrose Livingston, and Steve Hirschey were on the field crew.
Site and Transect Selection

Preliminary study sites were selected for the IFIM study by reviewing topographic maps. Actual site selection was done during field visits.

At the February 7, 1991, scoping meeting the rationale for these sites was to break the rivers into reaches based on significant changes in flow, critical spawning and rearing areas for fish, and areas where intense water diversions may or are occurring. We also wanted sites whose hydrology we could relate to Ecology's existing four control points on the Methow River and our three control points on the Chewack River, Twisp River, and Early Winters Creek.

These criteria overlapped well, and we picked the following seven reaches for IFIM sites for Ecology to measure in 1991:

1) The Methow River from Carlton upriver to the town of Twisp.
   This is represented by the Walsh site at RM 31.5.
2) The Methow River from the Diversion Bridge upriver to Winthrop.
   This is represented by the KOA site at RM 49.0.
3) The Methow River from Winthrop upriver to the Weeman Bridge.
   This is represented by the Weeman site at RM 59.0.
4) The Methow River from Weeman Bridge upriver to Early Winters Creek.
   This is represented by the Chokecherry site. at RM 66.5.
5) The lower reach of the Chewuch River.
   This is represented by the Chewuch site at RM 1.3.
6) The lower reach of the Twisp River.
   This is represented by the Twisp site at RM 1.8.
7) The lower reach of Early Winters Creek.
   This is represented by the Early Winters site at RM 1.0.

The IFIM sites are located on a basin-wide map in Figure 10. Individual IFIM site locations on maps in Figures 11 to 14.

Brad Caldwell (Ecology) arranged two tours of the Methow Basin to get technical approval of the sites and transects to be used in the IFIM study. The state and federal agencies, the tribes, Okanogan County, and other interested people were invited.
On March 29, 1991, he led a tour with Art Larson (Ecology), Jim Peterson (Ecology), Hal Beecher (Wildlife), and Olaf Langness (Colville Tribe). They all agreed that the sites and transects would adequately represent fish habitat in the seven reaches listed previously.

On April 4, 1991, he led a second tour of the Methow basin with Bill Zook (Fisheries), Larry Wasserman (Yakima Nation), Paul Waller (Okanogan County Public Works), Frank Gaffney (Northwest Renewable Resource Center), John Hayes (developer), Mike Fort (head of Groundwater Management Committee). Those with technical expertise on fish agreed that the sites and transects would adequately represent fish habitat in the seven reaches listed previously.

For background information at both of these tours, Brad Caldwell handed out a packet of information containing a work plan with the measurement dates and people needed to collect the data, maps from the Yakima tribe's Methow basin salmon surveys showing critical spawning areas, a Bureau of Reclamation list of major diversion canals and the flows diverted, and a hydrograph of the Methow River at Twisp to show the expected pattern and quantity of flow in-the river. Additionally, he explained in detail what information an IFIM study would provide: fish habitat versus flow relationships for each lifestage and species for each river reach selected.

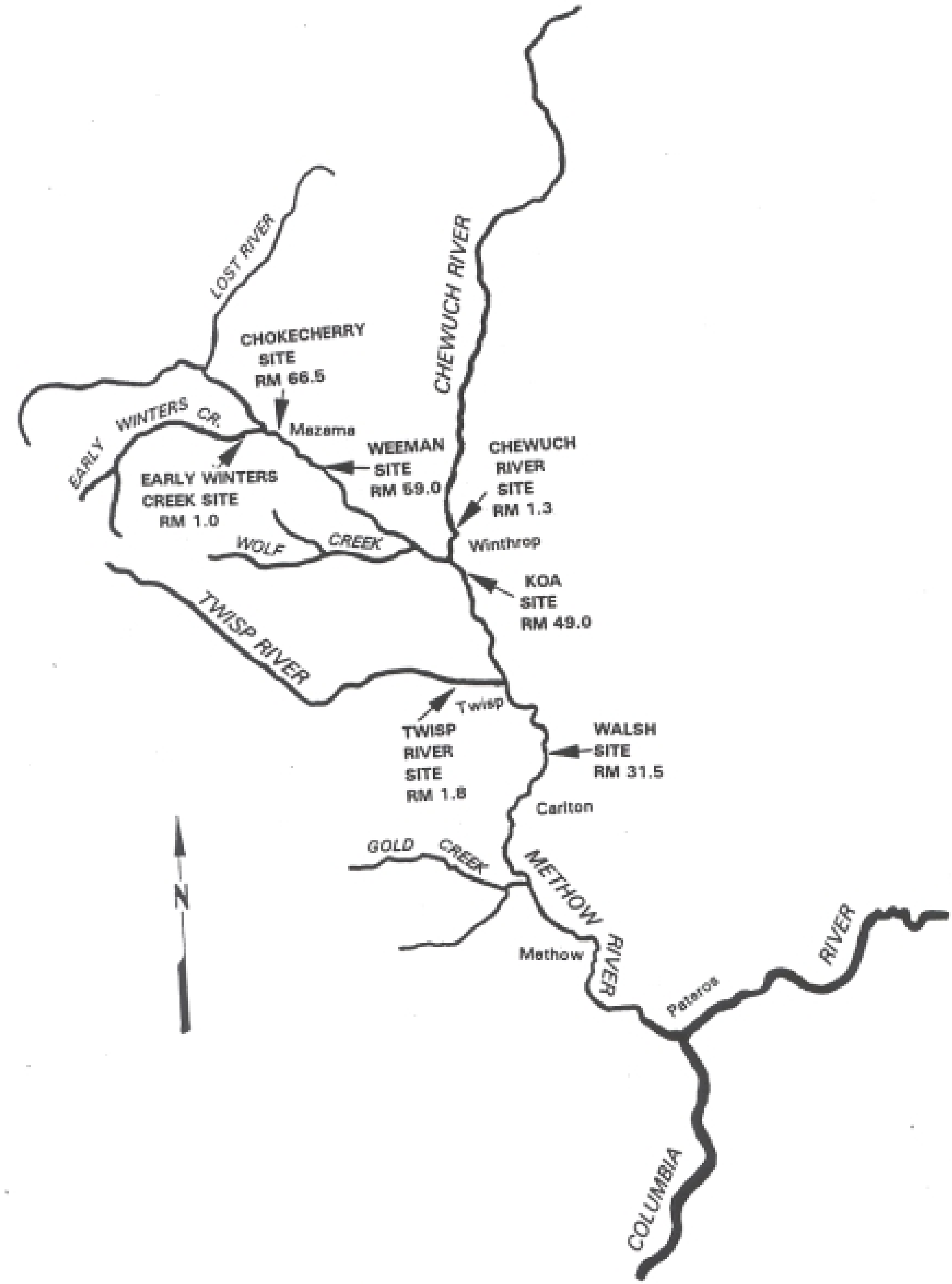


Figure 10. Location of Methow River basin IFIM sites.

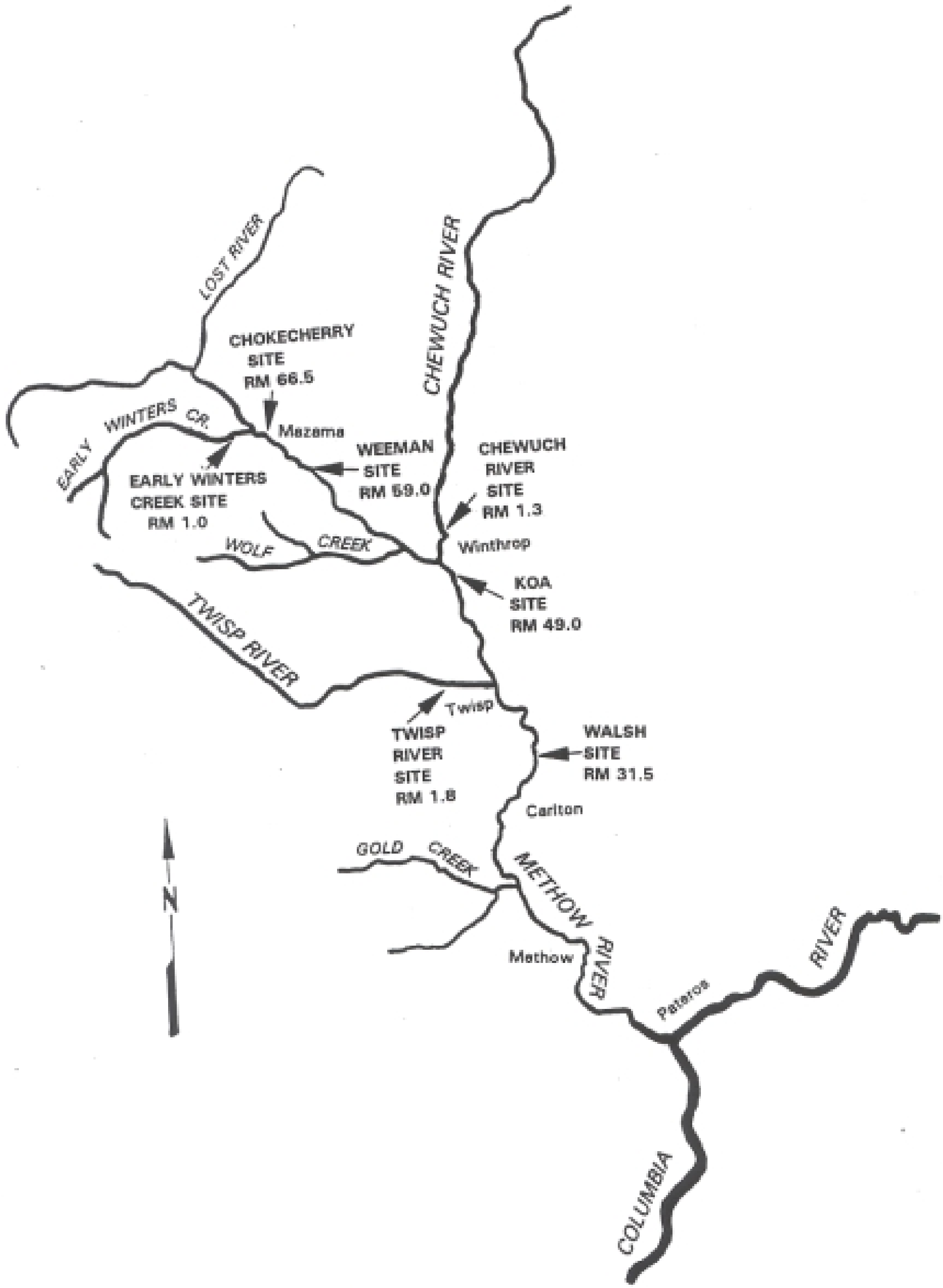
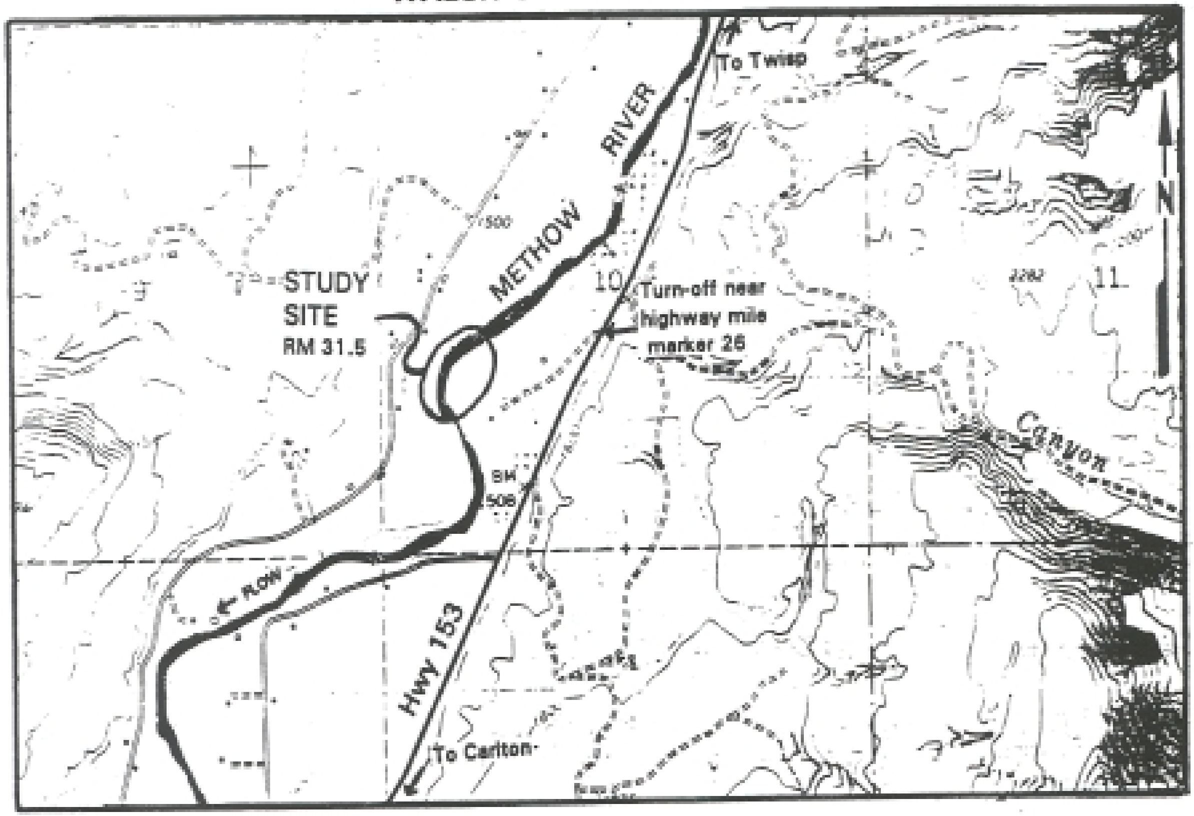


Figure 10. Location of Methow River basin IFIM sites.

WALSH SITE - METHOW RIVER



KOA SITE - METHOW RIVER

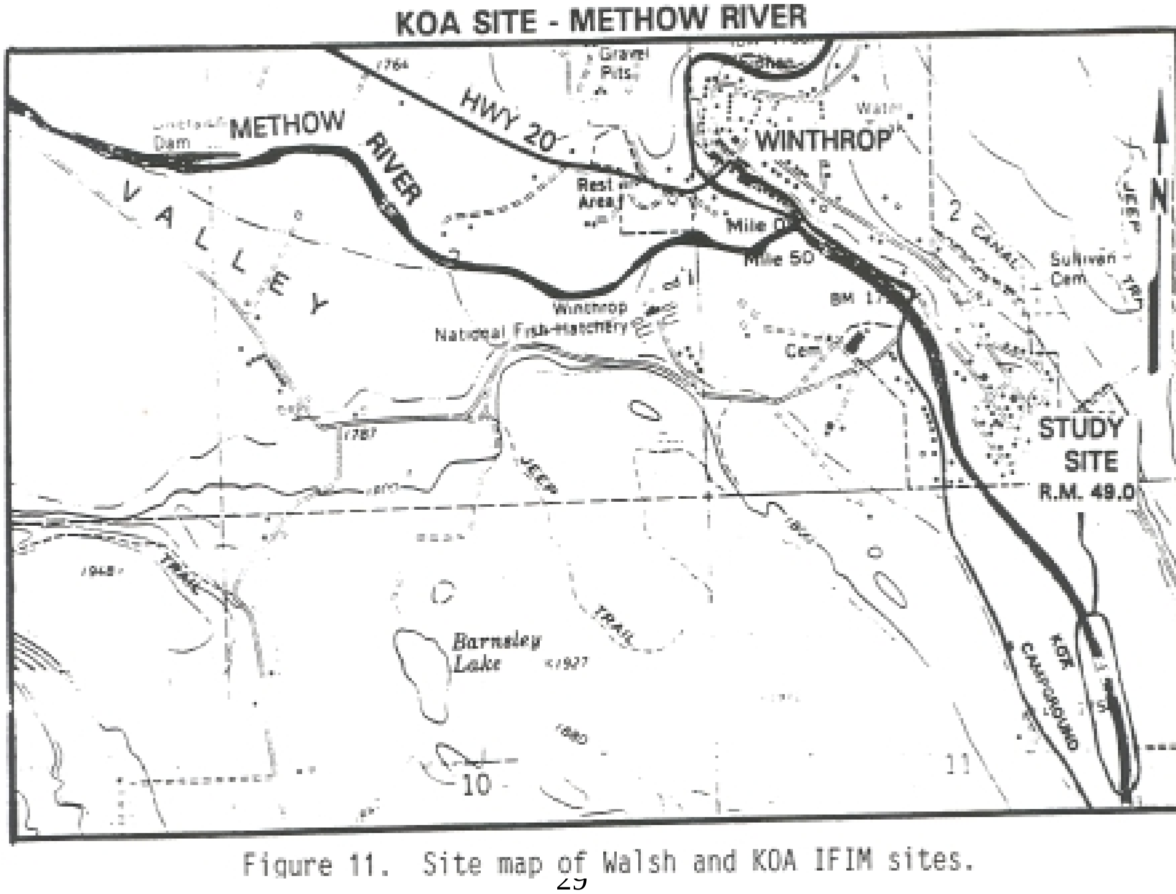
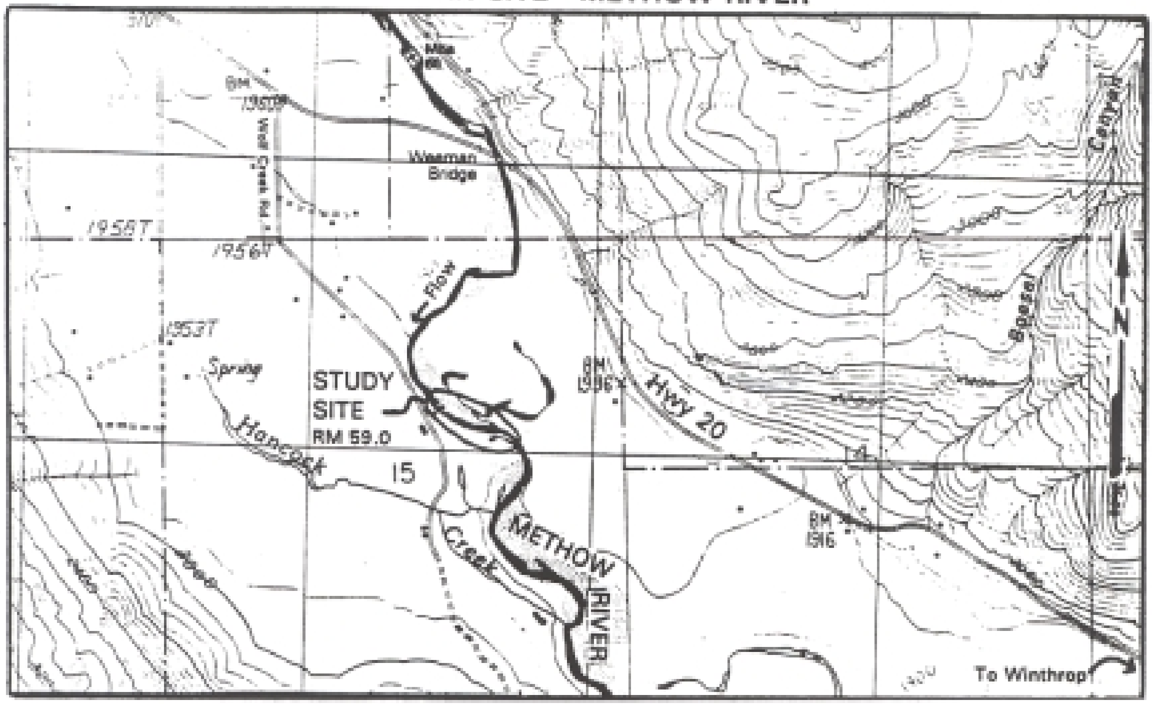


Figure 11. Site map of Walsh and KOA IFIM sites.

WEEMAN SITE - METHOW RIVER



CHOKECHERRY SITE - METHOW RIVER

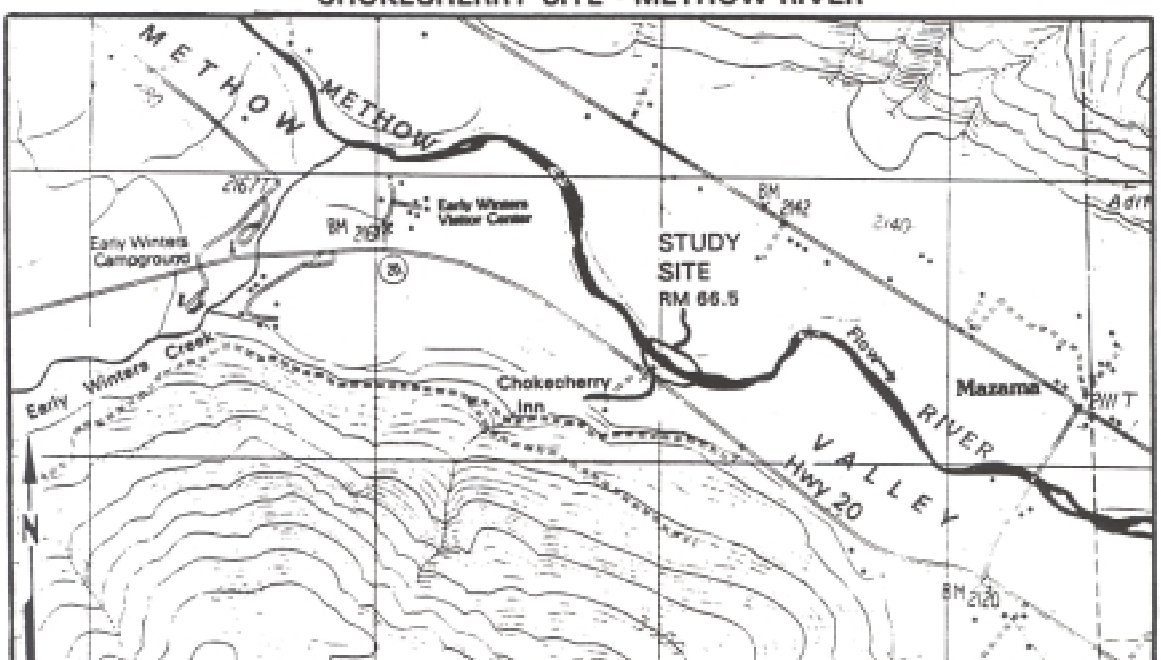


Figure 12. Site map of Weeman and Chokecherry IFIM sites.

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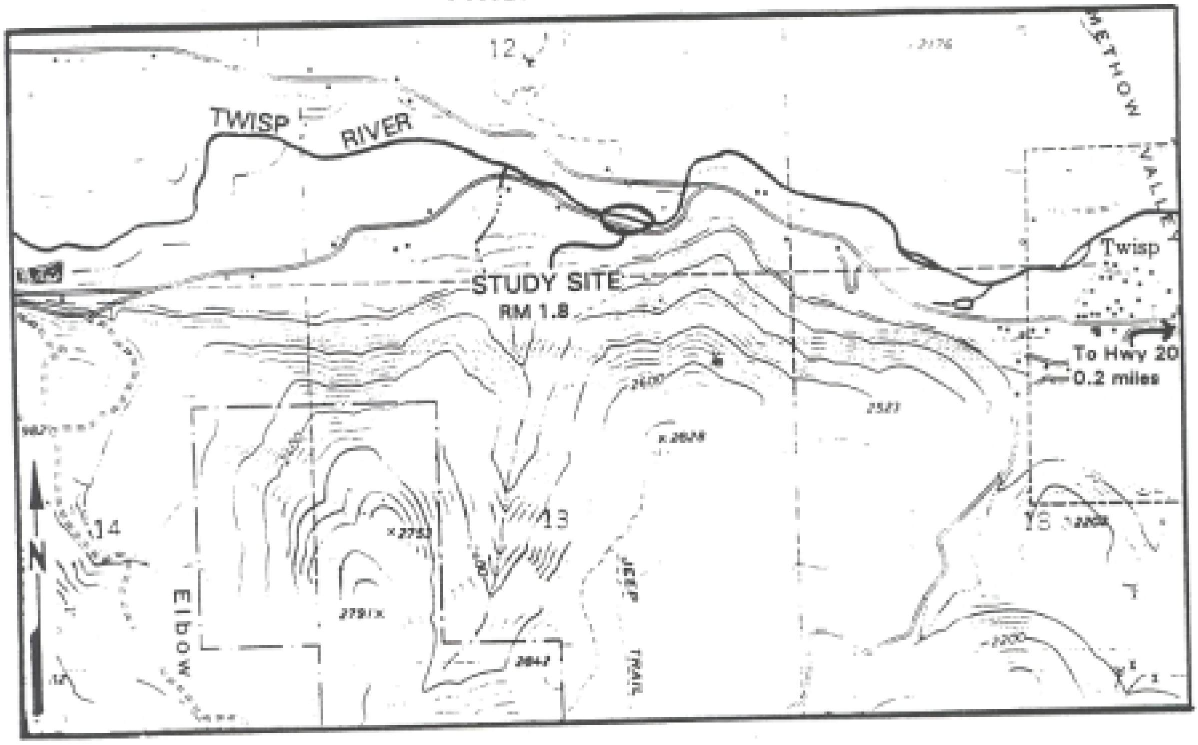
TWISP RIVER SITE



CHEWUCH RIVER SITE

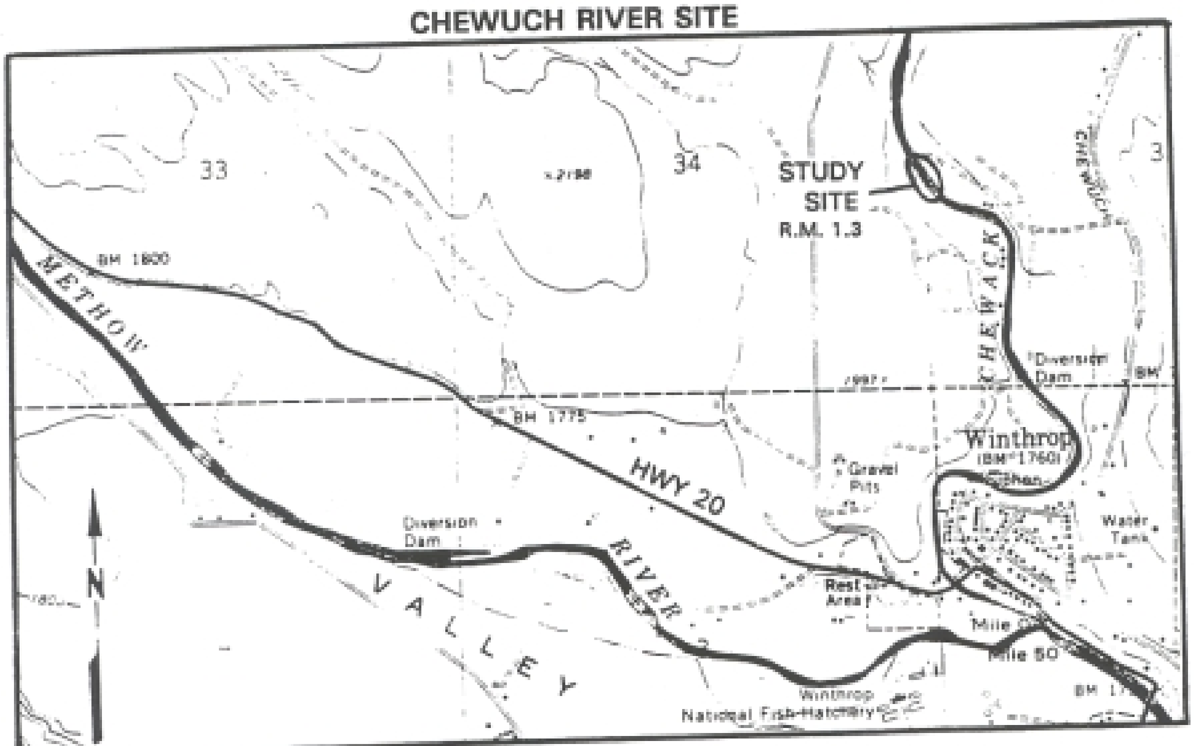


Figure 13. Site map of Twisp and Chewuch IFIM sites.

EARLY WINTERS CREEK SITE

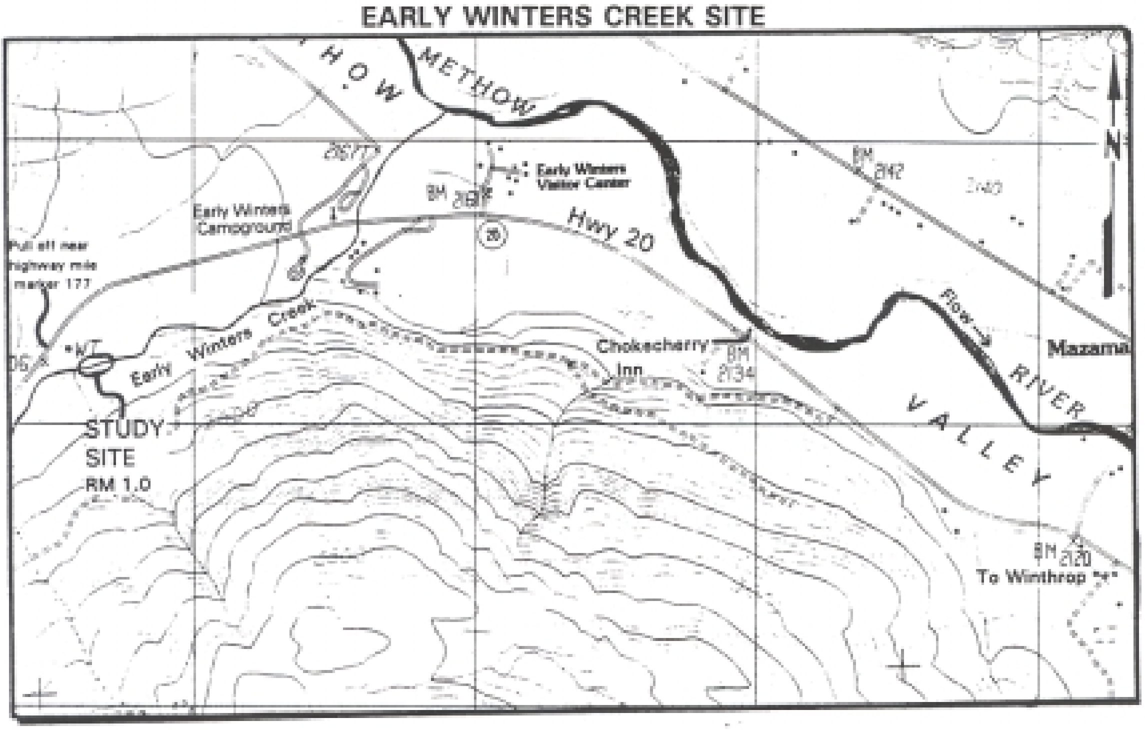


Figure 14. Site map of Early Winters IFIM site.

Field Procedures

IFIM measurements were collected in July, August, and September at the seven IFIM sites. The field work was delayed until almost August due to high sustained flows in the river. After the river began to drop at the end of July, we were able to collect field measurements over an excellent range of flows for calibrating the hydraulic computer models. We measured three different flows on the Methow River at the Walsh (RM 31.5) and KOA (RM 49) IFIM sites, but were able to gather an additional fourth flow at each of the other IFIM sites: Weeman (RM 59), Chokecherry (66.5), Chewuch River (RM 1.3), Twisp River (RM 1.8),.and Early Winters Creek (RM 1.0).

Measurements of water depth, water velocity, substrate composition, and cover were made at various intervals along each transect. A temporary gage at each site was used to verify that streamflow at each transect remained steady during measurement. Transects were marked using fence posts and or survey hubs and flagging. Water velocity was measured using standard USGS methods with a calibrated Swoffer velocity meter mounted on a top-set wading rod.

Water-surface elevations and stream-bank profiles were surveyed with a survey level and stadia rod. These points were referenced to an arbitrary, fixed benchmark. Substrate composition and cover were assessed by visually estimating the percent of the two main particle size classes and type of cover according to a scale recommended by WDF and WDW (Appendix J2). Any reference to a right or left bank in this report is determined by looking downstream.

Additionally, snorkel surveys of all the IFIM sites were conducted in August and September for presence of fish species, relative fish densities, and habitat use. All IFIM sites were videotaped at all flows except for the first measured flow.

Site Descriptions and Conditions During Measurement

Walsh Site on the Methow River

The Walsh site at RM 31.5 at a medium-low flow of 600 cfs has a wetted width of about 158 feet. Most of the habitat is glide/riffle with some deep pools over a substrate of mostly small and large cobble with large boulders in some of the riffles. Eight transects were measured at flows of 1437 cfs on 8-0191, 589 cfs on 8-28-91, and 311 cfs on 9-24-91. The three flows were well spaced for calibrating the hydraulic model. The flows were steady during measurement. No observable bed shifts occurred between flow measurements on the eight transects.

KOA Site on the Methow River

The KOA site at RM 49.0 at a medium-low flow of 450 cfs has a wetted width of about 144 feet. Most of the habitat is. glide/riffle with no pools over a substrate of mostly gravel and cobble. Eight transects were measured at flows of 1135 cfs on 8-02-91, 457 cfs on 8-29-91, and 229 cfs on 9-25-91. The three flows were well spaced for calibrating the hydraulic model. The flows were steady during measurement. No observable bed shifts occurred between flow measurements on the eight transects.

Weeman Site on the Methow River

The Weeman site at RM 49.0 at a medium-low flow of 240 cfs has a wetted width of about 111 feet. Most of the habitat is glide/riffle with a small amount of pool habitat over a substrate of mostly gravel and cobble. Small side channels are present with several fairly constant springs flowing into the Methow River. Eight transects were measured at flows of 658 cfs on 8-03-91, 380 cfs on 8-16-91, 238 cfs on 8-27-91, and 79 cfs on 9-26-91. The four flows were well spaced for calibrating the hydraulic model. The flows were steady during measurement. No observable bed shifts occurred between flow measurements on the eight transects.

Chokecherry Site on the Methow River

The Chokecherry site at RM 66.5 at a medium-low flow of 210 cfs has a wetted width of about 121 feet. Most of the habitat is glide/riffle with little pool habitat over a substrate of mostly gravel and cobble. Eight transects were measured at flows of 640 cfs on 8-04-91, 349 cfs on 8-16-91, 207 cfs on 8-2791, and 41 cfs on 9-26-91. The four flows were well spaced for calibrating the hydraulic model. The flows were steady during measurement. No observable bed shifts occurred between flow measurements on the eight transects.

Twisp River Site

The Twisp River site at RM 1.8 at a medium-low flow of 90 cfs has a wetted width of about 58 feet. Most of the habitat is cascade/riffle with no pool habitat over a substrate of mostly cobble and boulder. Eight transects were measured at flows of 308 cfs on 8-05-91, 166 cfs on 8-17-91, 90 cfs on 8-2991, and 35 cfs on 9-25-91. The four flows were well spaced for calibrating the hydraulic model. The flows were steady during measurement. No observable bed shifts occurred between flow measurements on the eight transects.

Chewuch River Site

The Chewuch River site at RM 1.8 at a medium-low flow of 120 cfs has a wetted width of about 85 feet. Most of the habitat is a fast glide/riffle with almost no pool habitat over a substrate of exposed bedrock with large cobble and small boulders. Seven transects were measured at flows of 290 cfs on 731-91, 236 cfs on 8-15-91, 121 cfs on 8-26-91, and 60 cfs on 9-23-91. The four flows were well spaced for calibrating the hydraulic model. The flows were steady during measurement. No observable bed shifts occurred between flow measurements on the seven transects.

Early Winters Creek Site

The Early Winters site at RM 1.0 at a medium-low flow of 80 cfs has a wetted width of about 52 feet. Most of the habitat is cascade with small pools over a substrate of mostly large cobble and boulder. One of the transects has 5 channels. Six transects were measured at flows of 227 cfs on 8-05-91, 132 cfs on 8-17-91, 78 cfs on 8-30-91, and 37 cfs on 9-27-91. The four flows were well spaced for calibrating the hydraulic model. The flows were steady during measurement. No observable bed shifts occurred between flow measurements on the six transects.

III. Hydraulic Model

Calibration Philosophy

Calibration of the hydraulic model involved checking the velocities and depths predicted by the model against velocities and depths measured in the field. This included examining indicators of the model's accuracy such as mean error and Velocity Adjustment Factor (VAF).

The calibration philosophy was to change data or to manipulate data using a computer calibration option only when doing so would improve the model's ability to extrapolate without reducing the accuracy of predicted depths and velocities at the measured calibration flows. Calibration of the IFG4 model was done cell by cell for each transect to decide whether the predicted cell velocities adequately represented measured velocities. Generally, if the predicted cell velocity at the calibration flow was within 0.2 feet per second (fps) of the measured cell velocity, the predicted velocity was considered adequate. Any change to a calibration velocity was limited to a change of 0.2 fps. The 0.2 fps was thought to be reasonable considering the normal range of velocity measurement error. All cell velocities were reviewed at the highest and lowest extrapolated flows to ensure that extreme cell velocities were not predicted.

Indicators of Model Accuracy

Two indicators of the IFG4 model's accuracy in predicting depths and velocities are the mean error and the Velocity Adjustment Factor (VAF). See Appendices B to H for mean errors and VAFS for each transect.

The mean error is the ratio of the calculated discharge (from depths and velocities at the measured flows) to the predicted discharge (from depth and velocity regressions). As a rule of thumb, the mean error for the calculated discharge should be less than 10 percent.

The Velocity Adjustment Factor (VAF) for a three-flow IFG4 hydraulic model indicates whether the flow predicted from the velocity/discharge regressions matches the- flow predicted from the stage/discharge regressions. The velocities predicted from the velocity/discharge regressions for a transect are all multiplied by the same VAF to achieve the flow predicted from the stage/discharge regression. Calculating and comparing the flows predicted from two different regressions gives an indication as to whether or not some of the model's assumptions are being met.

A range in the VAF value of 0.9 to 1.1 is considered good, 0.85 to 0.9 and 1.1 to 1.15 fair, 0.8 to 0.85 and 1.15 to 1.20 marginal, and less than 0.8 and more than 1.2 poor (Milhous, et al., 1984). The standard extrapolation range is 0.4 times the low calibration flow and 2.5 times the high calibration flow. The extrapolation range of the model is usually limited when two or more transects have VAFs which fall below 0.8 or above 1.2.

The VAFs for the one-flow IFG4 model do not have the same meaning as the three-flow IFG4 model. In a one-flow model the cell velocities are predicted from Manning's equation. All velocities on a transect are multiplied by the same VAF to achieve the flow predicted from the stage/discharge regression. The VAF range listed above does not apply to one-flow model VAFs. Instead of predicting velocities from a velocity/discharge regression (three-flow IFG4), the velocities are predicted from Manning's equation using a constant roughness factor (N). The bottom roughness factor is highest at low flow and becomes progressively lower as flow increases. Because the N value calculated by the computer is constant, the N value used to predict higher flow velocities is usually too high. The VAF corrects this problem by changing the velocities predicted to arrive at the flow on the stage/discharge regression. The VAF will be nearly one at the measured flow, usually less than one at lower flows, and more than one at higher flows.

Normal empirical values for bottom roughness do not apply to these Manning's Ns. These Ns are used only for calibrating velocities in the IFG4 hydraulic model.

Options in IFG4 Model

Several options are available in the IFG4 hydraulic model (see Milhous et al, 1989). Ecology's standard method is to set all the options to zero except for option 8 which is set at 2, and option 13 to 1 to get a summary of the velocity adjustment factors. The standard options were used for all models except for the KOA and Chewuch sites where option 22 was set at 1 to allow the model to run even though one cell had a regression slope greater than 3. The cell in each model correctly predicted velocities even though it was a steep regression.

Site Specific Calibration

Walsh Site on the Methow River

A three-flow IFG4 model was run for this site. The IFG4 input file, a summary of the calibration details, data changes, and the VAFS are included as Appendix B. The mean errors of the stage/discharge regressions range from 0.92 to 7.49 percent, all less than the 10 percent rule of thumb. Overall, the IFG4 model. is adequate for the standard extrapolation range of 124 to 3590 cfs.

KOA Site on the Methow River

A three-flow IFG4 model was run for this site. The IFG4 input file, a summary of the calibration details, data changes, and VAFS are in Appendix C. The mean errors of the stage/discharge relationships range from 0.29 to 4.33 percent. The model is adequate for the standard extrapolation range of 92 to 2838 cfs.

Weeman Site on the Methow River

A four-flow IFG4 model was run for this site. The IFG4 input file, a summary of calibration details, and VAFS are in Appendix D. The mean errors of the stage/discharge relationships range from 1.07 to 5.06 percent and are all less than the 10 percent guideline. The model is adequate for the standard extrapolation range of 45 to 1300 cfs.

A separate three-flow model was run for a side channel on the right side of transects 1 to 4. The side channel was fed by river flow. The side channel's mean errors were high, but insignificant and no calibration was needed. The E errors were from 0.1 to 0.4 cfs in predicting total flow. The measured flows ranged from 0.3 to 4.9 cfs. A small error at such small flows creates a large percentage error that is not significant.

A spring-fed side channel ran along the left side of transects 3 to 8, but it was not included since its flow was essentially constant even as the river dropped from 658 to 79 cfs.

Chokecherry Site on the Methow River

A four-flow IFG4 model was run for this site. The IFG4 input file, a summary of calibration details, and VAFS are in Appendix E. The mean errors of the stage/discharge relationship range from 1.06 to 8.91 percent and all are .less than the 10 percent guideline. The model is adequate for the standard extrapolation range of 16 to 1600 cfs.

Twisp River Site

A four-flow IFG4 model was run for this site. The IFG4 input file, a summary of calibration details, and VAFS are in Appendix F. The mean errors of the stage/discharge relationships range from 2.15 to 7.64 percent and all are less than the 10 percent guideline. The model is adequate for the standard extrapolation range of 13 to 750 cfs.

Chewuch River Site

A four-flow IFG4 model was run for this site. The IFG4 input file, a summary of calibration details, and VAFS are in Appendix G. The mean errors of the stage/discharge relationships range from 1.27 to 9.50 percent and all are less than the 10 percent guideline. The model is adequate for the standard extrapolation range of 25 to 725 cfs.

Early Winters Creek Site

A four-flow IFG4 model was run for this site for transects 3 to 7. The IFG4 input file, a summary of calibration details, and VAFS are in Appendix H. The mean errors of the stage/discharge relationships range from 2.39 to 10.88.

Transect 8 consisted of 5 channels. Channels 1 and 4 were run as four-flow IFG4 models. Channel 3 was run as a three-flow IFG4 model. Channels 2 and 5 were run as one-flow IFG4 models using the highest flow depths and velocities with four stage/discharges.

The overall model is adequate for the standard extrapolation range of 15 to 575 cfs.

Transect Weighting

Appendix I lists the percent weighting each transect received relative to the whole site. Transect weighting is determined one of two ways; either the model automatically determines weighting for each transect by using the distance between the transects or transect weight is set to predetermined levels by specifying distances between transects (this is composite weighing). Composite weighing is done when the transects are located far apart and the distances between the transects would create incorrect weighing, or the researcher wants to increase the weight of a particular type of fish habitat for that site. Transect weighting for the Methow basin IFIM sites was done using distances between transects, with only a few transects requiring composite weighting because of an unusually large spread between transects that would have given one transect far too much weight.

Agency and Tribal Approval of the Hydraulic Model

A meeting was held May 1, 1992 by Ecology to discuss and achieve a consensus on the adequacy of the Methow basin hydraulic models. Those in attendance were Dale Bambrick (YIN), Hal Beecher (WDW), and Brad Caldwell (Ecology). Also invited to the meeting were the WDF, USFWS, NMFS, and Jon Hansen (CCT). Consensus was achieved that the hydraulic models were calibrated adequately. Agreement was reached that there was no problem using a normal extrapolation range of 0.4 times the low calibration flow and 2.5 times the high calibration flow. Attendees also agreed to natural transect weighting with some composite weighting for the sites.

IV. HABITAT-USE MODEL (HABTAT)

Options Used in HABTAT

The HABTAT program combines the depths and velocities predicted from the IFG4 hydraulic model with the depths, velocities, cover, and substrate preferences from the habitat-use curves. The HABTAT program calculates WUA for each flow modeled. The IOC options used in HABTAT were 10000001010000.

Selection and Approval of Habitat-Use Curves Used in HABTAT

A meeting was held May 1, 1992 by Ecology to discuss and achieve a consensus on the habitat-use curves to be used with the hydraulic models. Those in attendance were Dale Bambrick (YIN), Hal Beecher (WDW), and Brad Caldwell (Ecology). Also invited to the meeting were the WDF, USFWS, NMFS, and Jon Hansen (CCT).

Consensus was achieved to use WDF's and Ecology's standard set of river and stream curves for Chinook salmon and WDW's standard curves for steelhead and bull trout (See Appendix J1). The Chinook curves matched closely the preference curves created by M. Stempel in 1984 from Yakima River spring Chinook since his data was given heavy weighting when the standard set of river curves were created. The trout curves were recently modified by Hal Beecher (WDW) using data from nearby basins.

For the Methow River sites, Walsh and KOA, habitat-use river curves were run for steelhead (spawning and juvenile), Chinook (spawning, rearing, and holding), and bull trout (rearing).

For the Methow River sites, Weeman and Chokecherry, habitat-use river curves were run for steelhead (spawning and juvenile), Chinook (spawning, rearing, and holding), and bull trout (spawning and rearing).

For the Chewuch, Twisp, and Early Winters Creek sites habitat-use stream curves were run for steelhead (spawning and rearing), Chinook (spawning and rearing), and bull trout (spawning and rearing).

The depth and velocity habitat-use curves and the substrate/cover codes used are in Appendices J1 and J2, respectively.

V. RESULTS AND DISCUSSION

The habitat versus flow results are presented in Appendix A. The figures are grouped by site: first the Walsh site, then the KOA site, Weeman site, Chokecherry site, Twisp River site, Chewuch River site, and finally the Early Winters Creek site. The figures are ordered by area, and then by fish species: steelhead, Chinook, and bull trout.

The flows that provide peak habitat values for each lifestage at each IFIM site are given in Table 2.

Each IFIM site and the corresponding minimum instream flow established by Ecology in 1976 is given in Table 3.

Factors To Consider When Developing A Flow Regime

Determining a minimum instream flow for a river or stream in the Methow basin requires more thought than choosing the peak WUA flow for one lifestage of one species at one reach from the IFIM study. For multiple lifestages existing simultaneously in a river, there is no one flow that will provide an optimum flow for all lifestages and species. Setting a minimum instream flow for a river or stream in the basin requires ranking the importance of each fish species and lifestage. This ranking requires a consensus on long-range management plans for the fishery resources from the state and federal natural resource agencies, and the Colville and Yakima Indian Nations.

In addition, minimum instream flows must include flows necessary for incubation of fish eggs, smolt out-migration, fish passage to spawning grounds, and prevention of stranding of fry and juveniles. These are variables not measured in an IFIM study. These variables require using your best professional judgement. Other variables which have to be considered include water temperature, water quality, and sediment load.

Table 2. The 1976 Adopted Minimum Instream Flows for the Methow River Basin.

Base Flows for Methow River (from WAC.173-148)
All figures in cfs

DATE	**LOWER METHOW** (Pateros to Twisp) Gauge at RM 40.0	**MIDDLE METHOW** (Twisp to Winthrop) Little Boulder Cr.)	**UPPER METHOW** (Winthrop to Little Boulder Cr.) Gauge at RM 50.2	**METHOW HEADWATERS** (All above mouth Measured at RM 65.3	**EARLY WINTERS CR.** Measured near	**CHEWACK RIVER** Gauge at RM 8.7	**TWISP RIVER** Gauge at RM 6.7
Jan. 1	350	260	120	42	10	56	34
Jan. 15	350	260	120	42	10	56	34
Feb. 1	350	260	120	42	10	56	34
Feb. 15	350	260	120	42	10	56	34
Mar. 1	350	260	120	42	10	56	34
Mar. 15	350	260	120	42	10	56	34
Apr. 1	590	430	199	64	14	90	60
Apr. 15	860	650	300	90	23	140	100
May1	1300	1000	480	130	32	215	170
May 15	1940	1500	690	430	108	290	300
June 1	2220	1500	790	1160	290	320	440
June 15	2220	1500	790	1160	290	320	440
July 1	2150	1500	694	500	125	292	390
July Is	800	500	240	180	45	110	130
Aug.1	480	325	153	75	20	70	58
Aug. 15	300	220	100	32	8	47	27
Sep. 1	300	220	100	32	8	47	27
Sep. 15	300	220	100	32	8	47	27
Oct. 1	360	260	122	45	11	56	35
Oct. 15	425	320	150	60	15	68	45
Nov. 1	425	320	150	60	15	68	45
Nov. 15	425	320	150	60	15	68	45
Dec. 1	390	290	135	51	12	62	39
Dec. 15	350	260	120	42	10	56	34
Represented in this study by	Walsh Site RM 31.5	KOA Site RM 49.0	Weeman Site - RM 59.0	Chokecherry Site - RM 66.5	Early Winters Cr. Site - RM 1.0	Chewuch River Site - RM 1.3	Twisp River Site - RM 1.8

Table 3. Flows that provide maximum habitat from WUA vs. Flow results.

Flow in cfs

SITE	STEELHEAD		BULL TROUT		CHINOOK SALMON		
	SPAWNING	JUVENILE REARING	SPAWNING	JUVENILE REARING	SPAWNING	JUVENIL REARING	ADULT HOLDING
WALSH (RM 31.5)	1000	1050	*	1400	1050	600	2000
KOA (RM 49)	800	650	*	1000	650	200	1300
WEEMAN (RM 59)	650	425	350	700	600	85	800
CHOCKECHERRY (RM 66.5)	500	500	75	600	400	250	850
TWISP RIVER (RM 1.8)	250	200	50	225	150	80	**
CHEWUCH RIVER (RM 1.3)	425	400	175	400	275	150	**
EARLY WINTERS CREEK (RM 1.0)	475	150	575+	175	325	50	**

* Bull Trout are not likely to spawn this low in the river system.
**Chinook adults are not likely to hold in the smaller tributary streams.

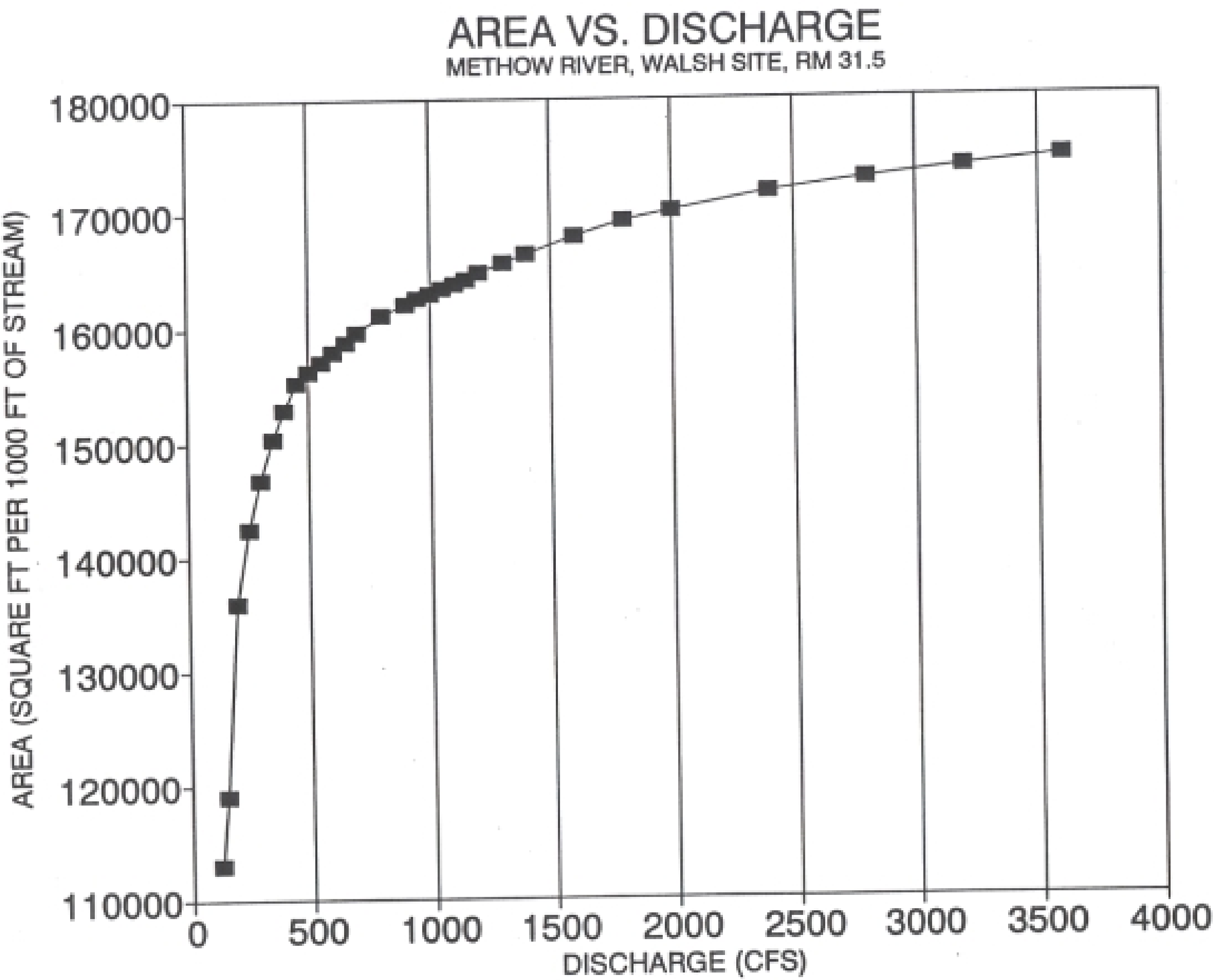
Appendix A

WUA VS FLOW GRAPHS

MEASURED:

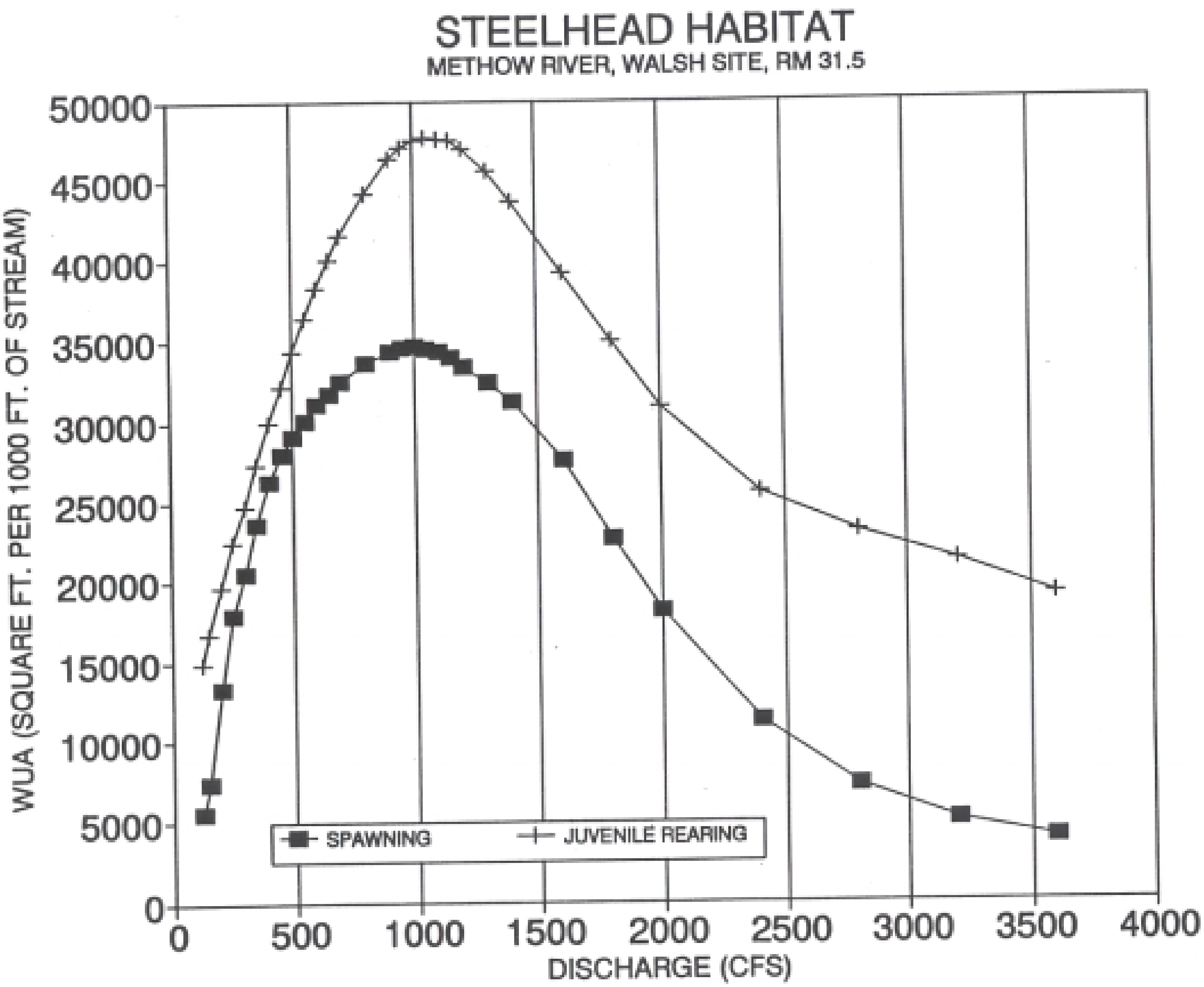
437 cfs	08/01/91
589 cfs	08/28/91
311 cfs	09/24/91

FLOW	AREA
125	112978
150	119048
200	136030
250	142472
300	146772
350	150269
400	152854
450	155225
500	156193
550	157057
600	157865
650	158766
700	159590
800	161032
900	162033
950	162512
1000	162957
1050	163387
1100	163801
1150	164202
1200	164775
1300	165676
1400	166299
1600	168000
1800	169263
2000	170157
2400	171695
2800	172796
3200	173780
3600	174678



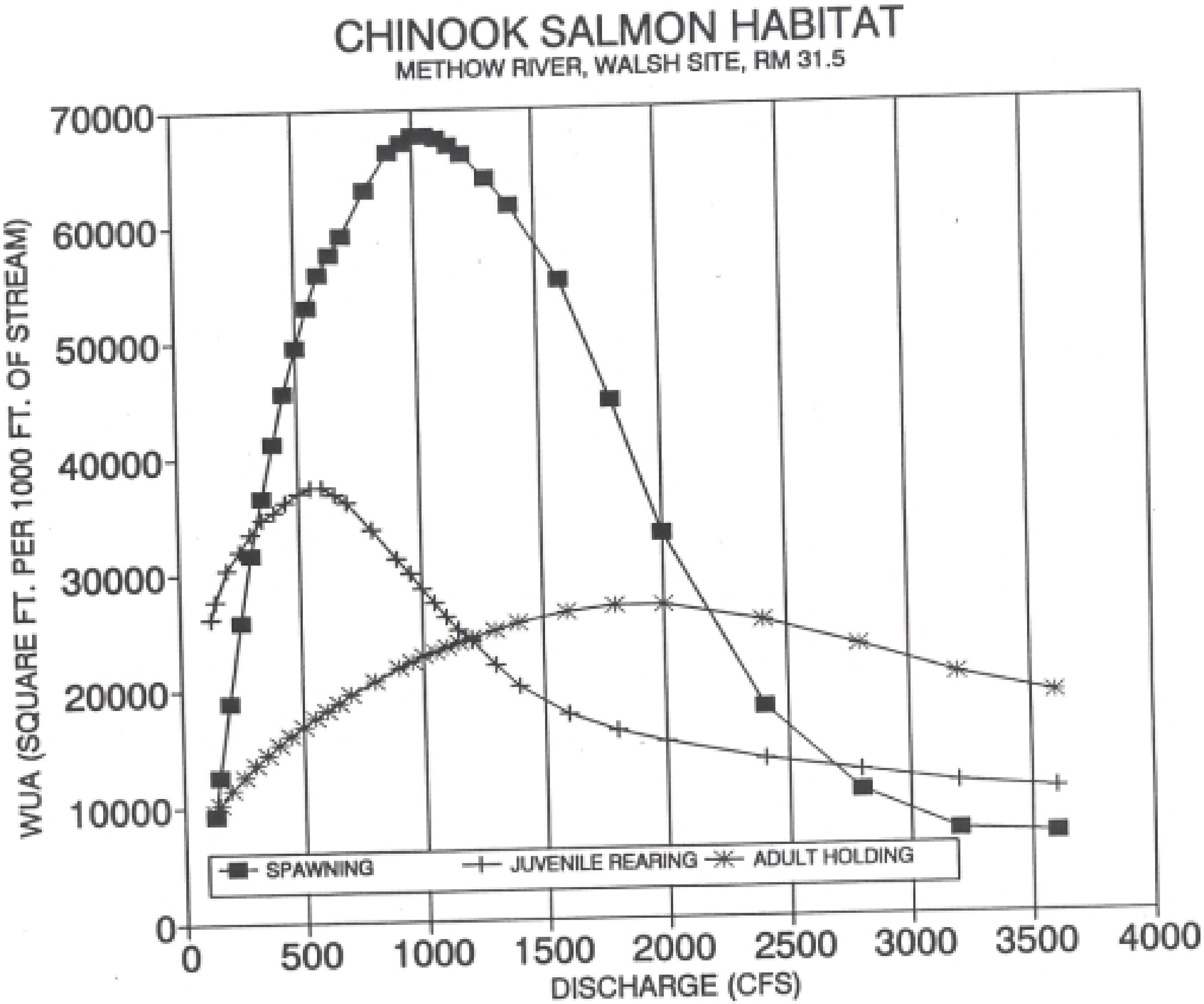
MEASURED:
1437 cfs 08/01/91
589 cfs 08/28/91
311 cfs 09/24/91

FLOW	SPAWNING	JUVENILE
125	5531	14914
150	7375	16701
200	13329	19719
250	17928	22434
300	20567	24753
350	23592	27322
400	26343	29979
450	27988	32197
500	29065	34377
550	30077	36418
600	31068	38343
650	31745	40132
700	32466	41554
800	33681	44166
900	34359	46414
950	34585	47059
1000	34690	47549
1050	34540	47693
1100	34315	47618
1150	33964	47476
1200	33418	47031
1300	32387	45600
1400	31190	43647
1600	27505	39229
1800	22631	34916
2000	18114	30806
2400	11182	25554
2800	7210	23108
3200	5035	21282
3600	3906	19080



MEASURED:
1437 cf 08/01/91
589 cfs 08/28/91
311 cfs 09/24/91

FLOW	SPAWNING	JUVENILE	ADULT
125	9247	26218	9553
150	12550	27689	10233
200	18891	30332	11443
250	25736	31993	12528
300	31650	33500	13502
350	36605	34633	14389
400	41281	35346	15219
450	45618	36208	16010
500	49577	36896	16747
550	52994	37364	17454
600	55792	**37370**	18129
650	57589	36851	18796
700	59194	36034	19438
800	63098	33759	20632
900	66380	31098	21701
950	67126	29807	22193
1000	67683	28506	22651
1050	**67769**	27268	23056
1100	67415	26080	23449
1150	66862	24944	23816
1200	66149	23888	24156
1300	64039	21873	24800
1400	61681	19966	25361
1600	55069	17446	26256
1800	44547	15979	26732
2000	32951	15047	**26740**
2400	17856	13421	25249
2800	10579	12253	23012
3200	7138	11203	20483
3600	6798	10539	18722

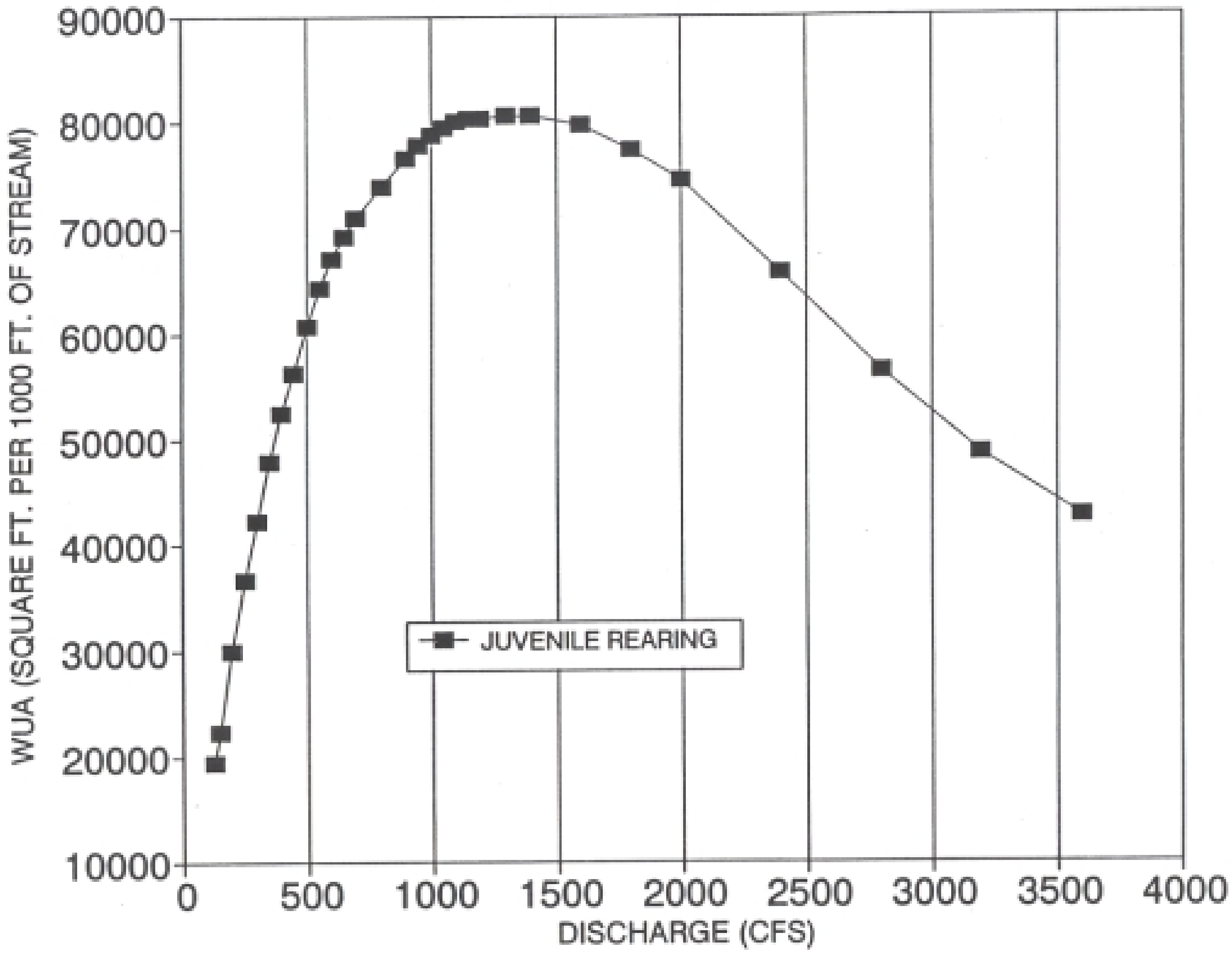


MEASURED:
1437 cfs 08/01/91
589 cfs 08/28/91
311 cfs 09/24/91

FLOW	JUVENILE
125	19386
150	22402
200	30055
250	36670
300	42205
350	47784
400	52507
450	56148
500	60679
550	64257
600	67068
650	69136
700	70920
800	73915
900	76494
950	77788
1000	78819
1050	79483
1100	79975
1150	80256
1200	80301
1300	80523
1400	80542
1600	79768
1800	77439
2000	74513
2400	65716
2800	56318
3200	48562
3600	42518

BULL TROUT HABITAT

METHOW RIVER, WALSH SITE, RM 31.5



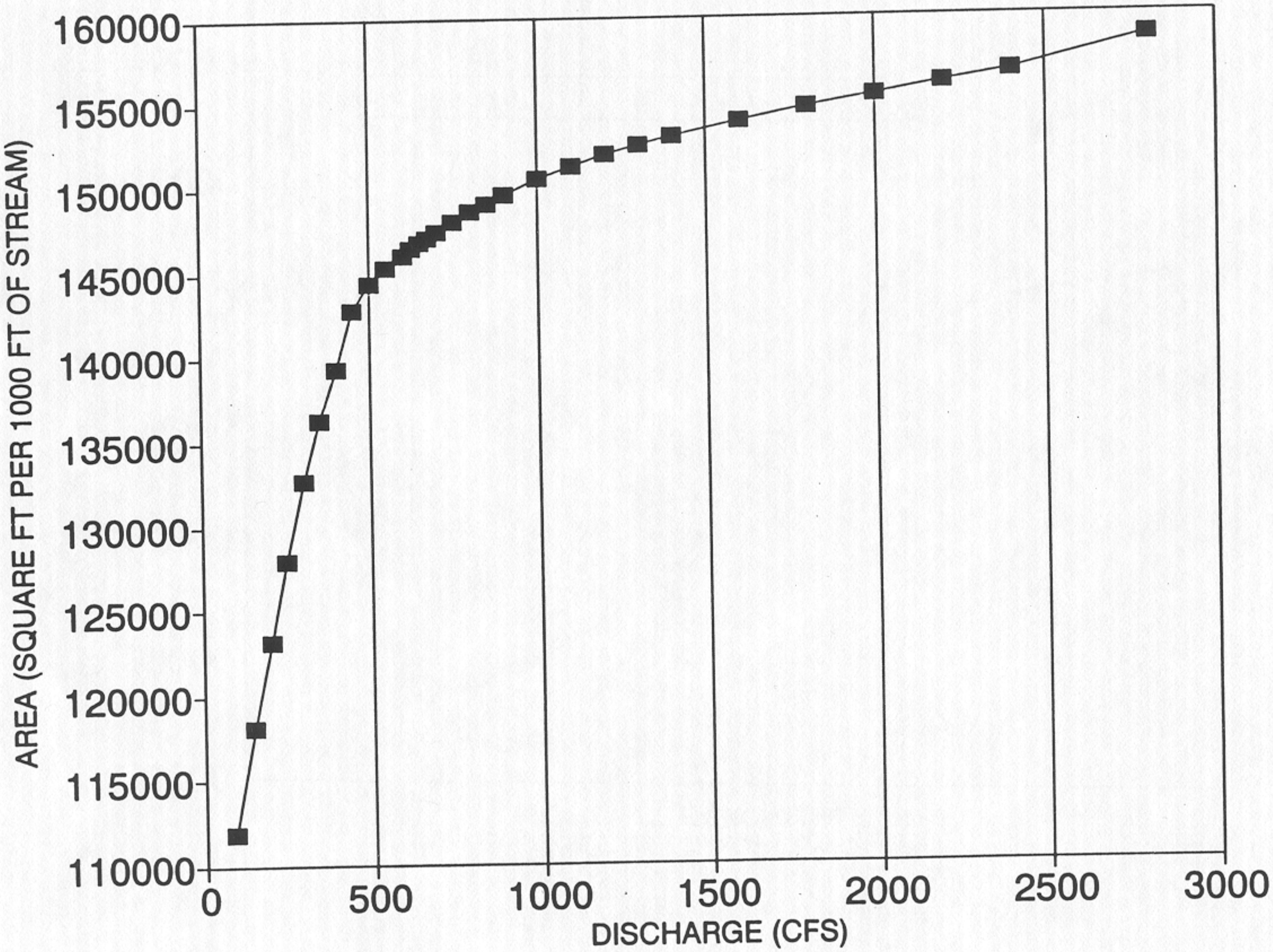
AREA VS. DISCHARGE

METHOW RIVER, KOA SITE, RM 49.0

MEASURED:

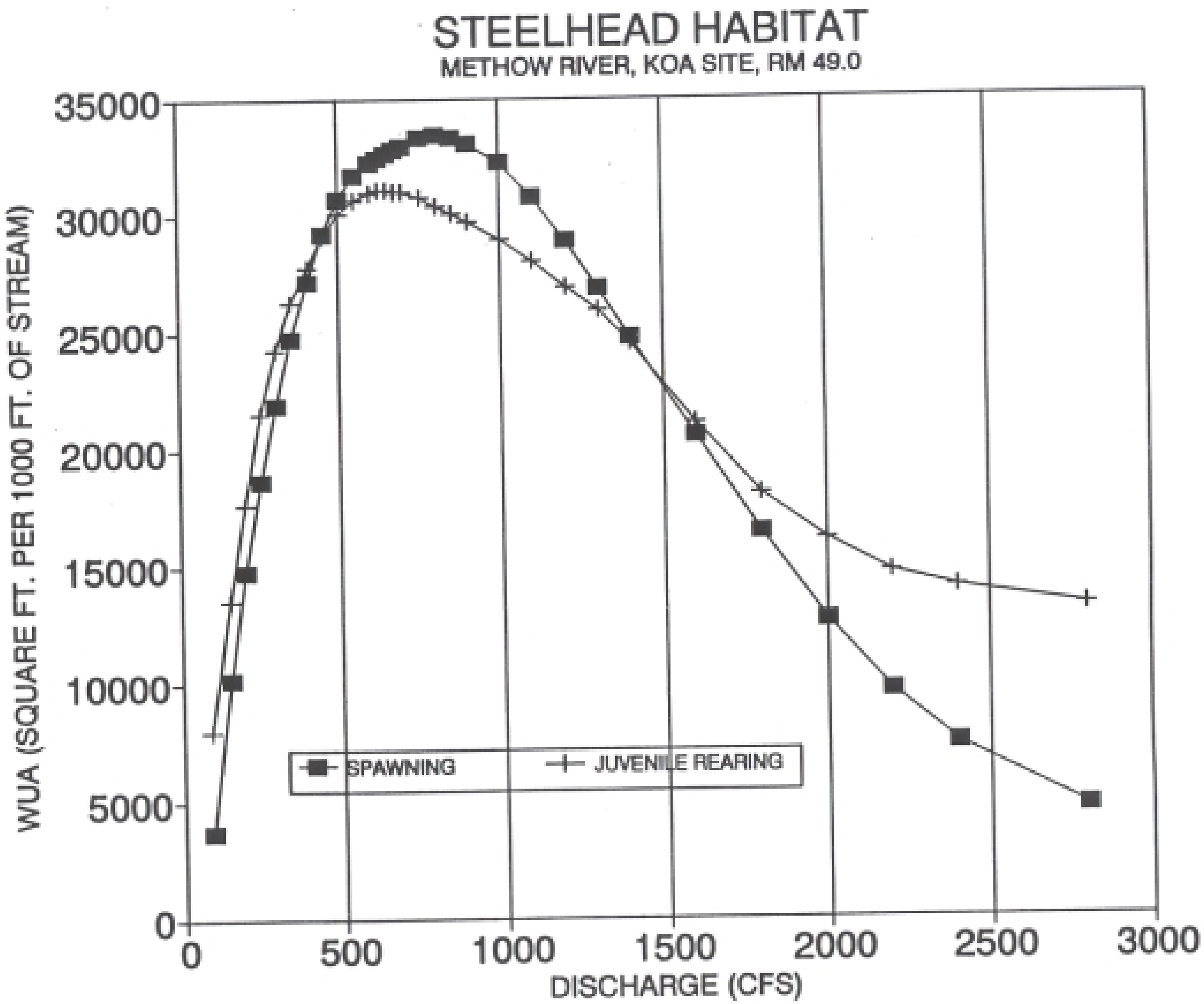
1135 cfs	08/02/91
457 cfs	08/29/91
229 cfs	09/25/91

FLOW	AREA
90	111879
150	118167
200	123216
250	128008
300	132696
350	136286
400	139351
450	142791
500	144330
550	145355
600	146061
625	146412
650	146762
675	147102
700	147434
750	148060
800	148595
850	149109
900	149604
1000	150534
1100	151275
1200	151928
1300	152459
1400	152964
1600	153880
1800	154645
2000	155383
2200	156043
2400	156626
2800	158607



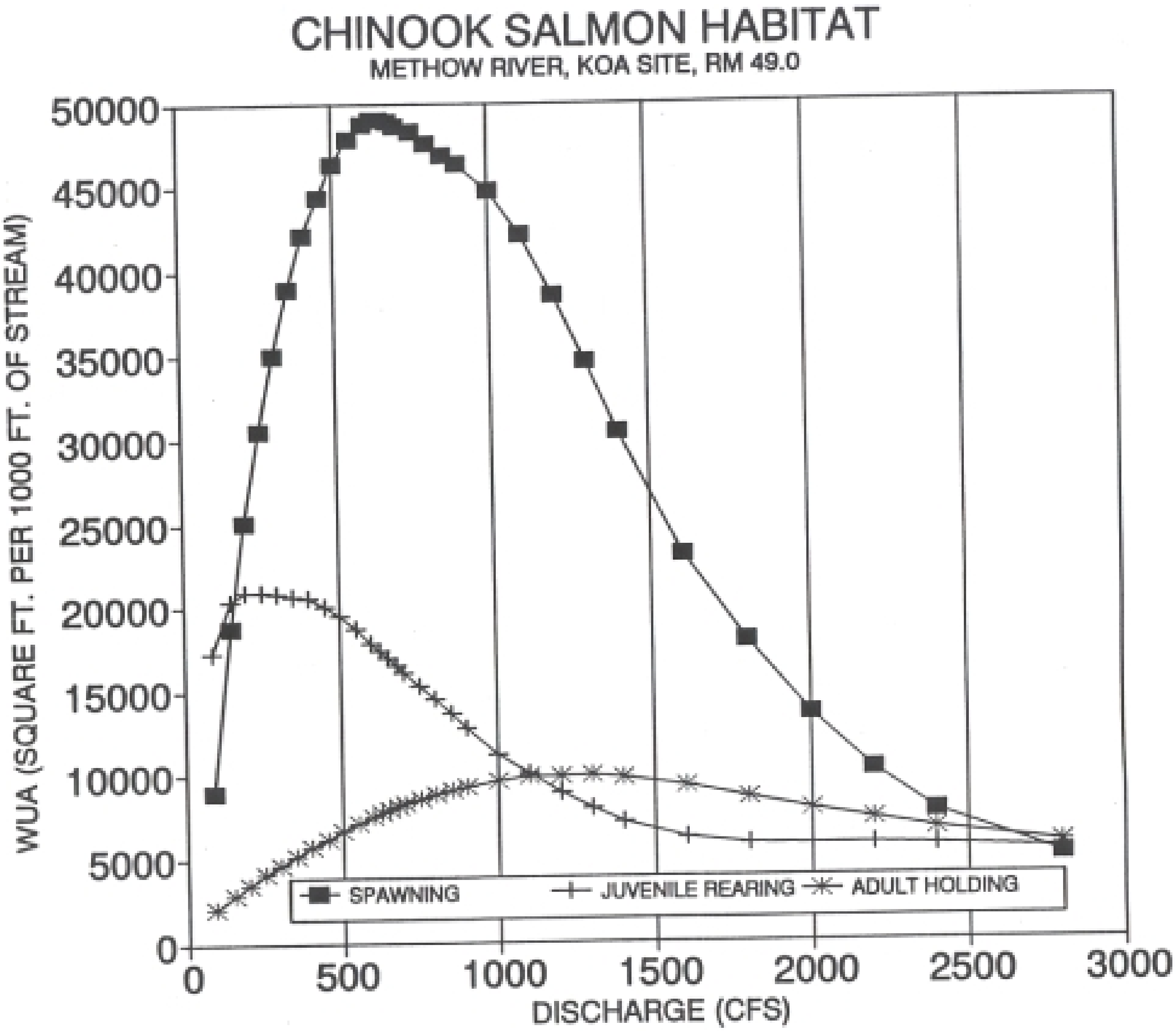
MEASURED:
1135 cfs 08/02/91
457 cfs 08/29/91
229 cfs 09/25/91

FLOW	SPAWNING	JUVENILE
90	3655	7921
150	10155	13496
200	14761	17654
250	18648	21521
300	21941	24243
350	24754	26333
400	27207	27782
450	29221	29100
500	30709	30082
550	31692	30649
600	32253	30979
625	32461	31067
650	32628	31072
675	32778	31039
700	32952	30990
750	33286	30773
800	33397	30401
850	33319	30064
900	33075	29722
1000	32278	28999
1100	30757	28032
1200	28912	26928
1300	26886	25937
1400	24785	24514
1600	20533	21097
1800	16410	18117
2000	12631	16098
2200	9633	14695
2400	7402	14007
2800	4680	13191



MEASURED:
135 cfs 08/02/91
457 cfs 08/29/91
229 cfs 09/25/91

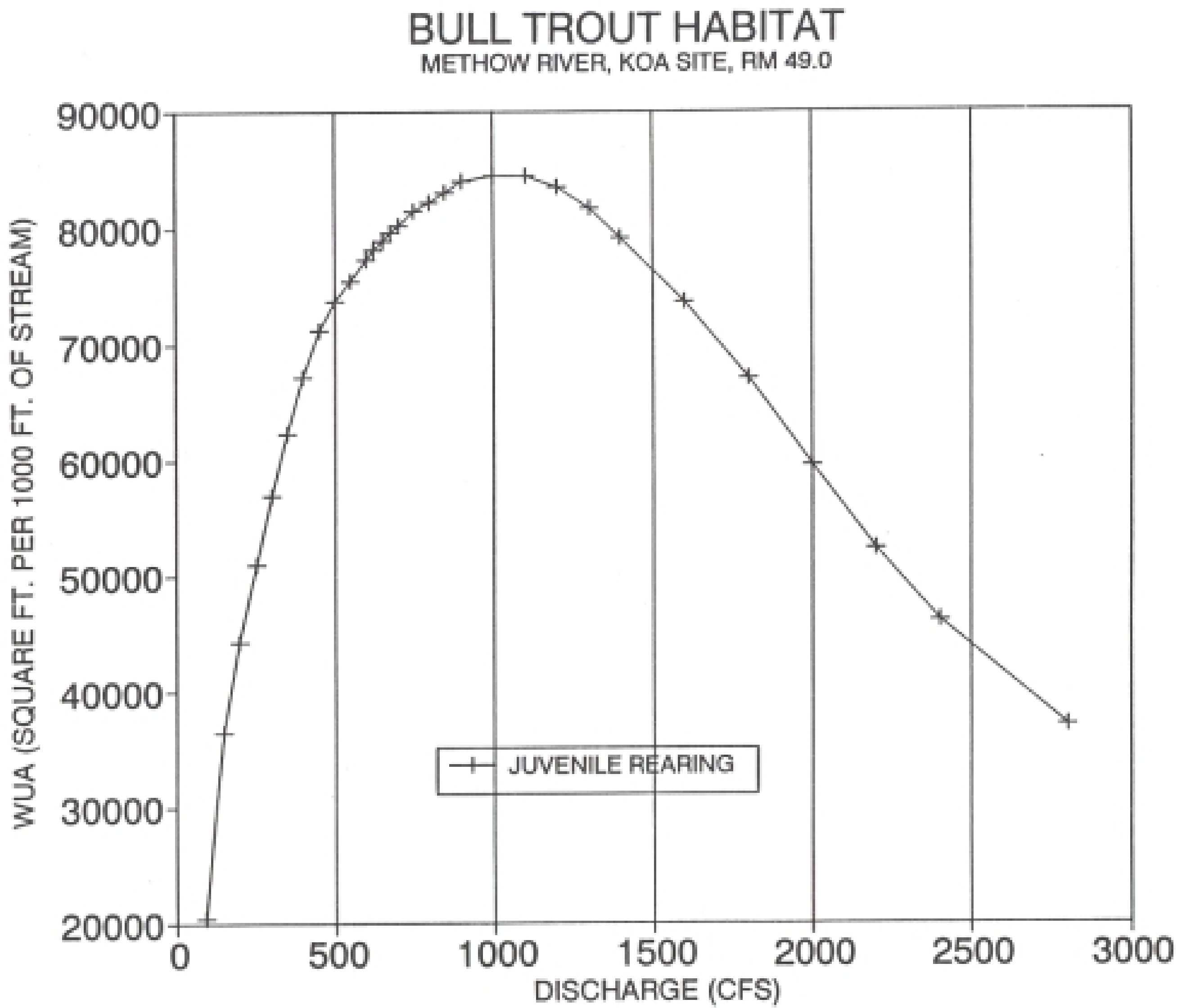
FLOW	SPAWNING	JUVENILE	ADULT
90	8959	17337	2031
150	18807	20391	2884
200	25047	20930	3509
250	30467	20895	4086
300	34965	20826	4644
350	38932	20660	5174
400	42117	20511	5672
450	44408	20060	6148
500	46381	19506	6610
550	47807	18729	7059
600	48694	17831	7478
625	48944	17384	7674
650	48995	16948	7860
675	48880	16520	8037
700	48674	16098	8206
750	48250	15316	8517
800	47593	14461	8788
850	46908	13583	9023
900	46353	12687	9226
1000	44733	11166	9566
1100	42159	9969	9774
1200	38531	8846	9847
1300	34564	7846	9881
1400	30318	7086	9757
1600	22981	6155	9230
1800	17950	5745	8480
2000	13496	5681	7786
2200	10132	5645	7132
2400	7649	5621	6524
2800	4999	5363	5681



MEASURED:

1135 cfs	08/02/91
457 cfs	08/29/91
229 cfs	09/25/91

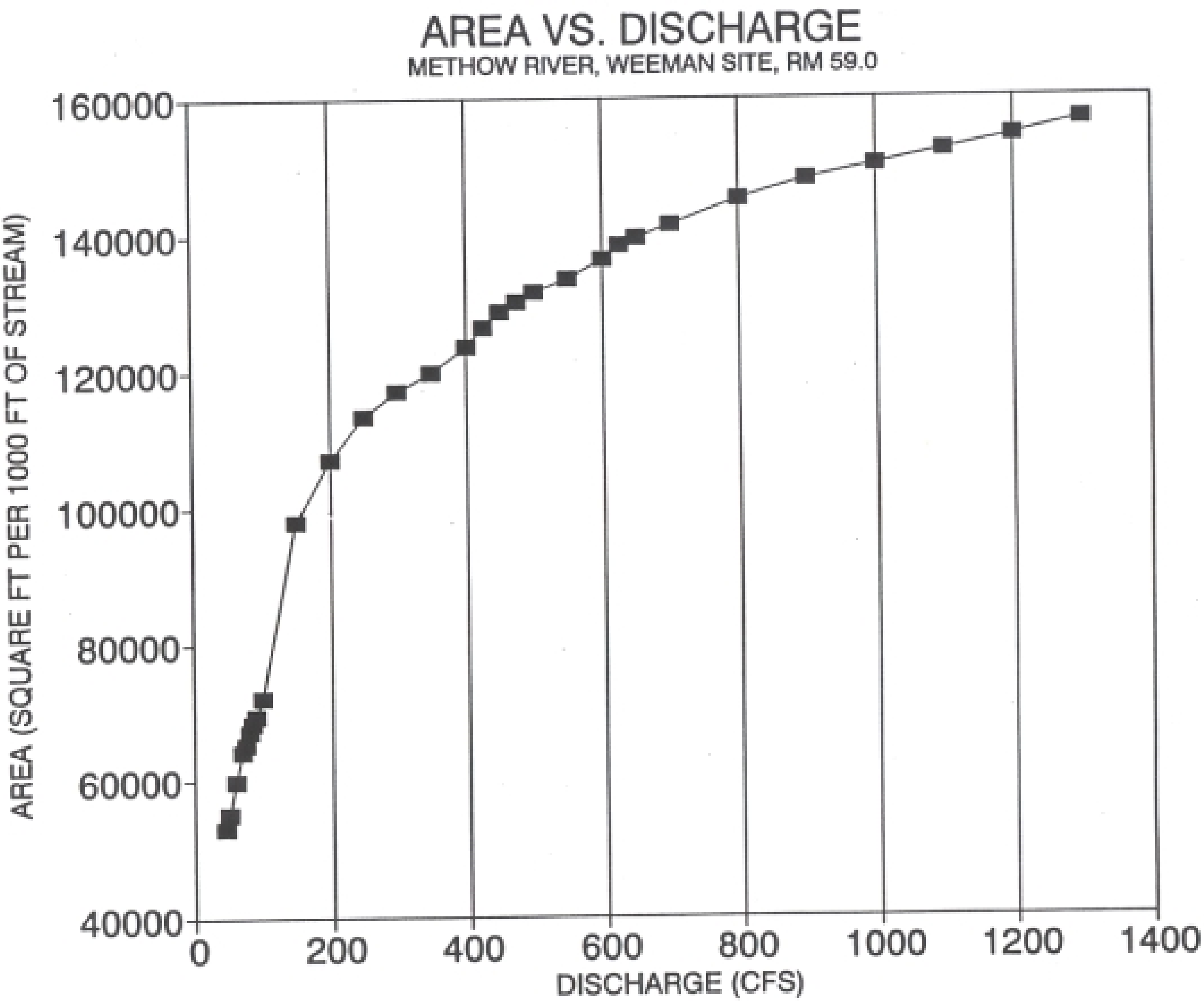
FLOW	JUVENILE
90	20480
150	36346
200	44248
250	50972
300	56917
350	62247
400	67162
450	71208
500	73753
550	75472
600	77276
625	78065
650	78814
675	79584
700	80244
750	81396
800	82087
850	83023
900	83910
1000	84510
1100	84491
1200	83468
1300	81701
1400	79074
1600	73597
1800	66952
2000	59425
2200	52268
2400	46034
2800	37007



MEASURED:

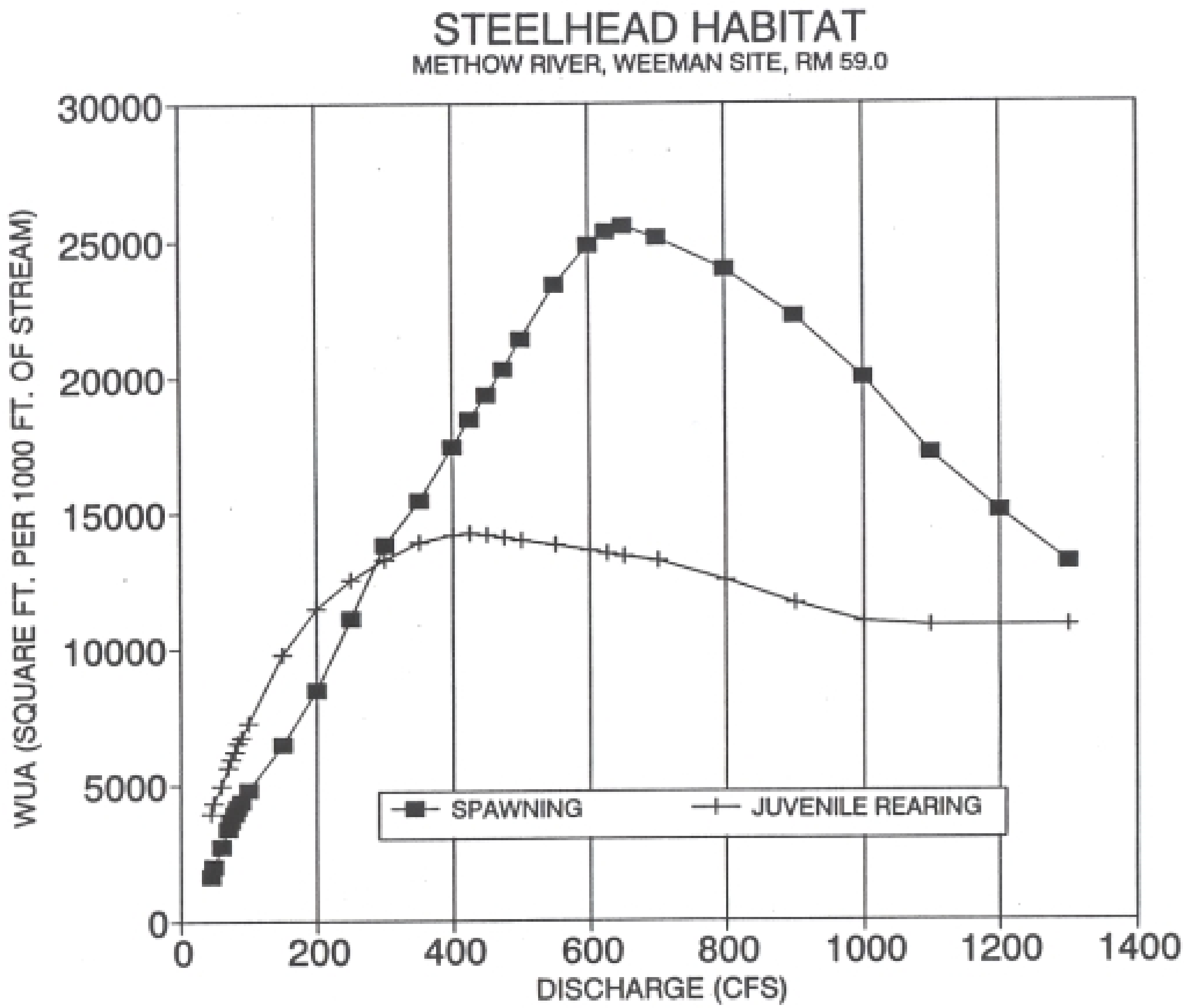
658 cfs	08/03/91
380 cfs	08/16/91
238 cfs	08/27/91
79 cfs	09/26/91

FLOW	AREA
45	52978
50	55180
60	59767
70	64143
75	65201
80	67184
85	68334
90	69437
100	72128
150	97858
200	107101
250	113303
300	117155
350	119725
400	123447
425	126516
450	128607
475	130062
500	131514
550	133561
600	136368
625	138544
650	139497
700	141364
800	145032
900	147992
1000	150196
1100	152152
1200	154269
1300	156482



MEASURED:
658 cfs 08/03/91
380 cfs 08/16/91
238 cfs 08/27/91
79 cfs 09/26/91

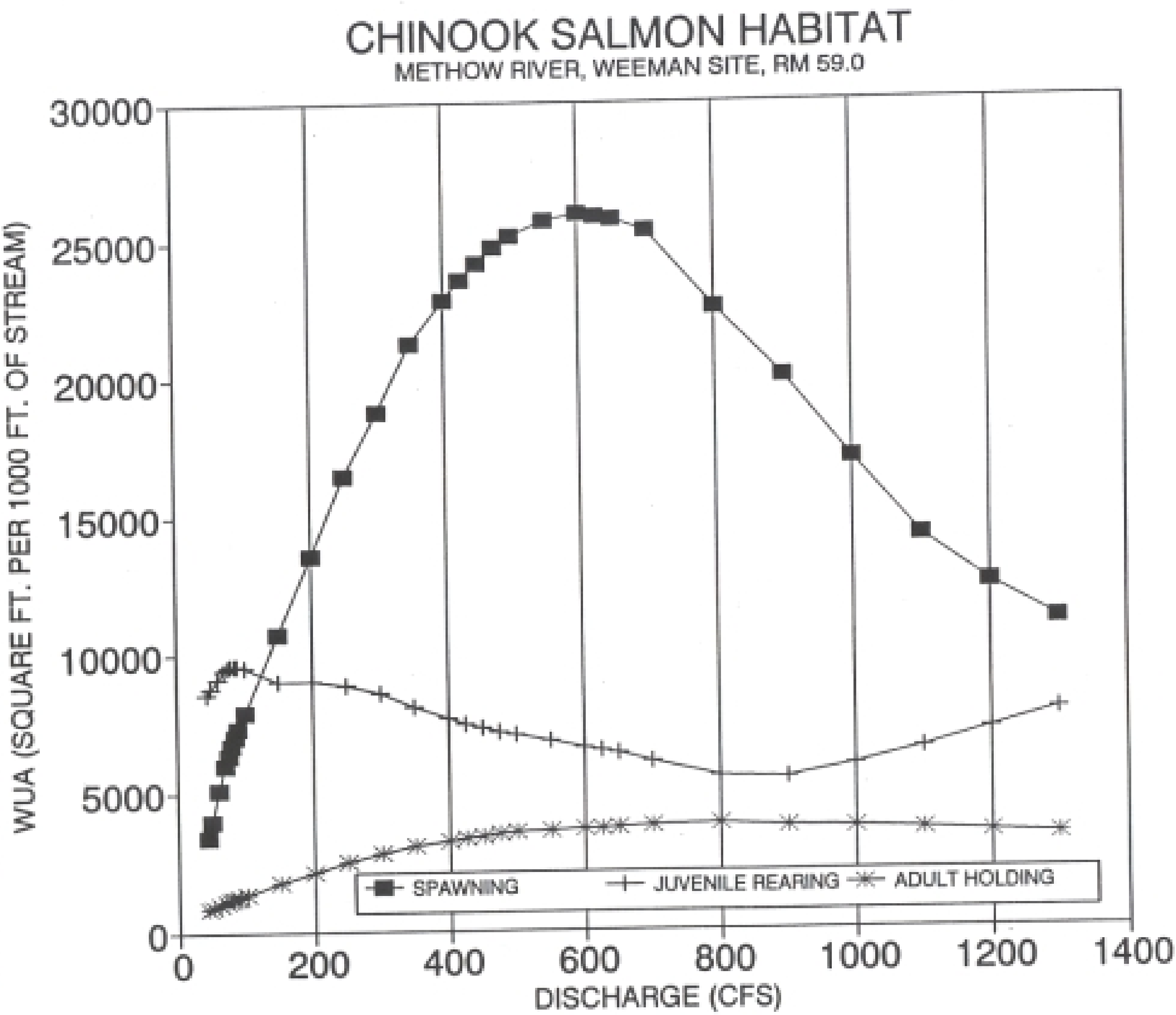
FLOW	SPAWNING	JUVENILE
45	1612	3916
50	1959	4281
60	2690	4937
70	3351	5591
75	3644	5899
80	3900	6207
85	4130	6479
90	4350	6729
100	4769	7257
150	6447	9783
200	8463	11443
250	11099	12489
300	13738	13216
350	15404	13880
400	17392	14142
425	18369	14195
450	19284	14135
475	20245	14025
500	21338	13919
550	23332	13778
600	24828	13549
625	25311	13436
650	25483	13349
700	25090	13177
800	23903	12462
900	22186	11583
1000	19919	10915
1100	17147	10767
1200	14983	10742
1300	13079	10775



MEASURED:

658 cfs	08/03/91
380 cfs	08/16/91
238 cfs	08/27/91
79 cfs	09/26/91

FLOW	SPAWNING	JUVENILE	ADULT
45	3433	8576	857
50	4012	8776	907
60	5101	9132	1005
70	5999	9454	1100
75	6374	9546	1145
80	6720	9596	1190
85	7027	9613	1233
90	7342	9594	1276
100	7913	9533	1363
150	10742	9009	1777
00	13584	9028	2145
50	16439	8874	2478
00	18772	8583	2786
50	21245	8076	3041
00	22836	7633	3240
25	23524	7442	3317
50	24148	7307	3386
75	24719	7148	3449
500	25150	7014	3504
550	25687	6816	3574
600	25949	6573	3618
625	25841	6466	3648
650	25759	6352	3685
700	25348	6032	3745
800	22504	5486	3781
900	19974	5445	3703
1000	17004	5885	3617
1100	14178	6468	3502
1200	12422	7109	3401
1300	11090	7784	3299



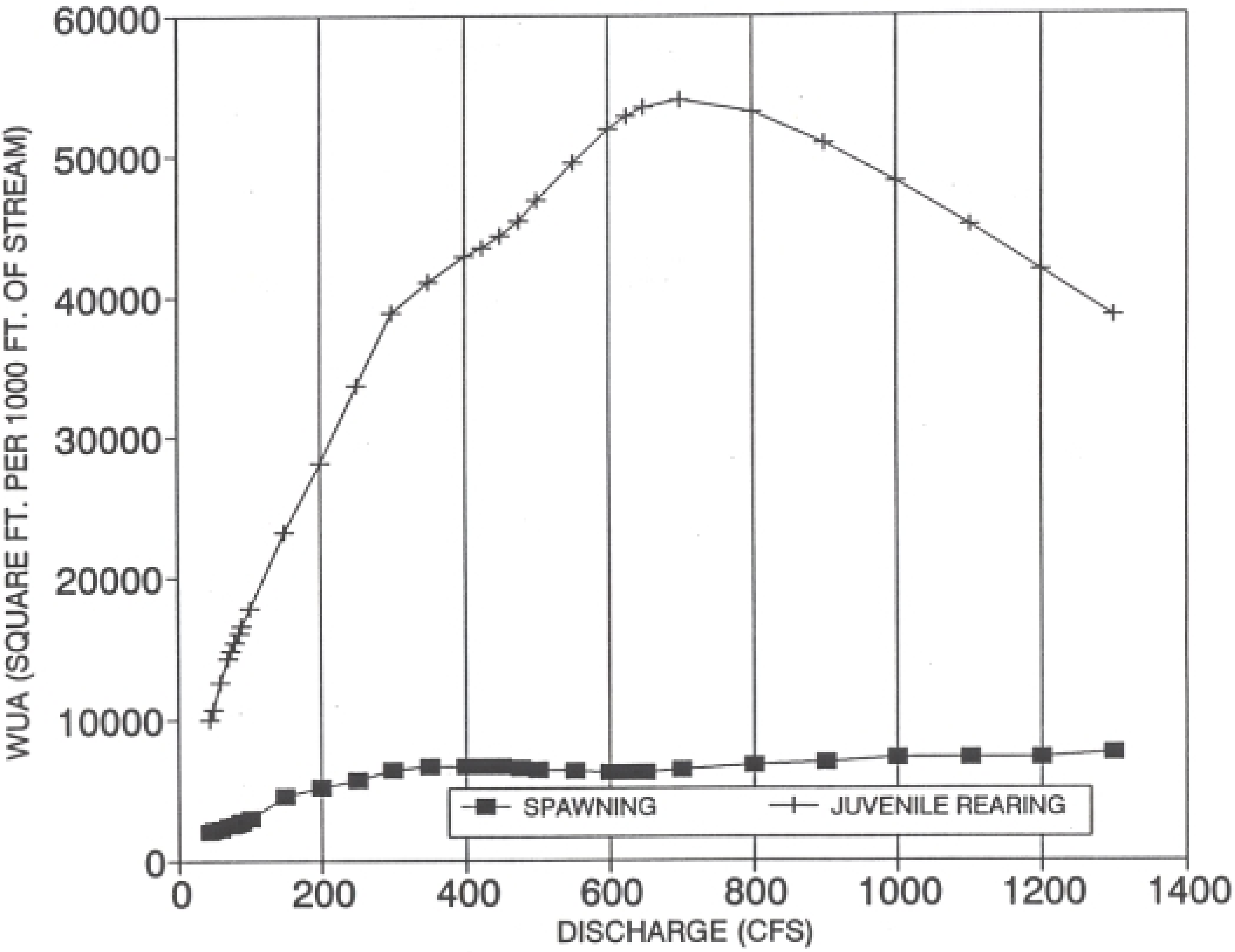
MEASURED:

658 cfs	08/03/91
380 cfs	08/16/91
238 cfs	08/27/91
79 cfs	09/26/91

FLOW	SPAWNING	JUVENILE
45	1993	9988
50	2100	10730
60	2268	12573
70	2419	14203
75	2455	14798
80	2550	15402
85	2663	15970
90	2783	16572
100	3007	17822
150	4546	23219
200	5142	28142
250	5705	33619
300	6369	38826
350	6668	41092
400	6660	42856
425	6666	43495
450	6641	44282
475	6542	45290
500	6438	46800
550	6281	49523
600	6180	51922
625	6210	52898
650	6259	53521
700	6454	54033
800	6745	53114
900	6934	50823
1000	7237	48183
1100	7247	45001
1200	7264	41835
1300	7545	38547

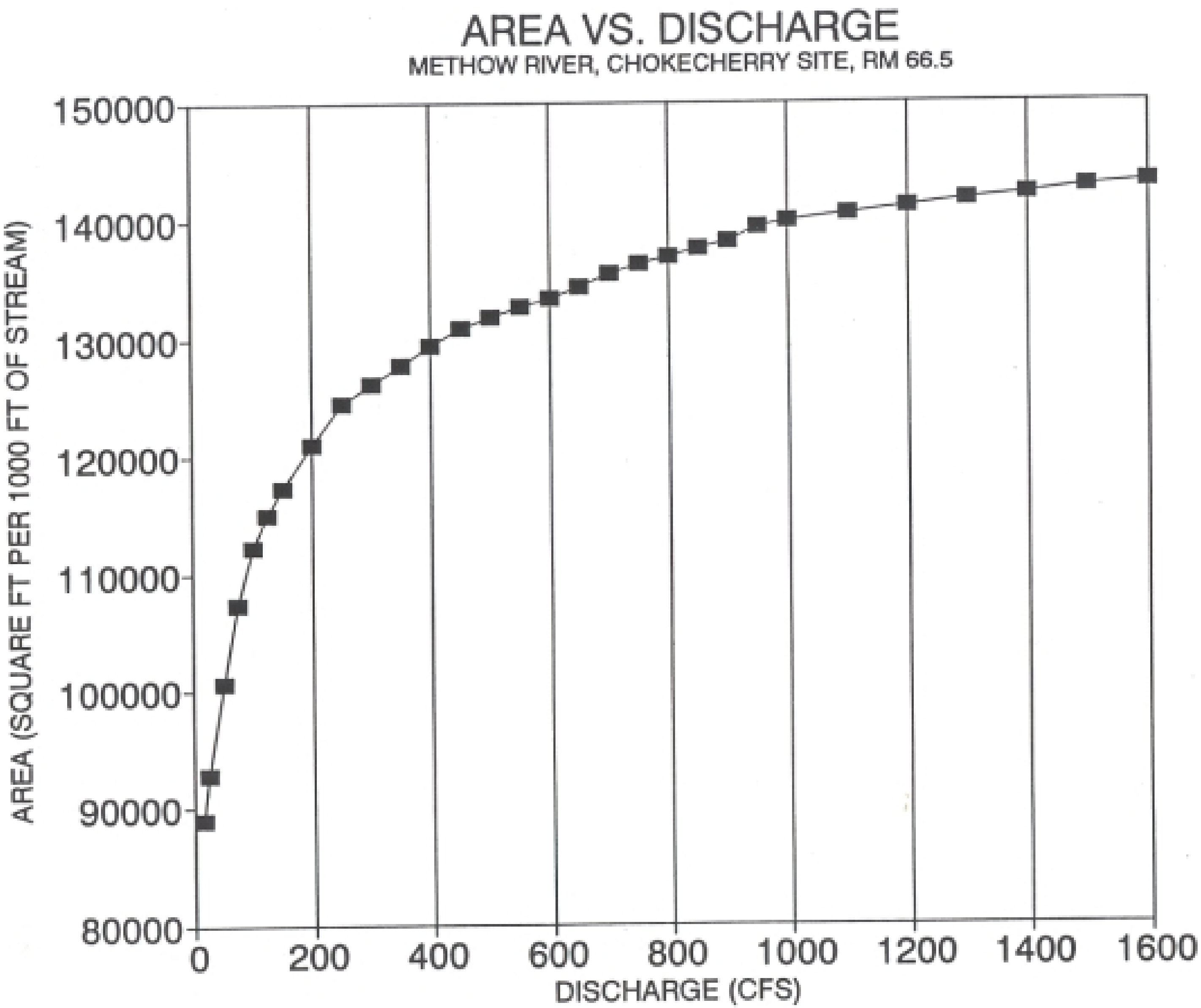
BULL TROUT HABITAT

METHOW RIVER, WEEMAN SITE, RM 59.0



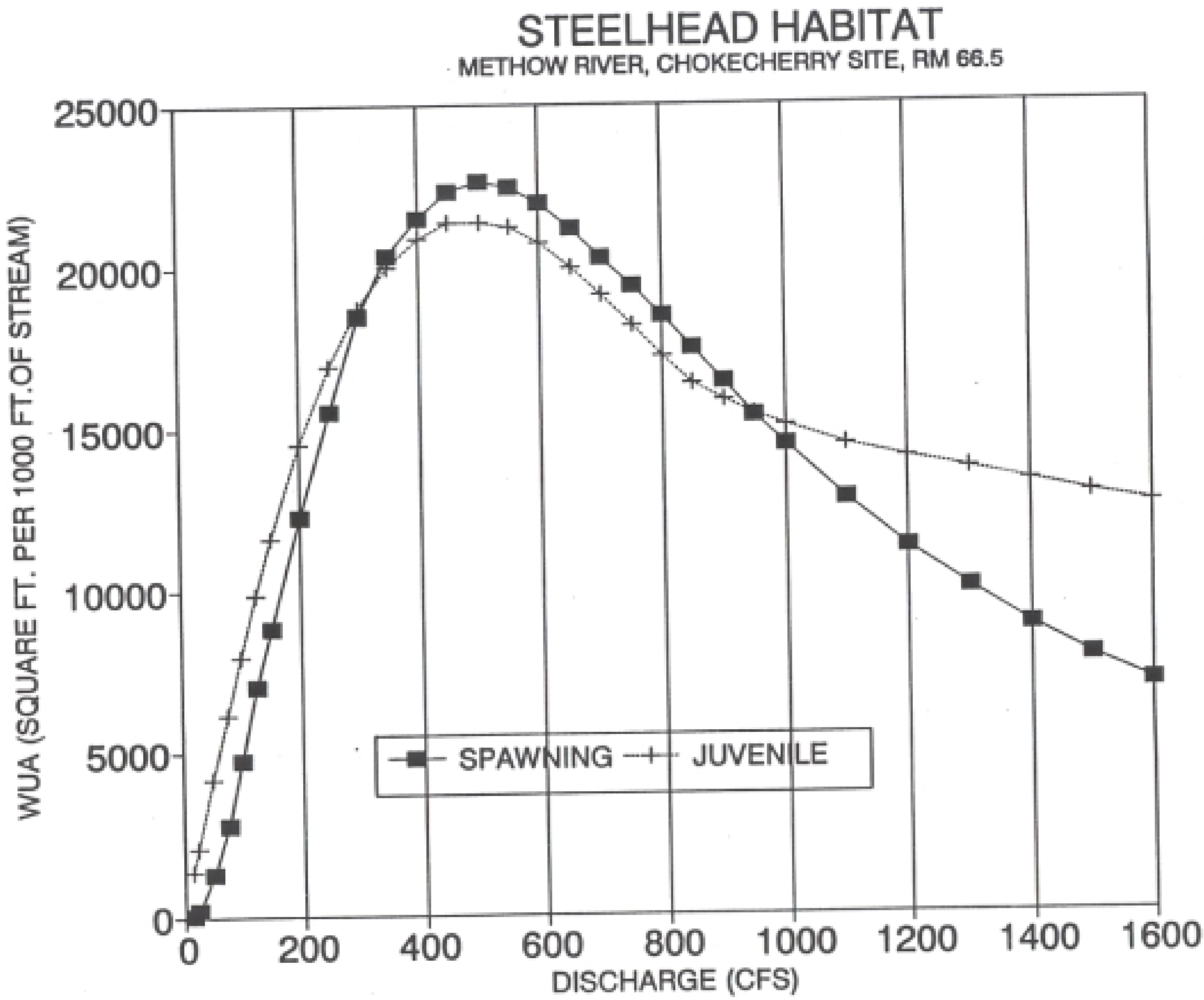
MEASURED:
640 cfs 08/04/91
349 cfs 08/16/91
207 cfs 08/27/91
41 cfs 09/26/91

FLOW	AREA
16	88972
25	92752
50	100533
75	107300
100	112254
125	115003
150	117291
200	120969
250	124474
300	126191
350	127786
400	129391
450	130846
500	131803
550	132616
600	133381
650	134316
700	135469
750	136230
800	136901
850	137544
900	138162
950	139353
1000	139817
1100	140486
1200	141114
1300	141681
1400	142191
1500	142676
1600	143139



MEASURED:
640 cfs 08/04/91
349 cfs 08/16/91
207 cfs 08/27/91
41 cfs 09/26/91

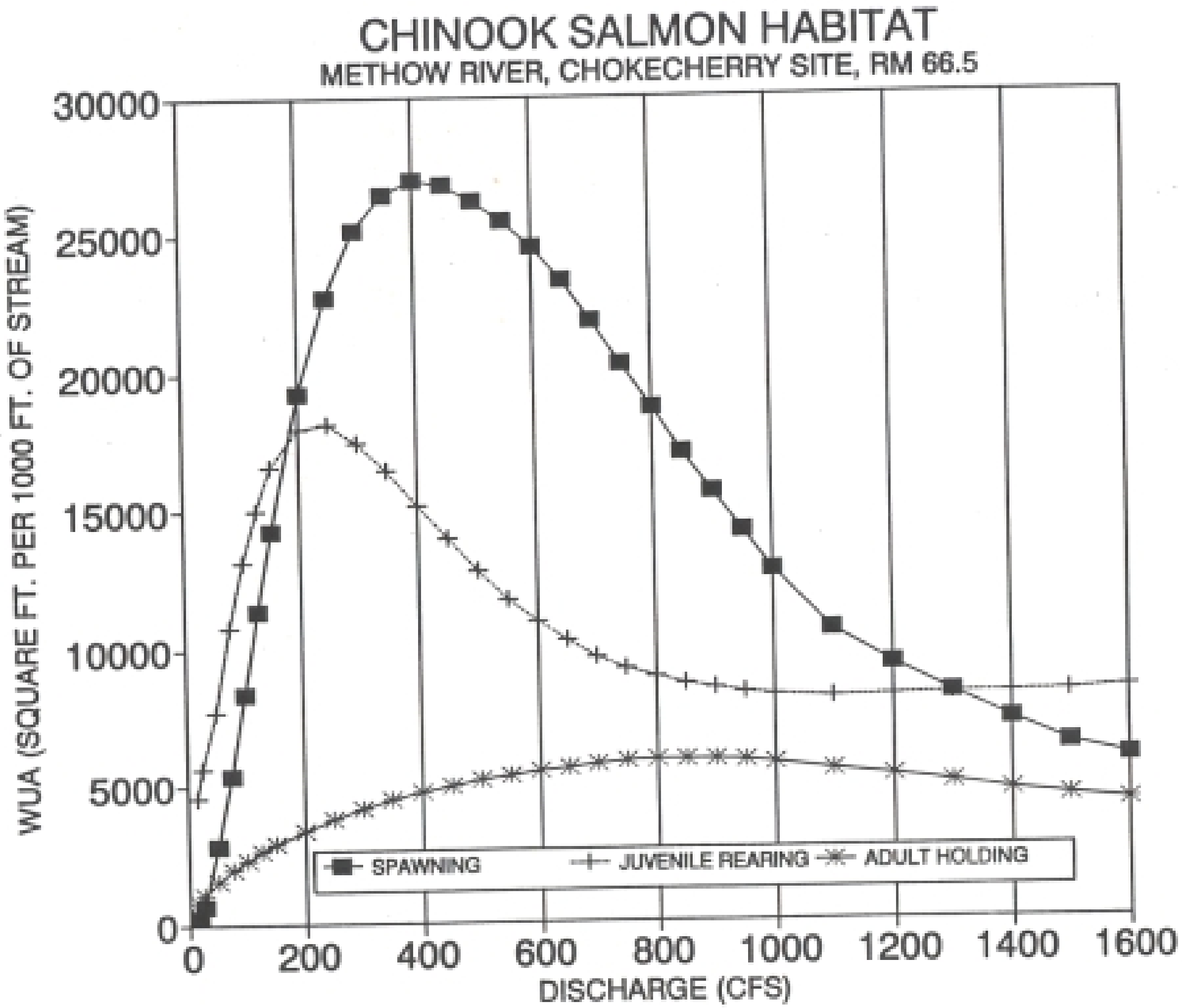
FLOW	SPAWNING	JUVENILE
16	38	1363
25	216	2063
50	1286	4161
75	2772	6135
100	4771	7948
125	7026	9881
150	8844	11637
200	12275	14513
250	15525	16925
300	18448	18724
350	20318	19979
400	21478	20850
450	22322	21325
500	**22610**	**21357**
550	22428	21225
600	21969	20744
650	21172	19965
700	20257	19121
750	19368	18130
800	18454	17193
850	17448	16366
900	16382	15810
950	15352	15404
1000	14420	15028
1100	12754	14437
1200	11266	14036
1300	10009	13677
1400	8823	13299
1500	7871	12893
1600	7023	12571



MEASURED:

640	08/04/91
349	08/16/91
207	08/27/91
41	09/26/91

FLOW	SPAWNING	JUVENILE	ADULT
16	251	4596	841
25	669	5654	1063
50	2817	7676	1569
75	5385	10743	1963
100	8346	13141	2300
125	11366	15021	2598
150	14276	16568	2874
200	19207	17954	3360
250	22747	18124	3782
300	25157	17435	4147
350	26420	16442	4457
400	26973	15184	4729
450	26802	13932	4956
500	26196	12778	5149
550	25480	11733	5321
600	24548	10903	5469
650	23330	10225	5595
700	21822	9629	5700
750	20216	9162	5770
800	18632	8839	5823
850	17022	8617	5852
900	15577	8419	5836
950	14139	8295	5787
1000	12748	8161	5690
1100	10578	8067	5422
1200	9310	8115	5207
1300	8236	8163	4966
1400	7233	8149	4638
1500	6343	8223	4399
1600	5829	8318	4209



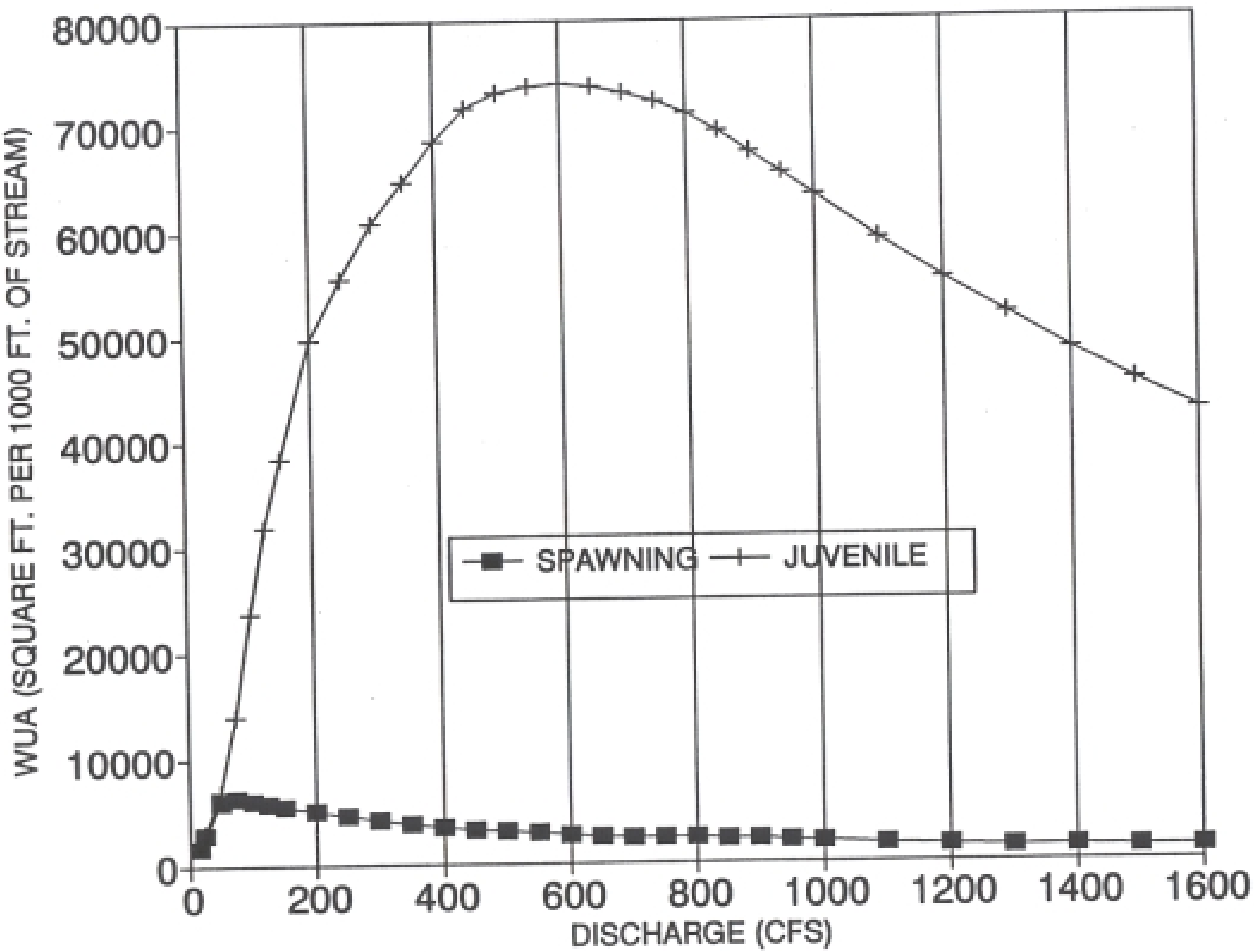
MEASURED:

640 cfs	08/04/91
349 cfs	08/16/91
207 cfs	08/27/91
41 cfs	09/26/91

FLOW	SPAWNING	JUVENILE
16	1632	2161
25	2992	3119
50	5980	6866
75	**6302**	14054
100	6076	23704
125	5740	31864
150	5483	38415
200	5023	49760
250	4593	55521
300	4157	60780
350	3760	64616
400	3432	68530
450	3240	71587
500	3058	73090
550	2894	73707
600	2666	**73902**
650	2486	73709
700	2422	73091
750	2367	72271
800	2306	71097
850	2247	69424
900	2173	67386
950	2076	65388
1000	1943	63267
1100	1707	59108
1200	1540	55253
1300	1406	51851
1400	1303	48462
1500	1234	45453
1600	1181	42556

BULL TROUT HABITAT

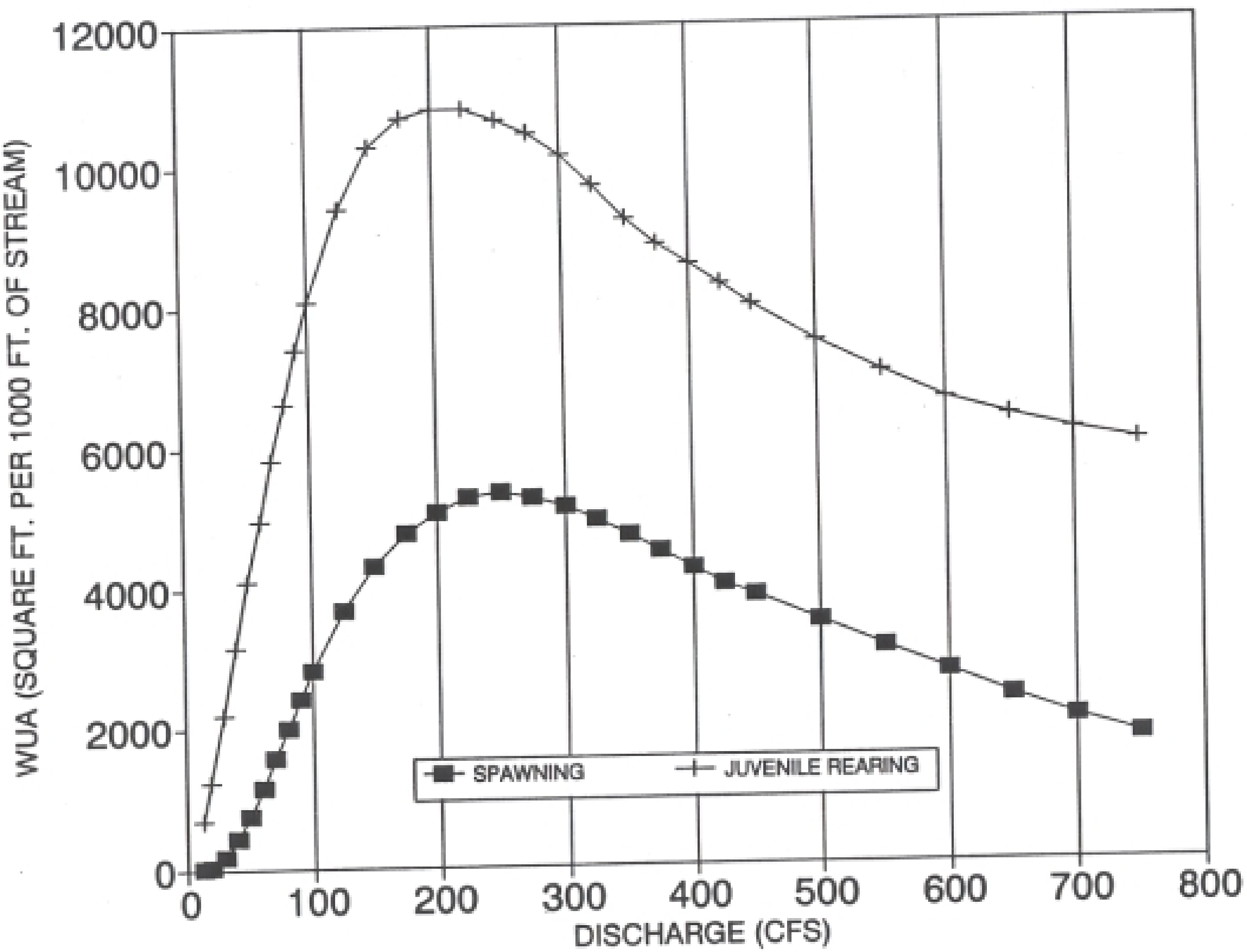
METHOW RIVER, CHOKECHERRY SITE, RM 66.5



MEASURED:
308 cfs 08/05/91
166 cfs 08/17/91
90 cfs 08/29/91
35 cfs 09/25/91

FLOW	SPAWNING	JUVENILE
13	3	688
20	32	1233
30	180	2176
40	426	3152
50	743	4086
60	1146	4957
70	1562	5812
80	1980	6631
90	2402	7407
100	2805	8079
125	3668	9408
150	4303	10277
175	4761	10682
200	5072	10813
225	5265	10808
250	5342	10651
275	5262	10456
300	5116	10138
325	4927	9699
350	4703	9219
375	4466	8863
400	4214	8549
425	3997	8261
450	3811	7978
500	3436	7447
550	3053	6993
600	2699	6605
650	2352	6354
700	2038	6146
750	1764	5958

STEELHEAD HABITAT
TWISP RIVER, RM 1.8



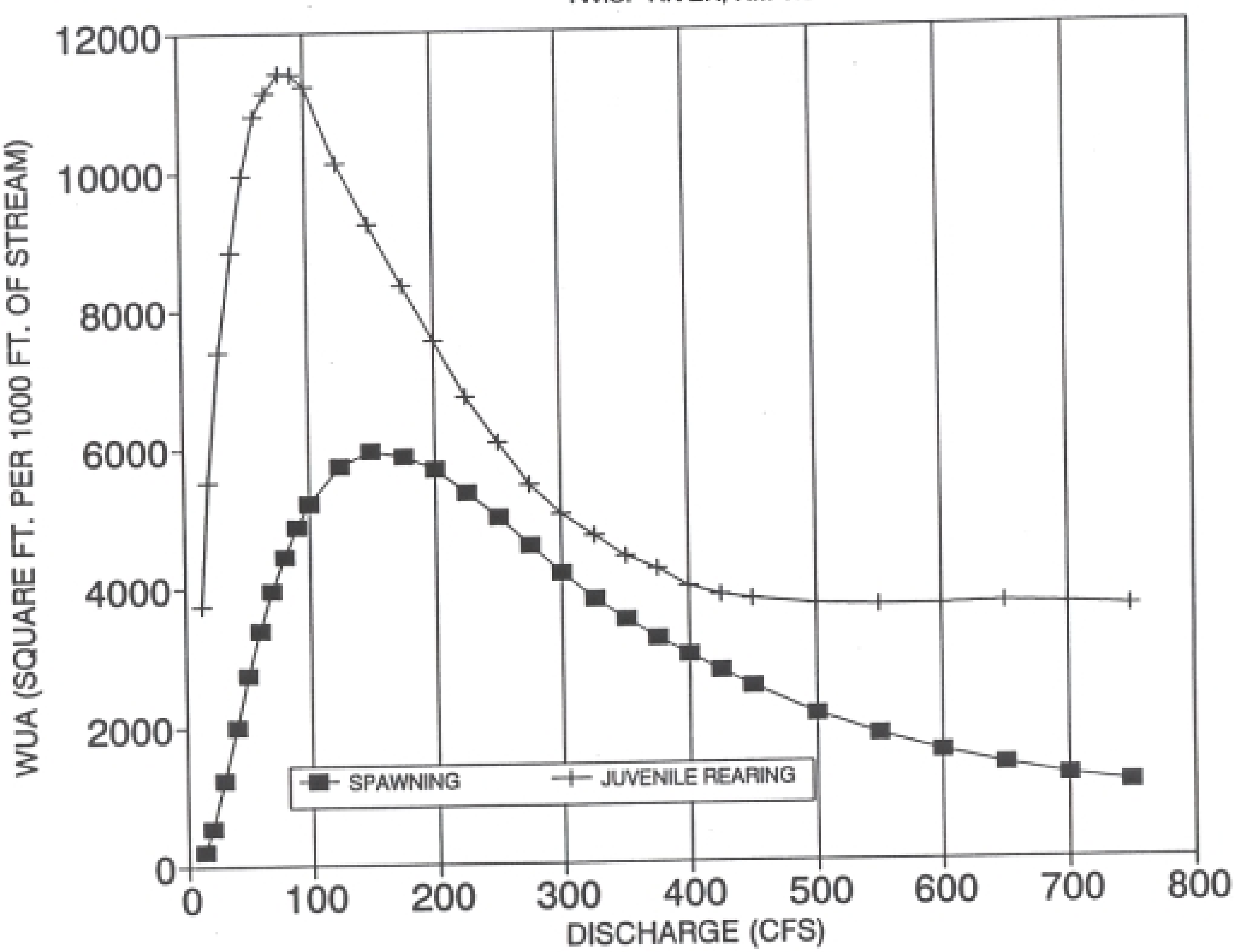
MEASURED:

308 cfs	08/05/91
166 cfs	08/17/91
90 cfs	08/29/91
35 cfs	09/25/91

FLOW	SPAWNING	JUVENILE
13	209	3742
20	546	5529
30	1232	7400
40	1980	8837
50	2734	9938
60	3381	10799
70	3939	11143
80	4429	11417
90	4851	11387
100	5193	11224
125	5727	10118
150	5938	9229
175	5862	8339
200	5662	7515
225	5339	6716
250	4958	6060
275	4568	5445
300	4157	5005
325	3784	4682
350	3482	4391
375	3202	4204
400	2968	3946
425	2728	3828
450	2490	3756
500	2098	3672
550	1795	3656
600	1533	3656
650	1341	3669
700	1186	3638
750	1075	3601

CHINOOK SALMON HABITAT

TWISP RIVER, RM 1.8

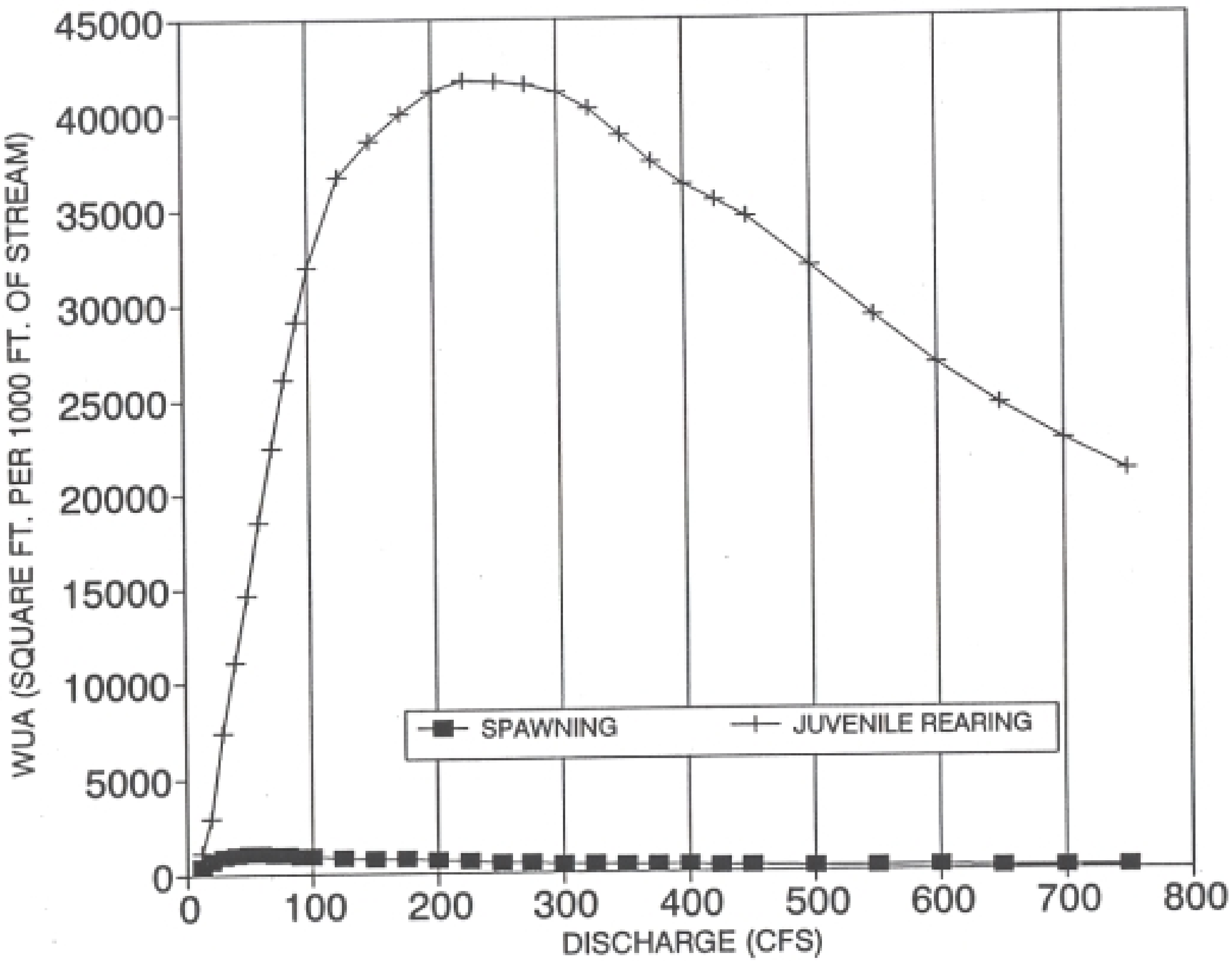


MEASURED:
308 cfs 08/05/91
166 cfs 08/17/91
90 cfs 08/29/91
35 cfs 09/25/91

FLOW	SPAWNING	JUVENILE
13	452	1162
20	697	2978
30	899	7458
40	994	11106
50	**1048**	14666
60	1046	18489
70	1020	22451
80	976	26070
90	938	29110
100	908	32004
125	846	36727
150	782	38594
175	711	39979
200	648	41216
225	591	**41717**
250	543	41635
275	495	41496
300	451	41120
325	411	40279
350	375	38834
375	343	37393
400	315	36244
425	289	35354
450	267	34492
500	223	31901
550	185	29224
600	157	26722
650	133	24535
700	114	22642
750	99	20969

BULL TROUT HABITAT

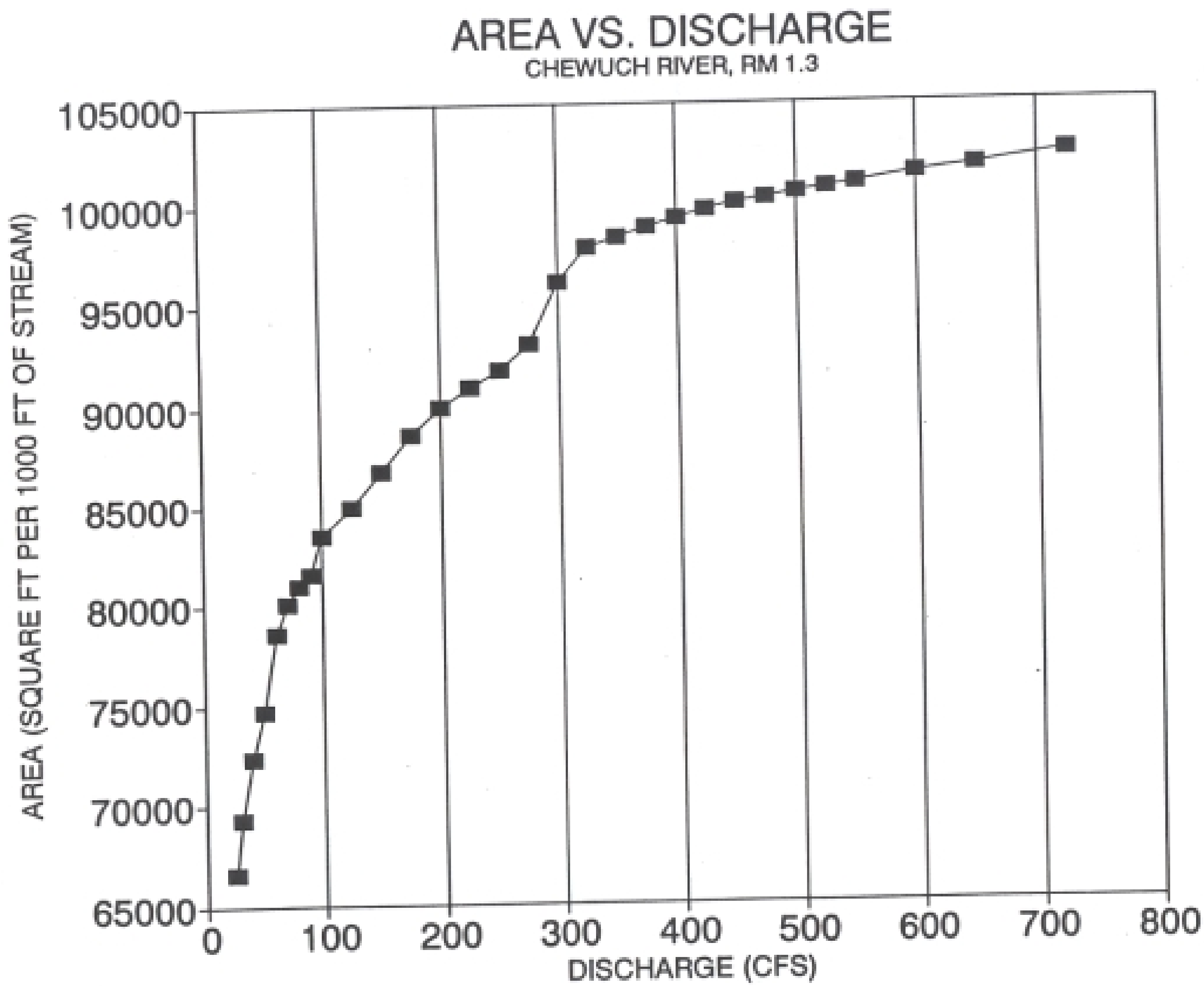
TWISP RIVER, RM 1.8



MEASURED:

290 cfs	07/31/91
236 cfs	08/15/91
121 cfs	08/26/91
60 cfs	09/23/91

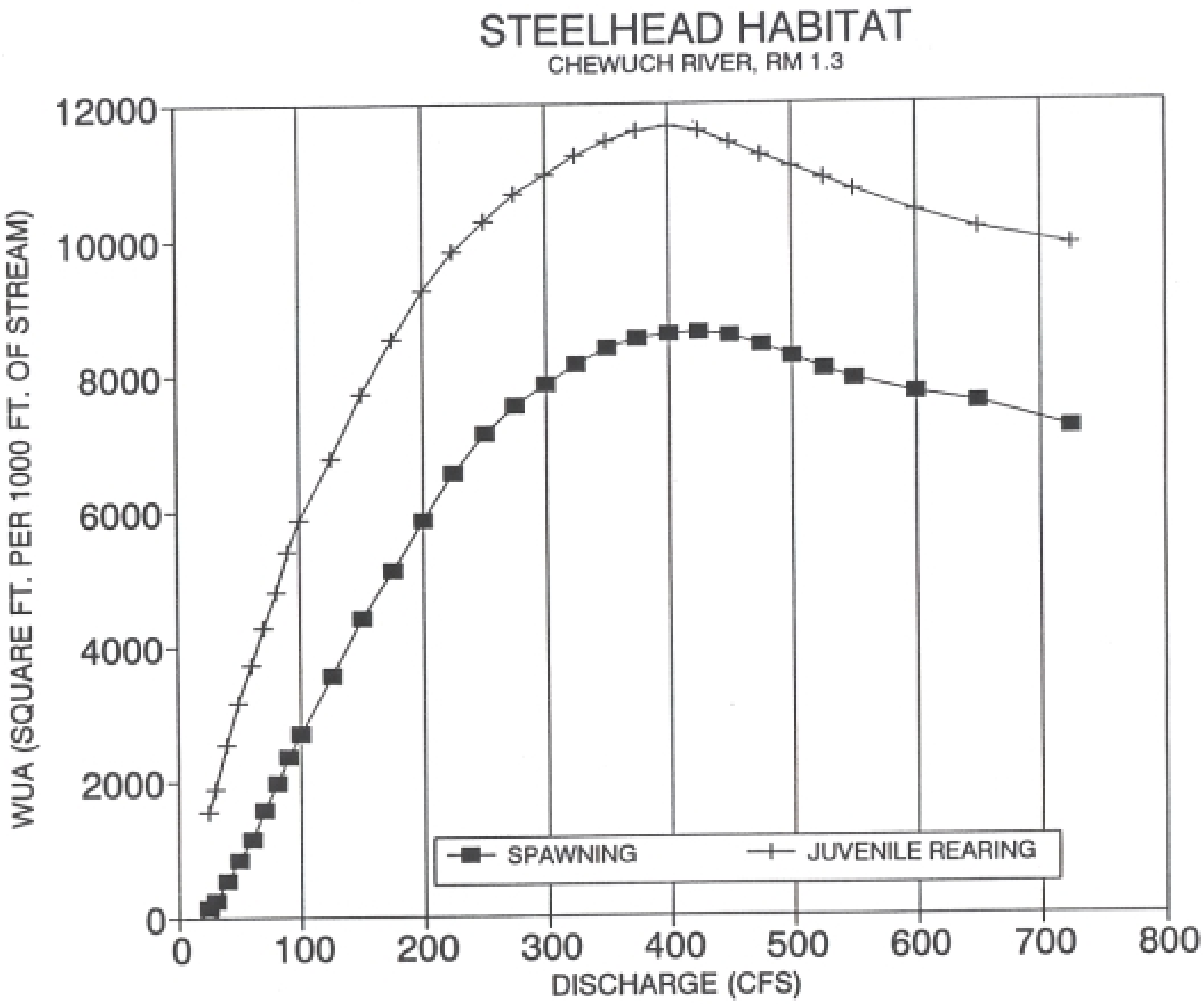
FLOW	AREA
25	66606
30	69308
40	72328
50	74668
60	78603
70	80108
80	81040
90	81600
100	83494
125	84901
150	86685
175	88526
200	89868
225	90881
250	91750
275	93005
300	96053
325	97758
350	98280
375	98775
400	99241
425	99608
450	99959
475	100229
500	100478
525	100718
550	100949
600	101389
650	101802
725	102377



MEASURED:

290 cfs	07/31/91
236 cfs	08/15/91
121 cfs	08/26/91
60 cfs	09/23/91

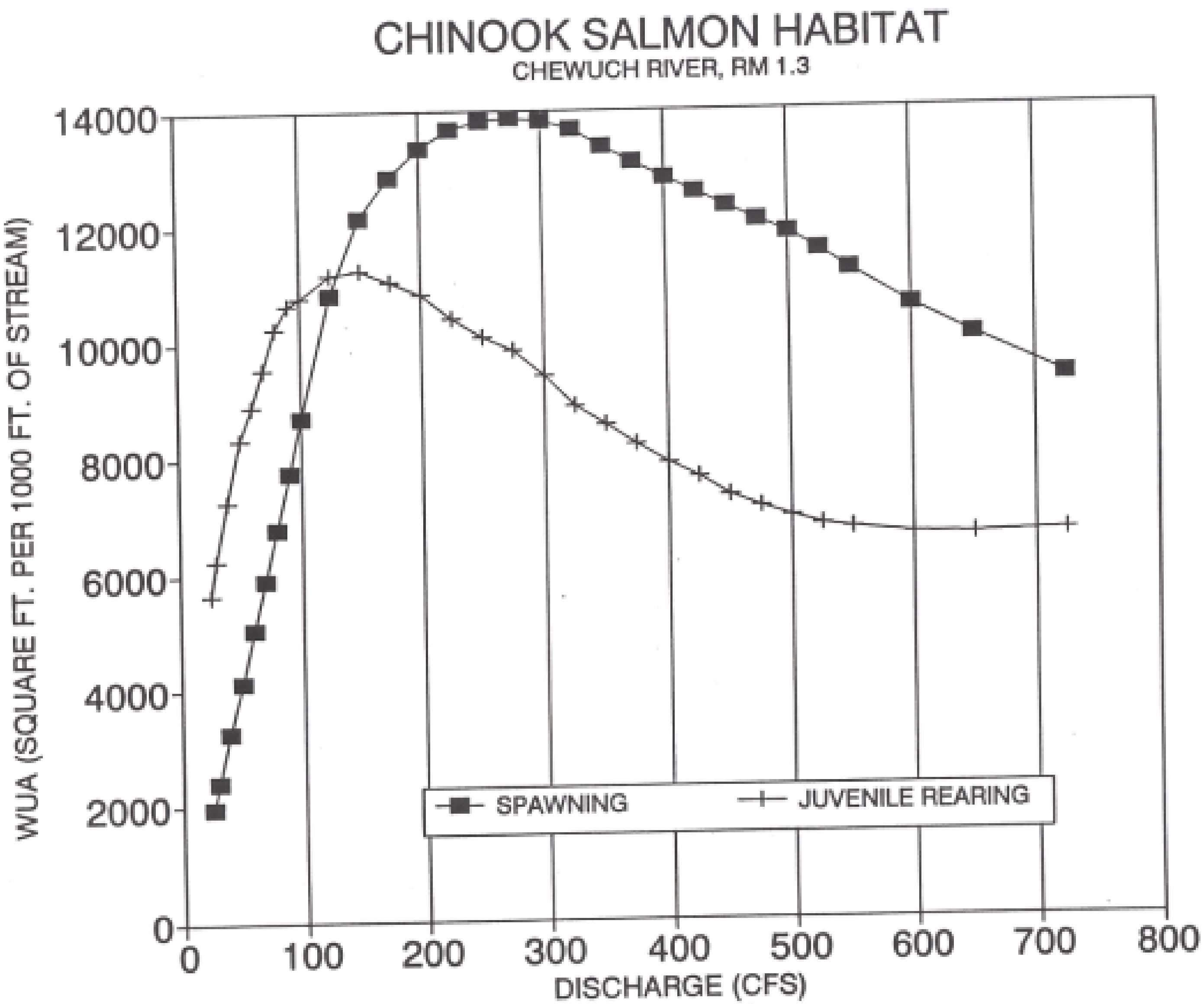
FLOW	SPAWNING	JUVENILE
25	141	1553
30	244	1906
40	533	2564
50	832	3169
60	1161	3729
70	1572	4274
80	1984	4809
90	2354	5402
100	2701	5857
125	3555	6776
150	4393	7735
175	5095	8536
200	5837	9244
225	6541	9822
250	7137	10276
275	7542	10670
300	7861	10940
325	8152	11218
350	8383	11449
375	8525	11587
400	8605	11656
425	8611	11585
450	8569	11420
475	8429	11220
500	8262	11056
525	8074	10892
550	7925	10722
600	7713	10400
650	7564	10151
725	7174	9885



MEASURED:

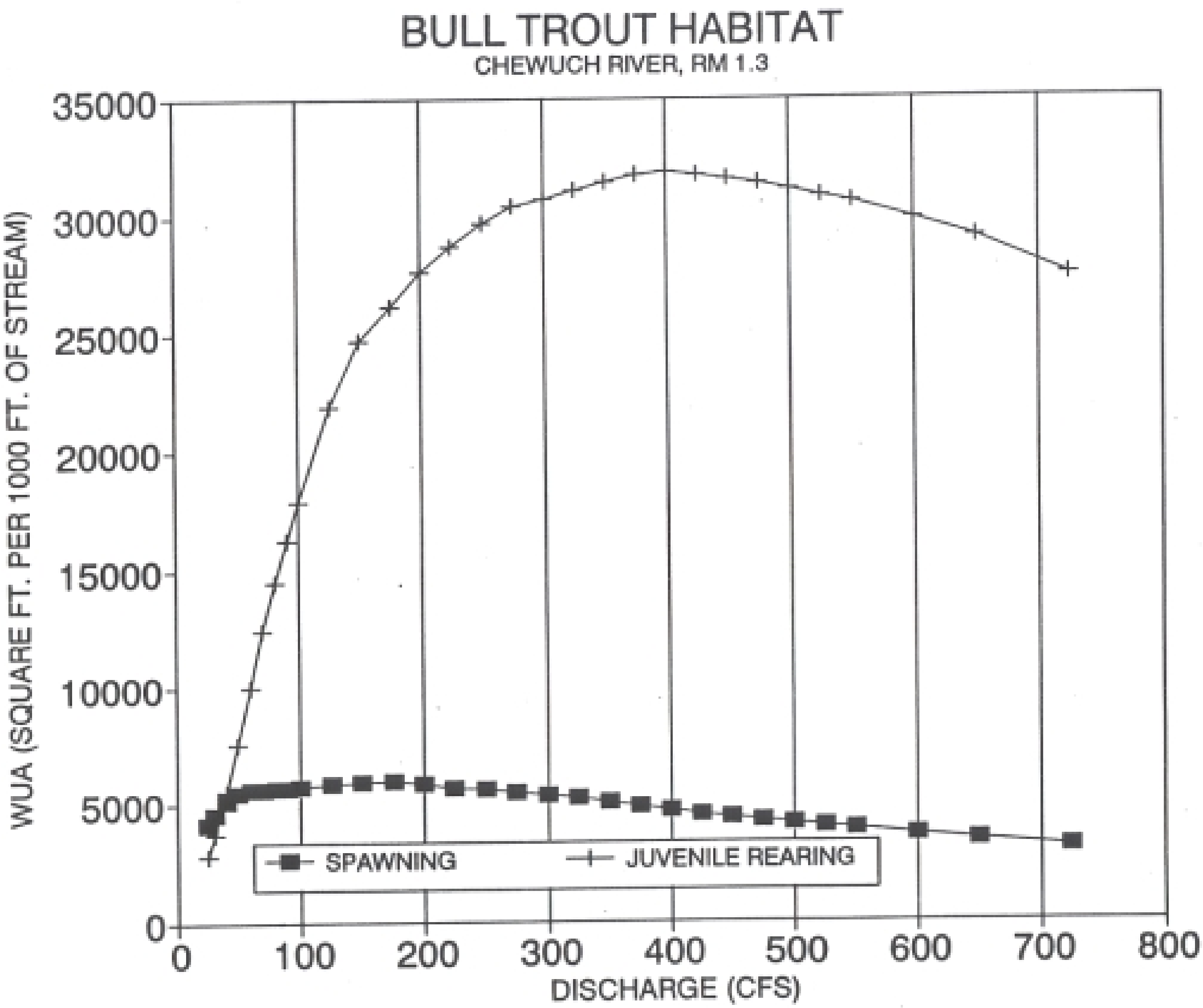
290 cfs	07/31/91
236 cfs	08/15/91
121 cfs	08/26/91
60 cfs	09/23/91

FLOW	SPAWNING	JUVENILE
25	1953	5648
30	2393	6238
40	3260	7262
50	4115	8329
60	5033	8915
70	5882	9545
80	6797	10244
90	7753	10649
100	8709	10785
125	10813	11167
150	12133	11245
175	12853	11038
200	13347	10835
225	13656	10388
250	13806	10072
275	13856	9853
300	13805	9398
325	13662	8887
350	13375	8559
375	13092	8196
400	12824	7895
425	12563	7631
450	12325	7306
475	12064	7120
500	11837	6949
525	11555	6795
550	11198	6717
600	10564	6614
650	10041	6597
725	9341	6648



MEASURED:
290 cfs 07/31/91
236 cfs 08/15/91
121 cfs 08/26/91
60 cfs 09/23/91

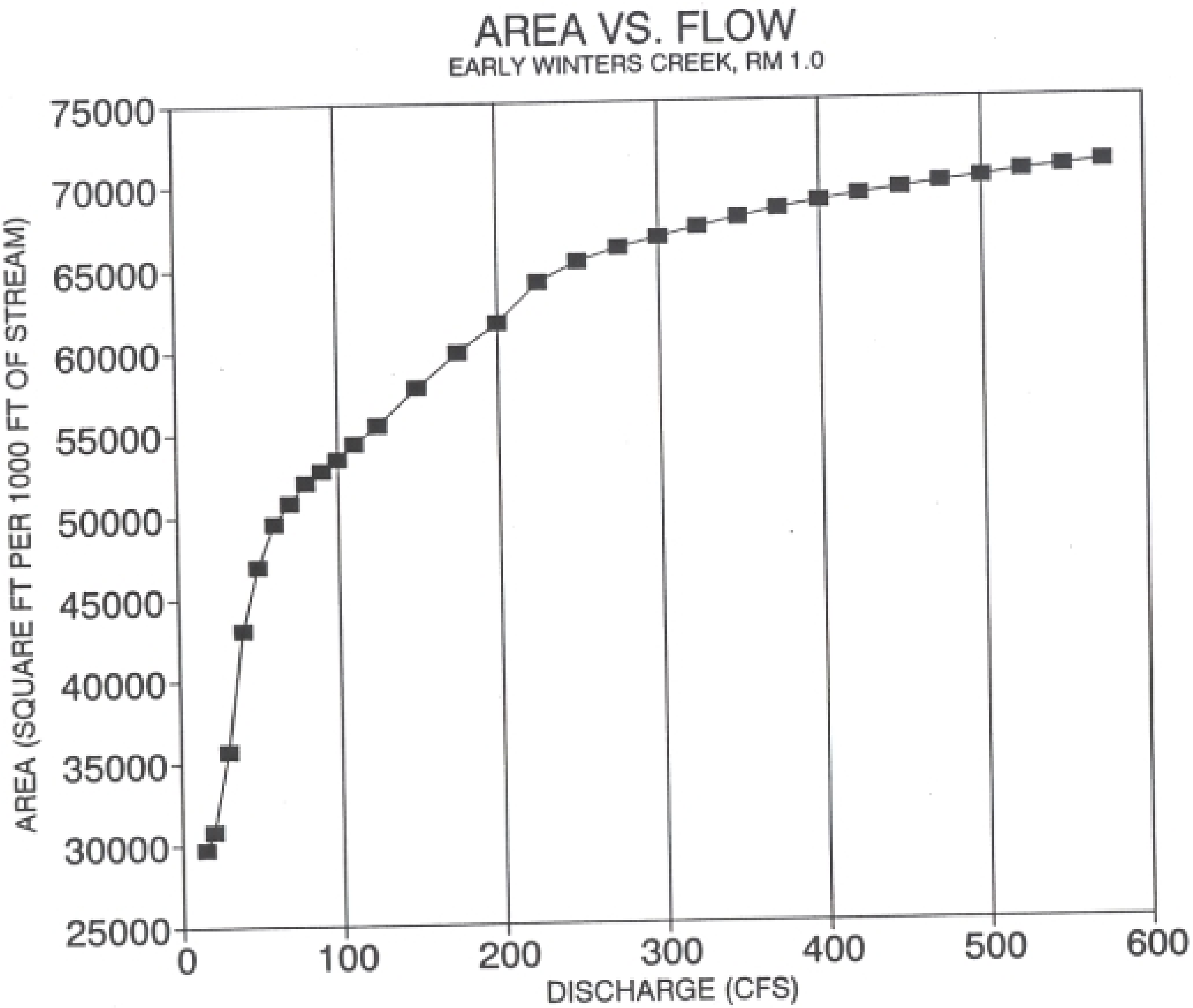
FLOW	SPAWNING	JUVENILE
25	4180	2822
30	4569	3708
40	5134	5536
50	5525	7585
60	5598	9985
70	5625	12450
80	5669	14487
90	5686	16255
100	5743	17890
125	5860	21935
150	5950	24687
175	5964	26160
200	5875	27619
225	5712	28727
250	5596	29707
275	5482	30422
300	5385	30737
325	5260	31106
350	5084	31463
375	4880	31739
400	4706	31841
425	4550	31740
450	4405	31563
475	4270	31354
500	4148	31147
525	4034	30866
550	3915	30586
600	3674	29875
650	3435	29057
725	3148	27461



MEASURED:

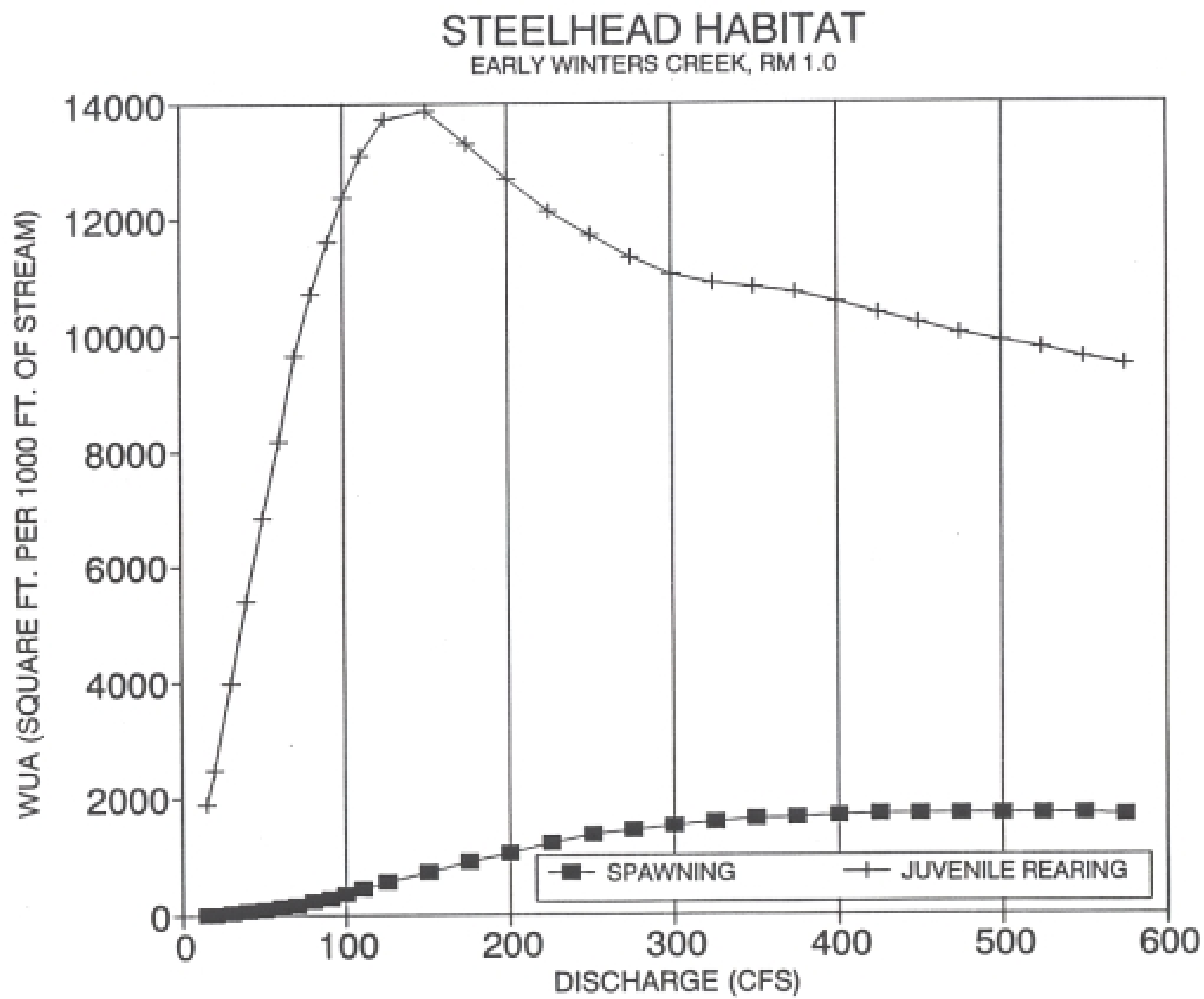
227 cfs	08/05/91
132 cfs	08/17/91
78 cfs	08/30/91
37 cfs	09/27/91

FLOW	AREA
15	29706
20	30761
30	35674
40	43041
50	46935
60	49555
70	50771
80	52016
90	52758
100	53455
110	54361
125	55478
150	57761
175	59878
200	61604
225	64034
250	65261
275	66107
300	66719
325	67306
350	67840
375	68343
400	68797
425	69186
450	69546
475	69872
500	70158
525	70436
550	70702
575	70959



MEASURED:
227 cfs 08/05/91
132 cfs 08/17/91
78 cfs 08/30/91
37 cfs 09/27/91

FLOW	SPAWNING	JUVENILE
15	5	1906
20	13	2499
30	45	3977
40	66	5401
50	88	6830
60	127	8159
70	163	9636
80	225	10722
90	286	11613
100	364	12365
110	440	13083
125	558	13732
150	736	13864
175	900	13289
200	1050	12683
225	1214	12129
250	1360	11713
275	1442	11315
300	1519	11032
325	1588	10885
350	1638	10820
375	1670	10712
400	1692	10545
425	1711	10346
450	1718	10168
475	1720	10006
500	1713	9872
525	1708	9733
550	1699	9579
575	1685	9449



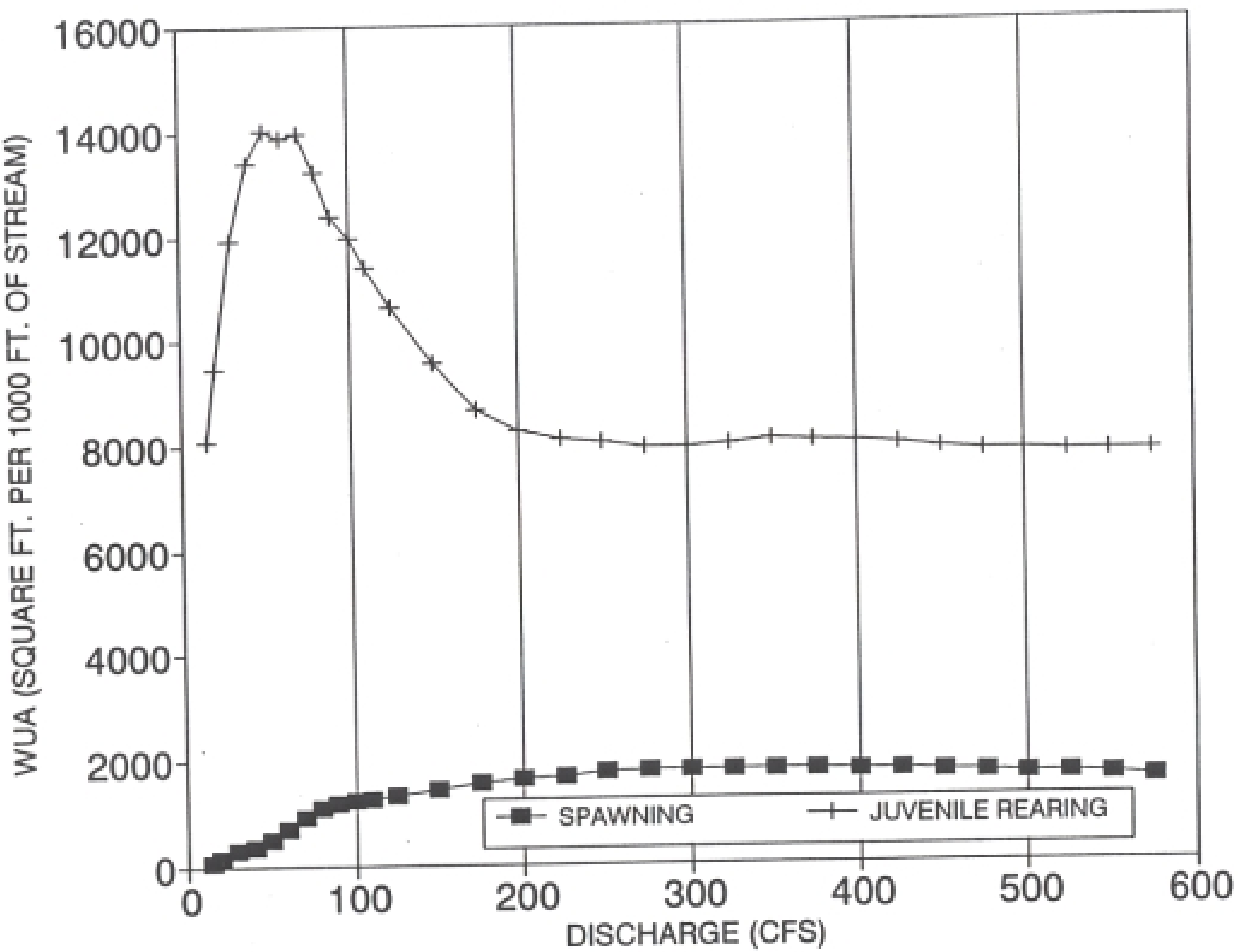
MEASURED:

227 cfs	08/05/91
132 cfs	08/17/91
78 cfs	08/30/91
37 cfs	09/27/91

FLOW	SPAWNING	JUVENILE
15	76	8072
20	156	9468
30	309	11933
40	360	13405
50	508	14028
60	704	13882
70	910	13980
80	1083	13244
90	1171	12394
100	1225	11970
110	1263	11388
125	1314	10630
150	1428	9554
175	1540	8651
200	1617	8258
225	1668	8083
250	1731	8015
275	1759	7911
300	1775	7915
325	1783	7975
350	1779	8059
375	1772	8035
400	1752	7990
425	1735	7947
450	1705	7858
475	1678	7795
500	1661	7793
525	1652	7784
550	1626	7780
575	1584	7786

CHINOOK SALMON HABITAT

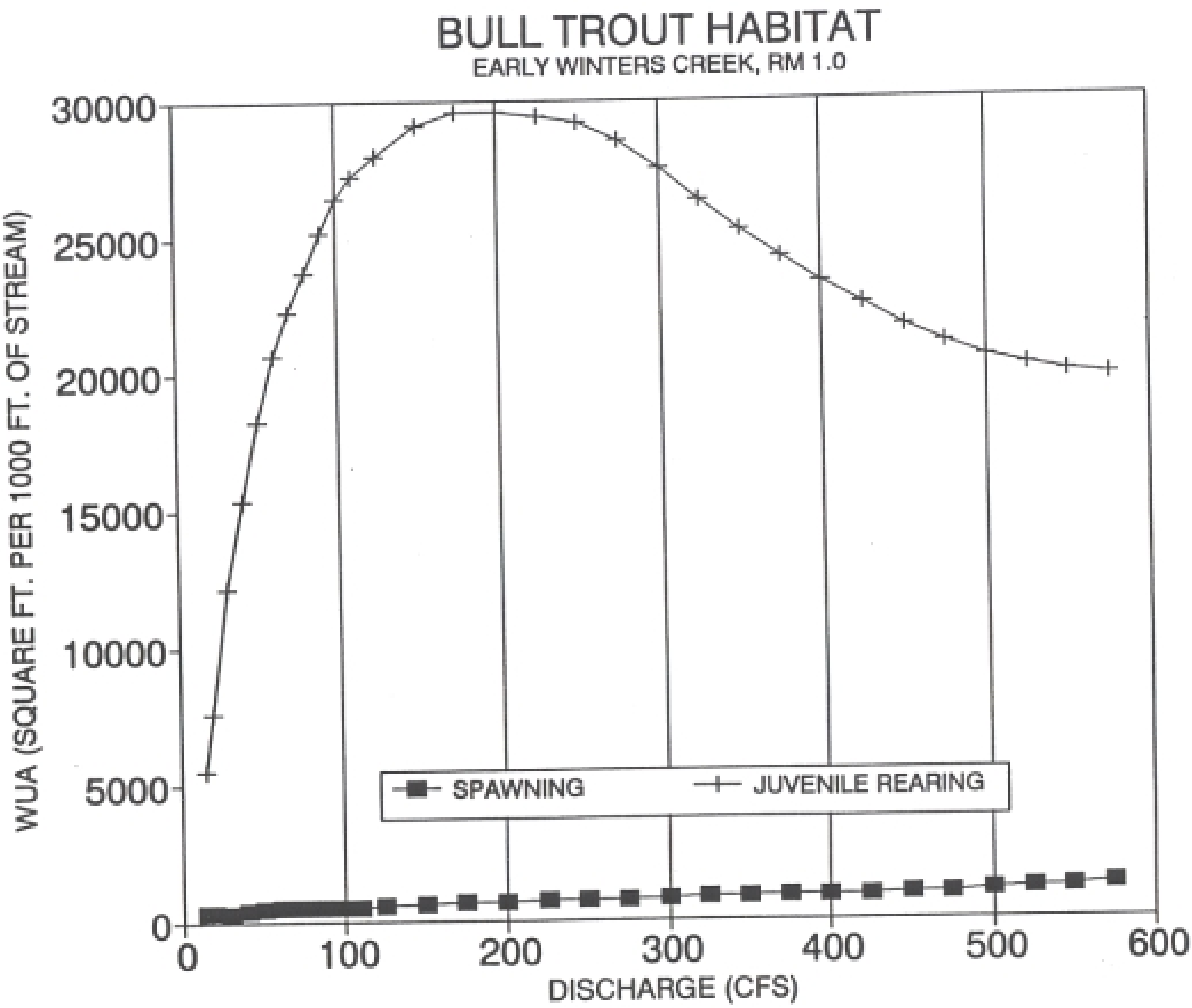
EARLY WINTERS CREEK, RM 1.0



MEASURED:

227 cfs	08/05/91
132 cfs	08/17/91
78 cfs	08/30/91
37 cfs	09/27/91

FLOW	SPAWNING	JUVENILE
15	338	5489
20	329	7595
30	315	12136
40	405	15363
50	472	18258
60	499	20669
70	519	22310
80	510	23694
90	498	25208
100	483	26456
110	496	27258
125	549	27970
150	621	29062
175	645	29562
200	661	29554
225	685	29393
250	707	29182
275	732	28484
300	758	27483
325	799	26323
350	821	25246
375	849	24213
400	869	23288
425	892	22477
450	923	21679
475	944	21046
500	1009	20525
525	1088	20180
550	1155	19927
575	1219	19754



APPENDIX b

WALSH SITE CALIBRATION INFORMATION

Appendix B1 IFG4 Input File, Walsh Site

METHOW RIVER - WALSH SITE - River Mile 31.5, WRIA 48
Measured on 8/1/91- 1437 cfs, 8/28- 589 cfs, 9/24- 311 cfs

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I0C       000000020000000000000
QARD3590.0
QARD1437.0
QARD 589.0
QARD 311.0
QARD 124.0
XSEC  1.0       0.0 .50      88.80     .00250
        1.0-13.0100.5        0.0       96.0 10.0          94.4  14.0          93.9  15.0          93.8  20.0          94.0
        1.0 25.0   93.7 30.0           93.2 35.0          93.1  40.0          92.7  45.0          92.6  50.0          92.5
        1.0 55.0   91.8      60.0      91.3 65.0          91.5  70.0          91.4  75.0          92.2  80.0          91.9
        1.0 85.0   91.7      90.0      91.4 95.0          91.3100.0           91.0105.0           91.4110.0           91.6
        1.0115.0  91.6120.0            92.0125.0          92.1130.0           92.0135.0           92.5140.0           92.1
        1.0146.5  91.4151.5            91.7156.5          92.1161.5           91.9166.5           91.7171.5           91.3
        1.0176.5  90.0181.5            89.8186.5          89.1191.5           89.4196.5           89.6201.5           88.8
        1.0206.5  89.7211.5            89.8216.5          90.1221.5           90.2226.5           91.7231.5           93.0
        1.0233.293.85236.196.48245.1100.5

NS      1.0        .80        .80      67.60      67.60      67.60      67.60
NS      1.0      67.60      87.50      87.50      87.80      87.80      86.50
NS      1.0      86.50      86.50      86.50      87.60      86.60      86.50
NS      1.0      87.50      68.60      68.60      68.60      87.80      86.60
NS      1.0      87.60      87.60      87.70      87.70      87.70      87.70
NS      1.0      87.80      87.70      87.90      87.70      87.70      87.80
NS      1.0      87.80      87.80      87.80      87.80      87.90      87.80
NS      1.0      87.80      87.80      87.90      87.90      88.90      88.90
NS      1.0      88.90        .80        .80
CALI  1.0      93.85    1437.00
VELl   1.0                              0.00      0.00  1.27    .73  2.65  2.07  2.81
VELl   1.0  2.63 4.03  1.53 2.96 3.07  3.41   1.76  3.17  3.66  1.30  2.50  3.39
VEL1   1.0  1.46 1.71  1.14 2.39 2.81  1.81   3.07   .08  1.97   .44  1.12  1.38
VELl   1.0  3.40 4.78  3.52 4.49 4.98  5.02   5.90  5.08  3.80  4.05  3.04   .24
VEL1   1.0
CAL2   1.0      92.87     589.00
VEL2   1.0                                                           .48    .53      .76
VEL2   1.0  1.17  2.00  1.39    .21  1.51  2.12  1.72  1.25  2.83    .22  1.46   1.65
VEL2   1.0    .17    .44    .69 .  .86    .70    .19    .65    .18    .24   .50     .45     .17
VEL2   1.0  1.48  3.10  3.12  2.16  3.19  3.60  4.55  3.75  2.94   .32   1.54   0.00
VEL2   1.0
CAL3   1.0      92.44     311.00
VEL3   1.0                                                          .20           0.00
VEL3   1.0    .45  1.19  1.03    .49  1.06   .63     .54    .72  2.23   .08  2.02   1.35
VEL3   1.0    .50    .57          1.01           .50 -   .01    .52    .39   .35   .61     .23
VEL3   1.0  1.26  1.68  1.80  1.42  1.40  1.27  2.10   2.98  1.64   .74  .37
VEL3   1.0
XSEC   2.0      194.0  .50     88.80     .00250
        2.0-12.0100.5     0.097.08 10.094.58 13.594.39     15.0  94.2 20.0  94.1
        2.0 25.0   93.8    30.0 93.5    35.0  93.4 40.0    93.2  45.0  93.0 50.0  92.8
        2.0 55.0   92.4    60.0 91.8    65.0  91.4 70.0    91.1  75.0  90.6 80.0  89.7
        2.0  85.0  89.3  90.0 89.0    95.0  88.6100.0  88.5105.0  88.4110.0  87.5
        2.0115.0  87.7120.0  87.8125.0  87.3130.0  87.6135.0  88.0140.0  87.8
        2.0146.5  87.8151.5  88.7156.5  89.0161.5  90.5166.5  92.2168.894.39
```

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2.0173.595.08182.5100.5
NS      2.0      .80     .80   77.90   76.60    76.60   65.70
NS      2.0    65.70   65.70   65.70   65.70    65.70   65.70
NS      2.0    65.70   65.70   65.70   65.80    65.70   65.80
NS      2.0    65.80   65.80   67.60   76.60    76.60   79.80
NS      2.0    79.70   88.90   88.90   88.90    88.90   88.90
NS      2.0    88.90   88.90   88.90   88.90    88.90   88.90
NS      2.0      .80     .80
CAL1    2.0    94.39 1437.00
VELl    2.0                    0.00 .  68 1.21 1.57 1.72 1.85  1.98 2.05
VELl    2.0  1.97 2.03  2.20 2.15 2.06 1.65 1.72 1.37 1.43 1.51  1.49 1.62
VELl    2.0  1.39 1.40  2.97 3.41 3.07 1.82 1.85 1.82 1.41 1.28  0.00 0.00
VELl    2.0
CAL2    2.0    93.31     589.00
VEL2    2.0                               .52   .47  .68
VEL2    2.0  .70   .77    .87   .59  1.12   .95 1.45 1.51    1.61 1.78  1.88 1.84
VEL2    2.0  1.26 1.89   1.90 1.93  1.08 1.25  1.50   .92     .56   .43    .28
VEL2    2.0
CAL3    2.0    92.75     311.00
VEL3    2.0
VEL3    2.0  0.00   .24    .29   .39  .37  .54   .53 .69    .87 1.06   .94 1.19
VEL3    2.0  1.19 1.35   1.27 1.18  .96  .83   .57 .42    .46   .25   .21
VEL3    2.0
XSEC    3.0      113.0 .50     88.80   .00250
        3.0 -18.0100.5   0.097.28 10.095.58 16.594.47     20.0 93.1  25.0   92.8
        3.0   30.0 92.5   35.0 92.0 40.0  91.5 45.0  91.5    50.0 91.5  55.0   91.2
        3.0   60.0 91.0   65.0 91.0 70.0  91.0 75.0  91.0    80.0 90.9  85.0   90.7
        3.0   90.0 90.3   95.0 89.3100.0 88.3105.0 87.5110.0   86.9115.0   86.1
        3.0120.0  85.0125.0  83.0130.0 84.6135.0 85.5140.0     86.8146.5  89.3
        3.0151.5  90.4156.5  93.2160.394.47162.497.18171.4100.5
NS      3.0      .80    78.50    78.50    76.80    46.80    46.80
NS      3.0    64.70    65.60    65.60    76.70    76.70    76.60
NS      3.0    65.80    65.80    65.90    65.90    65.70    65.60
NS      3.0    65.70    76.60    76.60    76.60    76.60    76.60
NS      3.0    76.60    76.60    88.90    88.90    88.90    88.90
NS      3.0    88.90    88.90    88.90      .80      .80
CAU     3.0    94.47  1437.00
VELl    3.0                         .32   .87  1.01 1.33  1.87 1.96  2.45 2.52
VELl    3.0 2.54 2.79   3.05 3.08  3.29 3.49  3.57 3.44  3.37 3.26  3.41 3.54
VELl    3.0 3.64 2.05   1.49  .73   .75   .39   .15  -.21
CAL2    3.0    93.34     589.00
VEL2    3.0                         0.00 0.00    .31   .45    .72   .71    .90   .91
VEL2    3.0   .98  1.13  1.31 1.44  1.45 1.36  1.37 1.63  1.91 2.08  2.28 2.36
VEL2    3.0 2.06  1.08    .55   .18    .03  -.20  -.20  -.36
CAL3    3.0      92.78      311.00
VEL3    3.0                      0.00  0.00   .10   .41  .25   .41  .48
VEL3    3.0   .60    .67   .68 .77  .89   .88    .97  .86 1.16 1.59  1.54 1.41
VEL3    3.0   .95 .    65  .12  .12 -.19 -.09   -.01
XSEC    4.0       172.0 .50      90.70   .00250
        4.0-25.0103.2    0.099.31 10.097.01 16.096.36 20.0 94.9  25.0 94.8
        4.0 30.0  94.5   35.0  94.2 40.0  94.0 45.0  93.9 50.0 94.2  55.0 93.9
        4.0 60.0  93.2   65.0 93.8  70.0  93.7  75.0  93.1 80.0 92.9  85.0 92.6
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```
            4.0 90.0 92.4 95.0 92.2100.0 91.9105.0 91.1110.0 90.3115.0 89.4
            4.0120.0 88.6125.0 87.0130.0 86.2135.0 86.7140.0 87.7146.5 91.2
            4.0151.5 91.9156.5 94.2161.596.36164.597.91175.0103.2

NS      4.0      .80      .80    87.50    56.70    56.70    56.80
NS      4.0    56.70    56.80    65.60    65.70    86.90    65.70
NS      4.0    79.80    65.60    65.70    56.70    65.60    56.70
NS      4.0    65.70    56.70    56.70    65.70    76.70    76.70
NS      4.0    79.70    79.70    79.60    79.60    87.90    87.90
NS      4.0    87.90    87.90    87.90      .80      .80
CAL1    4.0    96.36  1437.00
VELI    4.0                        .16  .94  1.20 1.65 1.99 2.16  2.00 2.27
VELl    4.01.416 2.22   1.95 2.08 2.63 3.16  3.09 3.64 3.49 3.33  3.43 2.97
VEL1    4.0 2.88  1.98   2.04 2.61 2.76 1.81    .50   .54 0.00
CAL2    4.0      95.18      589.00
VEL2    4.0                 0.00  .16   .28  .50   .69  .83   .98 1.10
VEL2    4.0  .98    .28   1.22 .80  1.14 1.30  1.36 1.92 1.67  1.90 1.93 2.10
VEL2    4.0 1.85 1.82   1.56 1.80 1.36  .38    .12 0.00
CAL3   4.0      94.58      311.00
VEL3    4.0                      0.00  .17   .34  .34   .47   .35
VEL3    4.0   .62   .90    .65 .85   .92  .79  1.05  .94 1.00   .98 1.41  1.53
VEL3    4.0 1.33 1.08   1.26 .98   .66  .26  0.00
XSEC    5.0      203.0  .50     91.60    .00250
            5.0-17.0103.2   0.098.21 7.096.45 10.0    95.7 15.0  95.0 20.0  94.7
            5.0  25.0 94.5   30.0 94.4 35.0 94.1 40.0  94.2 45.0  94.0 50.0  93.8
            5.0  55.0 93.8   60.0 93.8 65.0 93.7  70.0 93.5 75.0  93.4 80.0  93.1
            5.0  85.0 92.8   90.0 92.6 95.0 92.5100.0  92.6105.0  93.0110.0  93.1
            5.0115.0 93.2120.0 93.0125.0   92.6130.0  92.4135.0  92.0140.0  91.6
            5.0146.5 91.8151.5 91.7156.5   91.9161.5  92.5166.5  93.3171.5  95.0
            5.0176.5 96.3176.896.45185.5102.8
NS      5.0      .80       .80    72.70    72.70    87.70    65.70
NS      5.0    56.60     56.80    65.70    65.60    56.70    56.60
NS      5.0    56.60     56.70    65.60    65.60    65.70    65.80
NS      5.0    65.70     65.70    65.60    86.90    87.80    87.80
NS      5.0    86.70     65.70    65.70    65.80    56.80    65.70
NS      5.0    87.90     87.70    87.70    82.70    76.60    87.80
NS      5.0    87.70     88.90      .80
CAL1    5.0    96.45   1437.00
VELl     5.0                    .55   .86 2.42  2.83 2.60 2.22 2.95  2.87 3.07
VELI    5.0 3.17 3.26 2.71 3.45 3.23 3.53  3.33 2.88 2.50 2.51 3.77 2.96
VEL1    5.0 3.04 2.84 2.84 3.00 2.72 2.90  3.12 2.89 3.07 2.78 1.11 1.26
VELl    5.0 0.00
CAL2    5.0      95.23    589.00
VEL2     5.0                            0.00    .65 1.13   .99  1.46 1.91  1.81
VEL2    5.0 1.91 1.94   2.11 1.99 2.09 2.46  2.43 2.26 2.64  2.51 2.30  2.06
VEL2    5.0 1.82 1.56   1.77 1.82 1.68 1.99  1.41 1.97 1.92    .64   .20  0.00
VEL2    5.0
CAL1    5.0      94.61      311.00
VEL3    5.0                                  .31 1.09   .64    .78   .87 1.06
VEL3    5.0   .94   .90   1.06 1.07 1.67 1.78  1.80 2.13 2.31  2.38 2.21 1.91
VEL3    5.0 1.25 1.25   1.17 1.21 1.39 1.47    .90 1.26 1.03    .30   .11
VEL3    5.0
XSEC    6.0     176.0     .50     91.60     .00250
```

```
6.0 -7.0103.2    0.0100.0    1.896.59    5.0  94.6  10.0  94.3  15.0  93.6
6.0 20.0  93.3 25.0   93.4  30.0  93.2  35.0  93.4  40.0  93.6  45.0  93.5
6.0 50.0  93.5 55.0   93.4  60.0  93.5  65.0  93.4  70.0  93.5  75.0  93.5
6.0 80.0  93.4 85.0   93.6  90.0  93.5  95.0  93.7100.0  93.8105.0  93.8
6.0110.0  93.7115.0  93.9120.0 93.9125.0  94.2130.0  94.3135.0  94.4
6.0140.0  94.6146.5  94.2151.5 93.9156.5  93.5161.5  92.4164.0  91.9
6.0166.5  91.7169.0  91.6171.5 92.3176.5  94.6181.596.59186.0100.0
6.0192.0103.2
NS      6.0      .80      .80      .10     87.70    87.70    87.50
NS      6.0    76.60    76.60    76.60    65.70    65.70    65.70
NS      6.0    65.70    65.70    65.70    65.50    65.50    65.50
NS      6.0    65.50    65.50    65.50    76.50    76.50    67.60
NS      6.0    67.60    87.50    76.50    56.50    56.50    76.50
NS      6.0    65.50    76.50    76.50    76.50    76.50    76.50
NS      6.0    76.50   .78.60   88.90     87.70    87.70      .80
NS      6.0      .80
CAL1    6.0    96.59   1437.00
VELl    6.0                1.29 1.51 1.49  2.29 2.40  2.89 2.96  3.15 2.69
VELl    6.0 3.85 4.07 3.93 4.09 3.98 3.72  3.90 3.98  3.56 3.78  3.20 3.25
VEL1    6.0 2.96 2.73 3.09 3.02 3.29 2.96  3.02 2.66  2.77 2.72  2.20 2.20
VELl    6.0 1.96 1.57  .83  .14
CAL2   6.0     95.37     589.00
VEL2    6.0                 .21   .62   .14  1.58 1.53  1.71 2.20  1.71 1.70
VEL2    6.0   .17 2.59 3.05 3.12  3.24 3.17  2.86 2.97  2.56 2.70  2.42 2.24
VEL2    6.0 2.08 1.36 2.04  2.06 1.93 1.96  1.75 1.44  1.24 1.41  1.22 1.82
VEL2    6.0   .89 1.35  .50  .14
CAL3   6.0      94.80    311.00
VEL3    6.0                 .10    .22 1.20    .34 1.26  1.20 1.14  1.52 1.47
VEL3    6.0  1.72 1.95 2.36 2.61  2.49 2.31  2.56 2.26  2.18 2.08  2.03 1.60
VEL3    6.0  1.50   .67 1.32 1.33  1.30 1.05  1.46   .93    .43   .00    .94 1.26
VEL3    6.0  1.67 1.97 1.75   .91
XSEC   7.0     221.0 .50     91.00     .00250
        7.0-10.0102.3   0.098.48 2.095.85       5.0  93.3  10.0  93.1  15.0  91.5
        7.0  20.0  91.0  25.0 91.7  30.0  91.9   35.0  92.0  40.0  92.5  45.0  92.8
        7.0  50.0  92.8  55.0 93.7  60.0  93.1   65.0  93.2  70.0  93.2  75.0  93.3
        7.0    0.0  93.5  85.0 93.6  90.0  93.5   95.0  93.5100.0  93.6105.0  93.6
        7.0110.0  93.8115.0  93.6120.0  93.4125.0  93.4130.0  93.2135.0  93.0
        7.0140.0  93.0146.5  92.8151.5  92.6156.5  93.2159.895.85162.598.18
        7.0170.0102.3
NS      7.0      .80      .80      .80     87.90    87.90    87.90
NS      7.0    87.90    76.60    76.60    65.70    65.70    56.60
NS      7.0    56.70    56.60    56.50    56.60    45.60    67.70
NS      7.0    67.80    67.50    67.50    65.70    65.60    56.60
NS      7.0    56.70    64.60    52.60    52.70    65.70    65.70
NS      7.0    65.60    65.60    87.70    87.70    87.70      .80
NS      7.0      .80
CAU    7.0    95.85   1437.00
VELl    7.0                1.80 2.32 2.56  4.02 4.76  5.41 4.67  4.90 5.30
VELl    7.0 4.86 4.67 4.53 4.83 3.81 3.22  3.40 3.00  2.94 3.36  2.83 2.91
VEL1    7.0 2.57 2.69 2.32 2.52 2.27 2.43  2.32 2.28  1.69 0.00
VELl    7.0
CAL2  .7-0     94.65     589.00
```

Appendix Bl - IFG4 Input File,   Walsh Site (continued)

```
VEL2    7.0                 .       55  1.30 1.80  3.39  3.98  4.63  4.03 4.09 3.11
VEL2    7.0 2.87 2.97 2.90 2.21  2.08 1.68  1.62  1.52  1.31  1.25 1.03   .76
VEL2    7.0   .79   .92   .78   .86    .84 1.09  1.32    .92    .55  0.00
VEL2    7.0
CAL3    7.0       94.10      311.00
VEL3    7.0                          .21     .51 1.45  2.69  3.14 3.68  3.23 2.78 2.51
VEL3    7.0 2.12 1.88 1.74 1.41   1.43 1.04  1.31  1.33   .63    .62   .74   .94
VEL3    7.0   .77   .52   .26   .33     .30   .23    .31    .33   .23  0.00
VEL3    7.0

XSEC    8.0       261.0   .50       93.50     .00250
        8.0 -4.0102.3   0.0100.5    3.396.41  10.0    95.2  20.0  93.9  30.0  93.5
        8.0 40.0 93.6   50.0 93.6  60.0 93.7  65.0    93.8  70.0  93.8  75.0  93.9
        8.0 80.0 93.7   85.0 93.9  90.0 94.0  95.0    94.0100.0  94.2110.0  94.3
        8.0120.0 94.4130.0 94.7140.0 94.8151.5    95.2161.5  95.0171.6  95.3
        8.0181.5 94.8191.5 95.2197.8 96.4203.097.98212.0102.3
NS      8.0          .80          .80          .10     82.80       68.80      65.70
NS      8.0      65.60       65.80       65.70     56.70       56.70      56.70
NS      8.0      56.60       65.70       56.80     56.60       65.80      65.70
NS      8.0      65.60       56.80       65.60     65.60       65.60      65.60
NS      8.0      76.80       87.80       87.80          .80           .80
CAL1    8.0      96.41     437.00
VELl     8.0                         1.70  2.98 4.06  4.92  4.86 5.12 5.35  4.97 5.02
VELl     8.0 4.69 5.47  5.07 5.10  4.42 4.15  4.15  3.98 3.57 2.70  2.57 2.72
VELl     8.0 2.81 1.37
CAL2    8.0       95.54      589.00
VEL2     8.0                          .50  1.72 3.00  2.89  3.78 4.12 3.92  3.52 3.55
VEL2     8.0 3.23 3.27 3.35 3.52  2.69 3.07  2.54  2.56 1.74   .20  1.71 1.23
VEL2     8.0 1.08   .11
CAL3     8.0      95.12      311.00
VEL3     8.0                              1.34 1.12  2.91  3.23 2.40 2.95  2.80 2.91
VEL3     8.0 2.92 3.11 2.92 2.47 2.25 2.07  1.68    .59   .49   .20  0.00
VEL3     8.0   .29   .20
ENDJ
```

Appendix B2 - Summary of Calibration Details, Walsh Site

METHOW RIVER - WALSH SITE
Calibration Information for Calculated Discharge

Transect Number	1	2	3	4	5	6	7	8
Discharge								
	1605	1181	1592	1499	1483	1494	1497	1562
	614	653	613	649	582	588	557	621
	295	343	309	360	308	313	283	323
Stage								
	93.85	94.39	94.47	96.36	96.45	96.59	95.85	96.41
	92.87	93.31	93.34	95-18	95.23	95.37	94.65	95.54
	92.44	92.75	92.78	94.58	94.61	94.80	94.10	95.12
Plotting Stage								
	5.05	5.59	5.67	5.66	4.85	4.99	4.85	2.91
	4.07	4.51	4.54	4.48	3.63	3.77	3.65	2.04
	3.64	3.95	3.98	3.88	3.01	3.20	3.10	1.62
Ratio of measured versus predicted discharge								
	0.966	0.958	0.982	0.989	0.995	0.987	0.984	0.991
	1.105	1.120	1.051	1.031	1.014	1.036	1.046	1.023
	0.936	0.932	0.969	0.982	0.992	0.978	0.972	0.986
Mean error of stage/discharge relationship for calculated Q								
	6.60	7.49	3.30	2.00	0.92	2.35	3.00	1.49
Mean error of stage/discharge relationship for given Q								
	4.98	2.36	3.00	2.42	1.65	3.19	3.46	1.58
Stage/discharge relationship (S vs Q) S=A*Q**B+SZF								
A=	0.1172	0.7258	0.1135	0.8070	0.5261	0.6148	0.6671	0.1874
B=	0.1970	0.2868	0.2176	0.2659	0.3040	0.2860	0.2707	0.3725
SZF=	88.8	88.80	88.80	90.70	91.60	91.60	90.10	93.50
Beta coefficient log/log discharge/stage relationship								
	5.07	3.49	4.60	3.76	3.29	3.50	3.69	2.68

Appendix B3 - Data Changes for Calibration, Walsh Site

TRANSECT	VERTICAL	VEL	CHANGE
1	10	3	0.00 to 0.20
1	18	3	0.43 to 0.63
1	36	3	0.03 to 0.23
1	42	1	5.22 to 5.02
1	42	3	1.07 to 1.27
2	11	3	0.00 to 0.20
2	34	3	0.05 to 0.25
2	35	3	0.01 to 0.21
4	9	3	0. 14 to 0.34
5	7	3	0.11 to 0.31
5	34	3	0. 10 to 0.30
6	5	3	0.02 to 0.22
6	7	3	0. 14 to 0.34
6	33	3	0.23 to 0.43
6	34	3	0.23 to 0.00
6	35	1	2.40 to 2.20
6	35	3	0.74 to 0.94
6	36	3	1.06 to 1.26
6	37	3	1.47 to 1.67
6	38	3	1.77 to 1.97
6	39	3	1.55 to 1.75
7	29	3	0. 10 to 0.30
7	30	3	0.03 to 0.23
7	31	3	0.11 to 0.31
7	32	3	0. 13 to 0.33
7	33	3	0.03 to 0.23
8	20	1	4.18 to 3.98
8	20	3	0.39 to 0.59
8	22	3	0.00 to 0.20
8	25	3	0.09 to 0.29
8	26	3	0.00 to 0.20

Appendix B4 Velocity Adjustment Factors, Walsh Site

Transect	Discharge	VAF
1.00	3590.0	0.938
1.00	1437.0	1.022
1.00	589.0	1.024
1.00	311.0	1.006
1.00	124.0	0.960
2.00	3590.0	0.777
2.00	1437.0	0.990
2.00	589.0	1.046
2.00	311.0	0.989
2.00	124.0	0.833
3.00	3590.0	0.927
3.00	1437.0	0.994
3.00	589.0	1.006
3.00	311.0	1.005
3.00	124.0	1.106
4.00	3590.0	0.872
4.00	1437.0	1.000
4.00	589.0	1.024
4.00	311.0	0.984
4.00	124.0	0.860
5.00	3590.0	0.945
5.00	1437.0	0.996
5.00	589.0	1.005
5.00	311.0	0.997
5.00	124.0	0.977
6.00	3590.0	1.014
6.00	1437.0	1.002
6.00	589.0	0.988
6.00	311.0	1.019
6.00	124.0	1.233
7.00	3590.0	0.883
7.00	1437.0	0.992
7.00	589.0	1.014
7.00	311.0	0.994
7.00	124.0	0.930
8.00	3590.0	0.855
8.00	1437.0	0.992
8.00	589.0	1.018
8.00	311.0	1.005
8.00	124.0	0.941

APPENDIX C

KOA SITE CALIBRATION INFORMATION

Appendix Cl IFG4 Input File, KOA Site

```
METHOW RIVER    KOA SITE at river mile 49.0          WRIA 48
measured on 8/2/1991-1135 cfs, 8/29-457 cfs, 9/25-229 cfs
10C          00000002000000000000000
QARD    92.0
QARD  229.0
QARD  457.0
QARD  1135.0
QARD  2838.0
XSEC     1.0 0.0 .50      92.50      .00250
         1.0 -7.0101.8 0.097.85 3.396.09 5.0   93.4 10.0  93.4 15.0 93.1
         1.0 20.0 92.5 25.0 92.6 30.0 92.8 35.0 92.9 40.0 92.9 45.0 93.0
         1.0 50.0 93.0 55.0 93.3 60.0 93.3 65.0 93.6 70.0 93.7 75.0 93.9
         1.0 80.0 94.0 85.0 94.2 90.0 94.4 95.0 94.7100.0 94.7105.0 94.6
         1.0110.0 94.7115.0 94.7120.0 94.9125.0 94.9130.0 94.9135.0 95.
         1 1.0140.0 95.1146.5 95.0151.5 95.2156.5 95.2161.5 95.3165.096.09
         1.0168.396.45175.3101.8
NS       1.0      .80       .80          .10       78.60      68.60   87.70
NS       1.0  87.70   87.50       76.50       67.80      67.80   78.60
NS       1.0  76.50   57.60       75.60       75.50      65.50   87.50
NS       1.0  76.60   76.70       86 .50      78.70      78.60   68.60
NS       1.0  87.60   67.60       76.60       76.60      76.60   68.50
NS       1.0  87.50   87.50       87.50       87.70      87.70   87.70
NS       1.0      .80       .80
CAL1     1.0  96.09 1135.00
VEL1      1.0                       1.49 2.97 3.37 3.20 5.03 5.43 5.14  5.16 5.20
VELl      1.0 4.83 4.42 4.41 4.49 3.04 3.49 2.88 2.75 2.70 2.07 2.22 2.32
VEL1      1.0 2.02 1.95 2.05 1.72 1.71 1.75 1.67 1.53 1.67 1.41 1.41
VELl      1.0
CAL2     1.0  95.25  457.00
VEL2      1.0                         .98 2.05 2.54 2.01 3.00 3.01 3.02 2.74 2.63
VEL2      1.0 2.22 2.56 3.00 2.59 1.89 1.76 1.34 1.52 1.56 1.35 1.13   .98
VEL2      1.0   .90   .67   .41   .38   .52          .36   .53 0.00
VEL2      1.0
CAL      1.0  94.72   229.00
VEL3      1.0                         .81 1.57 1.65 1.95 1.85 2.40  2.17 2.43 1.90
VEL3      1.0 1.89 2.00 2.19 1.41 1.30 1.05   .72   .31    .33         0.00 0.00
VEL3      1.0 0.00 0.00 0.00
VEL3      1.0
XSEC      2.0  470.0 .50      93.10      .00250
          2.0 -5.0101.8 0.098.95 3.596.73 5.0   95.9 10.0  95.5 15.0 93.8
          2.0     20.0 93.8 25.0 93.1 30.0 93.2 35.0 93.2 40.0 93.3 45.0  93.5
          2.0     50.0 93.8 55.0 93.8 60.0 94.1 65.0 94.1 70.0 94.4 75.0   94.5
          2.0     80.0 94.5 85.0 94.7 90.0 94.9 95.0 95.0100.0 95.1105.0 95.2
          2.0110.0 95.0115.0 95.7120.0 95.3125.0 95.5130.0 95.5135.0 95.7
          2.0140.0 95.7146.5 95.8151.5 96.6151.796.73164.499.65169.4101.8
NS        2.0       .80       .80      78.70     87.80      87.70      87.70
NS        2.0  87.70      76.80      76.80     76.80      76.80      76.70
NS        2.0  76.70      76.70      76.70     76.70      67.70      67.70
NS        2.0  67.70      76.80      67.70     76.80      76.80      76.80
NS        2.0  76.80      76.80      76.80     67.70      67.70      76.80
NS        2.0  76.70       67.70     62.60     62.60          .80        .80
CAL1      2.0  96.73  1135.00
```

Appendix C1 - IFG4 Input File,   KOA Site (continued)

```
VELl     2.0                    0.00  1.20 2.25 4.26  4.98 4.33 4.88 4.39 4.96
VELl     2.0 4.86 4.13  3.70 3.68  3.47 3.28 2.91  2.79 2.52 2.77 2.42 2.84
VELl     2.0 2.67 2.38  2.31 2.04  1.61 1.32 1.31   .78 0.00
CAL2    2.0       95.82      457.00
VEL2    2.0                          0.00 1.42 2.72  3.41 3.09 3.37 2.76 3.19
VEL2    2.0 3.41 2.75  2.69 2.45   2.38 2.32 1.28  1.36 1.18 1.13 1.29   .95
VEL2    2.0   .65   .80     .87  .61     .24 0.00 0.00
CAL3    2.0     95.24    229.00
VEL3    2.0                                2.06 2.76  2.54 3.37 2.96 2.98 2.46
VEL3    2.0 2.14 2.04  1.79 1.43  1.30    .80   .68    .44  .24 0.00   .36 0.00
VEL3    2.0   .33
XSEC   3.0       352.0   .50     95.20    .00250
          3.0 -6.098.75   0.098.75 3.697.89 5.0     96.4 10.0 95.6  15.0 95.3
          3.0 20.0 95.2  25.0 95.8 30.0 96.2 35.0   96.0 40.0 96.2  45.0 96.3
          3.0 50.0 96.2  55.0 96.1  60.0 96.2 65.0  96.2 70.0 96.0  75.0 96.0
          3.0 80.0 95.7  85.0 95.5  90.0 95.5 95.0  95.7100.0 95.6105.0  95.5
          3.0110.0 95.6115.0 95.5120.0   95.4125.0  95.4130.0 95.5135.0  95.6
          3.0140.0 95.7146.5 95.8151.5   95.8156.5  96.3161.5 96.6166.5  96.9
          3.0168.097.89168.798.35178.7101.8
NS        3.0          .80         .80          .80      87.60      87.80          .50
NS        3.0      76.70      76.70      65.70      65.70      65.60      65.60
NS       3.0       67.70      67.70      65.60      65.60      78.80      76.80
NS       3.0       76.80      76.80      76.70      76.70      76.80      76.80
NS       3.0       76.70      76.60      76.70      76.80      67.70      67.80
NS       3.0       67.70      67.80      76.60      78.70      87.60      87.70
NS       3.0          .30         .80          .80
CAU   3.0      97.89  1135.00
VELl  3.0                       1.13    .97  .43  3.00 3.24  3.39 3.31  2.90 3.19
VELI   3.0 3.07 2.63  3.25 3.42  3.48 4.01 4.05  3.71 4.10 4.43  4.28 3.94
VELl   3.0 3.77 3.89  3.51 3.70  3,40 3.73 3.60  3.58 3.00 3.15  3.14 1.07
VELl   3.0
CAL2 3.0      97.14        457.00
VEL2  3.0                         .74    .81 1.53 2.19  1.97 l..84 1.57 1.63 1.74
VEL2  3.0 1.80 2.09  2.17 2.58  2.36 2.70 2.23  2.80 1.99 3.11 3.18 2.62
VEL2  3.0 2.31 2.59  3.05 2.56  2.45 2.51 2.76  2.51 2.48   .56 1.13   .18
VEL2  3.0
CAL3 3.0      96.73    229.00
VEL3  3.0                    .19  .32    .98  .62  .77   .95  .80 1.90
VEL3  3.0 1.65 1.62  1.53 1.46  2.26 1.87 1.71  2.20 1.04 2.21  2.90 2.26
VEL3  3.0 2.53 2.13  2.43 2.11  2.15 1.68 2.23  1.93 1.16    .20 0.00
VEL3  3.0 XSEC    4.0      498.0 .50      93.70    .00250
        4.0 -8.0104.8   0.098.24 3.596.45 5.0     96.0 10.0 94.5  15.0      94.0
        4.0 20.0 94.0  25.0 94.0 30.0 93.9 35.0   93.7 40.0 93.7  45.0      93.7
        4.0 50.0 93.9  55.0 93.9  60.0 94.0 65.0  94.3 70.0 94.3  75.0      94.4
        4.0 80.0 94.3  85.0 94.5  90.0 94.3 95.0  94.4100.0 94.5105.0      94.6
        4.0110.0 94.4115.0 94.5120.0   94.4125.0  94.7130.0 94.6135.0  94.7
        4.0140.0 94.7146.5 94.6151.5   94.4156.5  94.5161.5 94.6166.5  94.8
        4.0172.997.84186.9104.8
NS      4.0          .80         .80      87.60      87.60      87.60      87.60
NS      4.0      78.50      65.70      65.70      86.50      76.60      76.60
NS      4.0      76.50      76.50      76.60      76.70      76.50      76.50
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NS      4.0    75.60     75.60     78.60      57.50     67.50     67.50
NS      4.0    67.60     67.50     67.50      68.50     68.50     68.50
NS      4.0    68.50     76.60     78.60      78.60     78.60     78.60
NS      4.0      .10       .80
CAL1  4.0    96.45  1135.00

VELl    4.0                    .47  1.76 3.76  4.03 3.89 4.77 5.01  4.29 4.54
VELl    4.0 4.60 3.74  4.53 3.97  3.97 3.63  3.28 3.75 3.15  2.58 3.39  3.02
VELl    4.0 2.33 2.67  2.43 2.38  2.62 2.42  2.58 2.38 2.02  2.10 2.04  1.38
VELl    4.0
CAL2   4.0    95.65    457.00
VEL2   4.0                              1.00 2.33  2.91 3.03 3.43  2.82 2.82  2.90
VEL2   4.0 3.24 3.35  2.85 2.85  2.16 2.15  2.26 1.96 1.96  1.88 1.91  1.79
VEL2   4.0 1.82 1.37  1.14 1.17  1.21 1.00    .95   .99   .97    .66   .81   .14
VEL2   4.0
CAL3  4.0    95.26    229.00
VEL3   4.0                                .74 1.75  2.35 2.11 2.37  2.32 2.06  2.36
VEL3   4.0 2.27 2.19  1.76 1.97  1.70 1.54  1.56 1.52 1.43  1.52   .83  1.45
VEL3   4.0   .99 1.08    .69   .81    .77   .26    .58   .51   .57    .30   .35   .05
VEL3   4.0
XSEC   5.0     253.0  .50        93.70 .00250
         5.0 -7.0104.8  0.099.64 3.396.85 5.0      95.2 10.0  94.2 1.0  94.0
         5.0 20.0 93.5  25.0 93.1 30.0 92.7 32.5   92.3 35.0  92.2 37.5  92.3
         5.0 40.0 92.4  42.5 92.7  45.0 92.8  50.0 93.2  55.0  93.5 60.0  93.8
         5.0 65.0 94.0  70.0 94.0  75.0 94.1  80.0 94.3 85.0  94.4 90.0  94.5
         5.0 95.0 94.6100.0 94.7105.0  94.6110.0   94.9115.0  95.0120.0  95.2
         5.0125.0,95.4130.0 95.5135.0  95.6140.0   95.6146.5  95.8151.5  96.1
         5.0152.796.85155.598.24190.5104.8
NS      5.0        .80          .80       87.80      87.80     87.60     87.60
NS      5.0     87.60     87.80     87.80      87.80     87.60     67.60
NS      5.0     67.60     67.60     87.60      76.50     76.50     75.70
NS      5.0     75.70     75.70     75.70      85.60     68.60     86.60
NS      5.0     86.60     86.50     86.50      78.60     78.60     78.60
NS      5.0     78.60     78.60     78.60      78.60     78.60     78.60
NS      5.0     78.60          .80          .80
CAU  5.0    96.85   1135.00
VELl  5.0                        .66 1.47 2.69  2.97 3.67  3.78 4.13 4.19  3.90
VEL1 5.0 3.58 4.14  4.14 3.85 4.16 3.86  3.60 3.04  2.90 2.87 3.00  2.19
VELI  5.0 2.52 2.62  2.30 1.89 2.37 2.30  2.27 1.96  1.48 1.97 1.73    .69
VELl  5.0
CAL2 5.0     96.01      457.00
VEL2  5.0                      0.00    .69 1.49  1.75 1.87  2.25 2.93 2.32  2.40
VEL2  5.0 2.65 2.37  2.31 2.28  2.07 2.31  2.25 1.38  1.71 1.85 1.60  1.44
VEL2  5.0 1.25 1.44  1.29   .94 1.10    .48    .62   .54    .50   .51   .47
VEL2  5.0
CAL3  5.0     95.52        229.00
VEL3  5.0                      0.00    .74   .71  1.04 1.50  1.58 1.75 1.54  1.51
VEL3  5.0 1.64 1.41  1.66 1.45  1.20 1.37  1.17 1.14  1.29   .64   .97    .96
VEL3  5.0   .61   .89    .37   .30    .38          0.00 0.00
VEL3  5.0
XSEC 6.0     290.0  .50        93.70      .00250
        6.0 -9.0104.8    0.098.74 2.0  97.1 3.0   94.0     5.0 93.5 10.0   92.8
        6.0 12.5 92.8  15.0 92.8 17.5  93.1 20.0  93.2  22.5 93.1 25.0  93.1
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        6.0 27.5  92.9 30.0  92. 9 35.0 93.7 40.0  92.8  45.0 92.9  50.0  93.3
        6.0 55.0  93.5 60.0  93. 5 65.0 93.6 70.0  93.8  75.0 94.2  80.0  94.1
        6.0 85.0  94.3 90.0  94 .4 95.0 940100.0  94.8105.0 95.0110.0  95.4
        6.0115.0 95.8120.0 95.9125.0 96.3130.0 97.0130.2 97.1136.197.94
        6.0150.1104.8
NS      6.0        .80        .80     78.70      78.70      78.70      87.70
NS      6.0      87.60      87.70     87.80      87.80      87.80      87.80
NS      6.0      87.80      87.80     87.80      87.80      87.80      87.80
NS      6.0      87.60      87.60     86.70      86.70      67.70      67.70
NS      6.0      68.60      68.60     68.60      68.60      67.70      76.70
NS      6.0      78.60      78.60     76.70      72.70      72.70        .80
NS      6.0        .80
CAL1 6.0     97.10  1135.00
VELl   6.0                          .20  .65 2.72  3.32 3.07  3.19 3.35  3.39 3.02
VELl   6.0  3.65 3.78  3.87 3.83 3.87  4.20 3.95 4.43  4.04 3.30  3.19 2.51
VEL1  6.0  2.80 1.84  2.27 2.02 1.47  1.62 1.56 1.13     .51 0.00
VELl   6.0
CAL2  6.0     96.20     457.00
VEL2  6.0                        0.00  .36    .95 1.60 1.85  1.57 1.94  1.42 1.66
VEL2  6.0  1.72 1.89 1.98 2.04 2.12  2.20 2.51 2.57  2.06 1.81  1.73 1.71
VEL2  6.0  1.36   .82 1.14   .95   .85    .32  .28  0.00
VEL2  6.0
CAL3  6.0     95.64     229.00
VEL3  6.0                          .18   .19    .66   .91   .73  1.00   .89  1.09  .90
VEL3  6.0  1.24 1.27  1.18 1.37 1.13  1.58 1.68 1.59  1.29 1.15  1.26 1.18
VEL3  6.0   .54   .51    .51   .50   .27  0.00
VEL3  6.0
XSEC 7.0     231.0  .50     90.10     .00250
        7.0  -5.0100.0   0.0 97.0 3.893.62 5.0    93.4  10.0 92.0  15.0 91.4
        7.0  20.0 90.9  25.0 90.8 30.0 90.6 35.0  90.8  40.0 90.5  45.0 90.1
        7.0  50.0 90.1  55.0 90.1 60.0 90.1 65.0  90.2  70.0 90.5  75.0 90.4
        7.0  80.0 90.3  85.0 90.7 90.0 90.9 95.0  91.1100.0 91.7105.0 91.5
        7.0110.0 92.7115.0   92.9120.0 93.1125.0  93.4128.093.62138.8 95.5
        7.0163.8100.0
NS     7.0       .80       .80     78.60      87.60      87.70      78.60
NS     7.0      87.80     87.80     78.80      78.70      87.60      87.60
NS     7.0      76.80     87.60     87.70      76.80      76.80      76.70
NS     7.0      87.60     76.60     68.70      78.70      76.60      67.70
NS     7.0      87.80     87.70     87.70      87.60      78.70        .80
NS     7.0       .80
CAL1 7.0     93.62      1135.00
VELl   7.0                        1.01 1.05 2.20  2.14 3.79  4.47 5.04  4.53 4.44
VEL1  7.0  4.89 5.30  5.39 5.45 5.34 3.83  2.65 2.87  1.58 2.33  2.25 1.94
VELl   7.0  1.96  1.40  .44 .14
CAL2   7.0     92.60    457.00
VEL2  7.0                              0.00   .79  1.15 2.08  2.21 3.34  2.88 3.27
VEL2  7.0  2.46 3.64  3.31 3.83 3.69 2.19  1.53 1.03    .71   .74    .62   .38
VEL2  7.0  0.00
CAL3 7.0     92.06      229.00
VEL3  7.0                                     0.00   .20 1.01   .79 1.71  2.21 1.79
VEL3  7.0  1.67 1.74  3.12 1.92 2.82  1.37 1.15   .60   .55   .42    .32 0.00
VEL3  7.0
```

Appendix C1 - IFG4 Input File, KOA Site (continued)

```
XSEC  8.0      443.0 .50    92.50     .00250
      8.0 -7.0100.0  0.0  97.1   .195.46 5.0        94.1 10.0 93.2 15.0 92.5
      8.0 20.0 92.7 25.0  92.5 30.0 92.8 35.0      92.8 40.0 92.8 45.0 92.7
      8.0 50.0 92.6 55.0  92.7 60.0 92.6 65.0      92.6 70.0 92.7 75.0 92.8
      8.0 80.0 92.9 85.0  93.0 90.0 93.2 95.0       93.1100.0 93.2105.0 93.3
      8.0110.0 93.2115.0  93.3120.0 93.7125.0   93.6130.0 93.8135.0 94.0
      8.0140.0 94.2145.0  94.3150.0 94.4155.0   94.7160.0 94.8165.095.46
      8.0168.2 94.9175.2100.0

NS    8.0       .80       .80       .10      76.80    86.70     87.60
NS    8.0     76.70     87.60     87.70      78.70    67.70     76.70
NS    8.0     76.80     76.70     76.70      76.70    67.70     67.70
NS    8.0     67.70     76.70     76.70      67.80    67.80     67.80
NS    8.0     76.80     67.70     67.70      67.70    67.70     68.70
NS    8.0     76.70     76.70     76.70      67.80    67.80     27.80
NS    8.0       .80       .80
CALl  8.0     95.46   1135.00
VELl   8.0                   1.53 2.65 2.44  2.84 3.65  3*82 3.61  3.27 3.29
VELl   8.0 3.58 3.65  3.63 3.48 2.91  3.43 3.17  2.89 2.94 3.26  2.84 3.22
VELl   8.0 3.78 2.70  3.53 2.97 2.70  2.60 2.97  2.47 2.10 1.58    .45
VELl   8.0
CAL2  8.0     94.66      457.00
VEL2   8.0                    .52 1.01   .90  1.82  2.43 1.87  2.21  2.12 1.85
VEL2   8.0 2.40 2.39  2.27 2.43 1.99  2.25 2.44  1.95 2.39  1.98  1.83 1.84
VEL2   8.0 2.09 1.92  2.03 1.67 1.32   .95    .58  0.00 0.00  0.00
VEL2   8.0
CAL3  8.0     94.25      229.00
VEL3   8.0                   0.00    .67    .81 1.46  1.75 1.63 1.64  1.76 1.46
VEL3   8.0 1.78 1.62  1.65 1.64 1.69  1. 88 1.85  1.66 1.85 1.64  1.00   .98
VEL3   8.0 1.12 1.02    .84   .57   .39  0.00  0.00
VEL3   8.0
ENDJ
```

Appendix C2 - Summary of Calibration Details, KOA Site

METHOW RIVER - KOA SITE
Calibration Information for Calculated Discharge

Transect Number							
1	2	3	4	5	6	7	8
Discharge							
1141	1054	1093	1146	1160	1177	1106	1080
420	420	474	453	461	453	425	428
217	233	236	235	224	219	194	232
Stage							
96.09	96.73	97.89	96.45	96.85	97.10	93.62	95.46
95.25	95.82	97.14	95.65	96.01	96.20	92.60	94.66
94.72	95.24	96.73	95.26	95.52	95.64	92.06	94.25
Plotting Stage							
3.59	3.63	2.69	2.75	3.15	3.40	3.52	2.96
2.75	2.72	1.94	1.95	2.31	2.50	2.50	2.16
2.22	2.14	1.53	1.56	1.82	1.94	1.96	1.75
Ratio of measured-versus predicted discharge							
1.023	1.030	0.986	0.991	0.998	1.010	0.983	1.002
0.949	0.938	1.034	1.023	1.004	0.978	1.041	0.996
1.029	1.036	0.981	0.986	0.998	1.013	0.977	1.003
Mean error of stage/discharge relationship for calculated Q							
3.48	4.33	2.23	1.05	0.29	1.52	2.68	0.30
Mean error of stage/discharge relationship for given 0							
0.98	1.58	0.77	2.66	0.21	1.44	1.13	2.18
Stage/discharge relationship (S vs Q) S=A*QB+SZF**							
A= 0.4736	0.3225	0.2013	0.2192	0.2984	0.3226	0.3287	0.2714
B= 0.2887	0.3493	0.3697	0.3586	0.3339	0.3336	0.3379	0.3422
SZF= 92.5	93.10	95.20	93.70	93.70	93.70	90.10	92.50
Beta coefficient log/log discharge/stage relationship							
3.46	2.86	2.71	2.79	2.99	3.00	2.96	2.92

Appendix C3 - Data Changes for Calibration, KOA Site

TRANSECT	VERTICAL	VEL	CHANGE
1	24	3	0.03 TO 0.00
1	31	2	0. 16 TO 0.36
2	23	3	0. 16 TO 0.36
2	24	3	0.05 TO 0.00
2	25	3	0. 13 TO 0.33
3	34	1	3.15 TO 2.95
3	34	2	0.56 TO 0.76
5	34	2	0.31 TO 0.51
5	35	2	0.27 TO 0.47
7	9	1	4.47 TO 4.27
7	9	3	0.59 TO 0.79

Appendix C4 Velocity Adjustment Factors, KOA Site

Transect	Discharge	VAF
1.00	92.0	0.934
1.00	229.0	0.996
1.00	457.0	1.017
1.00	1135.0	0.988
1.00	2838.0	0.898
2.00	92.0	0.895
2.00	229.0	0.996
2.00	457.0	1.031
2.00	1135.0	0.975
2.00	2838.0	0.813
3.00	92.0	1.050
3.00	229.0	1.004
3.00	457.0	1.004
3.00	1135.0	1.000
3.00	2838.0	0.942
4.00	92.0	1.014
4.00	229.0	1.000
4.00	457.0	1.004
4.00	1135.0	0.999
4.00	2838.0	0.948
5.00	92.0	0.910
5.00	229.0	0.991
5.00	457.0	1.019
5.00	1135.0	0.989
5.00	2838.0	0.865
6.00	92.0	0.955
6.00	229.0	0.997
6.00	457.0	1.011
6.00	1135.0	0.994
6.00	2838.0	0.922
7.00	92.0	0.932
7.00	229.0	0.993
7.00	457.0	1.018
7.00	1135.0	0.990
7.00	2838.0	0.888
8.00	92.0	0.953
8.00	229.0	0.992
8.00	457.0	1.010
8.00	1135.0	0.992
8.00	2838.0	0.922

APPENDIX D

WEMAN SITE CALIBRATION INFORMATION

Appendix Dl - IFG4 Input Files, Weeman Site

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METHOW RIVER - WEEMAN SITE at river mile 59.0                    WRIA 48
measured on 8/3/91 - 658 cfs, 8/16 - 380 cfs, 8/27- 238 cfs, 9/26-79 cfs
IOC        0000000200001000000000
QARD    45.0
QARD    80.0
QARD   250.0
QARD   400.0
QARD   650.0
QARD 1300.0
XSEC        1.0          0.0 .50       91.10      .00250
            1.0-99.0100.7   -3.5100.7   0.0   97.5    5.594.89 7.5      94.2 10.0  93.1
            1.0 12.5  92.4   15.0 92.0  17.5   91.2 20.0   91.0 22.5    91.1 25.0  91.0
            1.0 27.5  91.1   30.0 91.3  32.5   91.5 35.0   91.6 40.0    92.2 45.0  92.5
            1.0  50.0 92.9   55.0 93.1  60.0   93.3 65.0   93.4 70.0    93.5 75.0  93.7
            1.0  80.0 93.9   85.0 94.0  90.0   94.2 95.0   94.3100.0   94.4105.0  94.4
            1.0110.0  94.5115.0 94.6120.0   94.4125.0   94.4130.0  94.7135.0  94.7
            1.0140.0  94.8146.5 94.8169.2   96.5269.2   96.5
NS          1.0        .80        .80     52.70        87.60     87.60      76.80
NS          1.0      76.80      76.80     76.80        76.70     67.70      65.70
NS          1.0      65.70      65.60     65.60        65.70     65.80      65.80
NS          1.0      65.70      65.70     65.60        65.70     65.80      76.60
NS          1.0      76.80      76.80     76.80        76.80     76.80      76.80
NS          1.0      76.70      76.60     66.90        66.90-     65.80 0.1  76.50
NS          1.0      65.80      56.80     22.90        26.50
CAL1        1.0      94.89     658.00
VELl        1.0                             .11 2.52  2.63 3.25  4.97   5.16 5.60  5.07
VELl        1.0 4.68 4.51   4.20 4.09  3.69  3.05 3.18 2.93  3.20   2.75 2.73  2.28
VELl        1.0 2.40 1.83   1.29 1.28   .41   .64   .30   .26  0.00     .20   .72  0.00
VEL1        1.0 0.00  0.00
CAL2       1.0      94.34       .380.00
VEL2       1.0                             .37  1.27 1.62   3.07 4.09  4.46 4.80  4.65
VEL2       1.0 4.18  3.81  3.61 3.33  2.78  2.32 2.19   1.98 2.24  1.98 1.60  1.28
VEL2       1.0 1.26    .73  0.00 0.00
VEL2       1.0
CAL3      1.0       93.84       238.00
VEL3       1.0                                 .74  1.69   2.20 3.04  4.22 4.47  3.77
VEL3       1.0 3.19 3.33   3.32 2.68  2.28 1.45  1.34    .99   .83    .77   .70  0.00
VEL3       1.0 0.00
VEL3       1.0
CAL4      1.0     93.11                 79.00

VEL4    1.0                                          1.10 1.57  1.90 2.02  1.73
VEIA    1.0 1.78 1.98   1.62 1.63 1.04 .44 .33
VEIA    1.0
VEIA    1.0
XSEC    2.0      328.0  .50     92.20      .00250
        2.0-50.0 97.4   0.097.25   3.895.54   5.0     94.0 10.0  92.3 12.5  92.2
        2.0 15.0 92.2   17.5 92.2 20.0 92.2 22.5      92.5 25.0  92.8 27.5  93.1
        2.0 30.0 93.3   32.5 93.6  35.0 93.8  37.5    93.8 40.0  93.9 45.0  93.9
        2.0 50.0 93.9   55.0 93.8  60.0 93.7  65.0    93.7 70.0  94.0 75.0  94.0
        2.0 80.0 94.2   85.0 94.5  90.0 94.6  95.0    94.5100.0  94.3105.0  94.2
        2.0110.0 93.9115.0   93.5117.5 93.2120.0  93.1122.5  93.2125.0  93.4
        2.0130.0 94.3135.0   95.1152.7 97.3202.7  97.3252.7  97.4
```

Appendix D1 - IFG4 Input Files, Weeman Site (continued)f

NS	2.0	.80	.80	.10	72.70	76.90	76.90	
NS	2.0	76.90	77.90	77.90	77.90	77.90	77.90	
NS	2.0	77.90	77.90	77.90	77.90	77.90	77.90	
NS	2.0	77.90	77.90	77.90	.77.90	77.90	77.90	
NS	2.0	77.90	77.90	77.90	77.90	77.90	77.90	
NS	2.0	77.90	77.90	77.90	77.90	77.90	77.90	
NS	2.0	77.90	77.90	77.90	72.30	62.50	62.50	
CAL1	2.0	95.54	658.00					
VEL1	2.0		.19	1.38 3.54	3.48 4.56	3.86 4.02	4.39 3.95	
VEL1	2.0	4.51 3.60	4.18 3.65	4.08 3.04	3.66 3.05	3.44 2.76	2.97 3.44	
VEL1	2.0	2.98 2.82	2.49 1.77	2.12 1.71	2.18 1.95	1.90 2.00	1.82 1.67	
VEL1	2.0	.96 .72						
CAL2	2.0	95.04	380.00					
VEL2	2.0			1.75 2.70	3.11 2.86	3.08 3.51	3.04 3.20	
VEL2	2.0	3.01 3.61	3.17 2.73	3.28 2.85	2.96 3.08	3.32 2.31	3.10 2.52	
VEL2	2.0	1.76 1.65	1.57 .73	1.23 .92	1.18 1.48	1.07 1.48	1.39 1.45	
VEL2	2.0	1.51.						
CAL3	2.0	94.66	238.00					
VEL3	2.0			1.20 2.43	3.15 3.18	3.38 3.24	3.36 3.96	
VEL3	2.0	3.22 2.83	2.85 3.00	2.87 3.00	2.18 2.90	2.36 2.47	2.08 2.39	
VEL3	2.0	1.85 .82	.75 .40	2.05 .32	.34 .90	1.17 1.41	1.36 1.20	
VEL3	2.0	.78						
CA14	2.0	94.03	79.00					
VEL4	2.0			.80 2.89	2.63 2.83	2.73 2.19	1.76 2.63 E"f	
VELA	2.0	1.21 1.35	1.00 1.44	.99 1.68	1.14 1.42	1.89 1.15	.88 .60 lyf	
VEL4	2.0	0.00		.45	.20 .17	.28 .19	.31 0.00	
VELA	2.0							
XSEC	3.0	239.0	.50 93.90 .00250				~"	
		3.0	0.0 98.6 20.0 98.0	40.0 98.0	52.5 96.5		55.0 96.5	60.0 96.4
	3.0	65.0 95.7	70.0 95.5	75.0 95.0	80.0 94.9	85.0 94.6	90.0 94.4 ;„	
	3.0	95.0 94.2100.0 93.9105.0 93.9110.0 93.9115.0 93.9120.0 94.1 9'1						
	3.0125.0 94.9130.0 94.8135.0 95.2140.0 95.6145.0 96.3150.0 96.5							
	3.0187.0 97.5212.4 98.0237.4100.0							
NS	3.0	52.80	65.60	65.50	65.70	65.70	76.60	
NS	3.0	76.60	76.60	76.60	65.50	65.50	75.50	
NS	3.0	76.70	78.60	87.60	87.60	76.80	76.70	
NS	3.0	78.50	78.50	78.50	78.50	78.50	78.50	
NS	3.0	.80	.80					
CAL1	3.0	96.52	658.00					
VELl	3.0			.16	1.08 1.65	2.94 4.15	3.83 4.87	
VEL1	3.0	5.02 5.21	4.99 5.67	5.40 4.98	4.98 4.02	2.58 1.21	.66	
VEL1	3.0							
CAL2	3.0	96.21	380.00					
VEL2	3.0				.58 1.28	1.27 2.78	2.98 3.56	
VEL2	3.0	4.16 3.95	3.96 4.26	4.48 3.76	3.41 2.58	1.76 .72	0.00	
VEL2	3.0							
CAL3	3.0	95.89	238.00					
VEL3	3.0				0.00 .81	1.24 1.15	2.11 2.92	
VEL3	3.0	2.45 2.85	3.22 2.92	2.93 2.47	2.52 1.79	.99 .42		
VEL3	3.0							
CAL4	3.0	95.36	79.00					
VEL4	3.0					.30 .51	.98 1.48	

Appendix D1 - IFG4 Input Files, Weeman Site (continued)

```
VEL4         3.0    1.48    1.49    1.74  1.65    1.52    1.76  1.33    .57      .33
VEL4         3.0
XSEC         4.0  235.0   .50 91.70  .00250
             4.0-99.0   95.8   0.0 96.0 10.0   94.4 20.6   94.2   25.0   93.7   30.0 93.7
             4.0 35.0   93.3   40.0 93.3 45.0   93.2 50.0   93.1   55.0   93.1   60.0 93.1
               4.0 65.0   93.0   70.0 93.0 75.0   93.1 80.0   93.0   85.0   92.9   90.0 93.2
             4.0 95.0   92.9100.0 92.7105.0   92.6110.0   92.5112.5   92.3115.0 92.2
             4.0117.5   91.9120.0 91.912.2.5   91.7125.0   92.1127.5 92.1130.0 91.9
             4.0135.0   92.4140.0 92.4145.0   92.7150.0   93.1155.0 93.3160.0 93.5
             4.0165.0   93.2170.0 93.1175.0   93.3178.9   94.2187.0   95.4262.0 95.4
NS           4.0  26.50  26.50  67.70  76.50  76.50  76.50
NS           4.0  87.50  87.50  87.50  87.50  67.50  67.50
NS           4.0  67.50  67.70  67.70  67.70  67.70  67.70
NS           4.0  65.80  65.60  65.50  65.50  65.50  65.50
NS           4.0  65.50  76.60  67.60  67.60  87.60  78.60
NS           4.0  78.50  78.50  76.60  78.80  78.70  78.70
NS           4.0  78.50  76.60  76.60  67.60      .80      .80
CAL1         4.0  94.15  658.00
VEL1         4.0                              1.01   1.14 2.37   2.20   2.45   3.49 2.74 2.73
VEL1         4.0 2.83  4.02   2.81 2.11 2.77   2.51 3.26   4.24   4.19   4.81 5.03 4.89
VEL1         4.0 4.33  5.25   5.36 4.83 4.66   4.64 5.14   5.44   3.40   1.95 3.57 2.97
VEL1         4.0 2.75  2.53   1.55
CAL2         4.0         93.76              380.00
VEL2         4.0                                     0.00   .98  1.09  1.23  2.11  2.40  2.45
VEL2         4.0 2.29  2.26  2.65  2.07  1.80  1.55  2.37  3.22  2.59  3.03  4.08  3.82
VEL2         4.0 4.33  5.25  5.36  4.83  4.66  4.64  5.14  5.44  3.40  1.95  3.57  2.97
VEL2         4.0 1.87  2.00  1.26
CAL3         4.0       93.44        238.00
VEL3         4.0                                          .44    .56  1.02    .95  1.26 1.54
VEL3         4.0 2.24   1.58  .90 1.44 1.07  2.51 3.01  3.14  3.71  3.50  4.88 4.49
VEL3         4.0 4.13  4.35   4.39 3.39 5.03   3.75 4.28   3.83   1.81   .69.82 .57
VEL3         4.0 1.62  1.17   0.00
CAL4         4.0        92.91          79.00
VEL4         4.0
VEL4         4.0                         0.00 0.00            .61   1.66   2.11   1.65 2.15 2.56
VEL4         4.0  2.75   3.36   3.14 3.35 2.63   2.18 2.44     .86      .50
VELA         4.0
XSEC         5.0  207.0   .50 91.70  .00250
             5.0 -60.0   95.5   0.0 95.5 10.0   95.6 20.0   94.3   20.2   94.6   25.0 94.2
             5.0  30.0   94.0   35.0 94.0 40.0   93.9 45.0   93.9   50.0   93.8   60.0 93.5
             5.0  70.0   93.5 80.0 93.5 90.0  93.6100.0 93.6110.0  93.5120.0 93.3
             5.0130.0  93.1135.0 92.6140.0   91.1142.5  90.8145.0  90.4147.5 90.4
             5.0150.0   90.2152.5 90.3155.0  90.3157.5  90.5160.0  90.6162.5 90.9
             5.0165.3  92.3167.9 94.6172.5  96.8178.5  99.8
NS           5.0      .80  62.50  67.70  67.70  67.70  76.70
NS           5.0  76.70  76.60  76.60  76.70  76.70  76.70
NS           5.0  76.70  76.70  76.60  76.60  76.60  76.60
NS           5.0  67.70  67.70  76.80  76.80  76.90  77.90
NS           5.0  77.90  77.90  77.90  76.90  76.90      .50
NS           5.0  .    50      .50      .80      .80
CAL1         5.0  94.56 658.00
VEL1         5.0                        .39 .       98   1.09  1.28   1.47   1.80 1.58
```

```
VEL1      5.0  2.18  2.55  2.53  2.28  2.47  2.42  2.78  2.40  2.86  3.42  3.90  4.14
VEL1      5.0  4.40  4.44  4.91  4.26  4.54  1.65    .05
CAL2      5.0         94.22       380.00
VEL2      5.0                                    .34   .72   .47   .76          .70
VEL2  .   5 .0  1.50 1.36 1.53 1.70 1.90 2.14 2.03 1.79 2.04 2.87 3.12 3.29
VEL2      5.0  3.62  3.60 4.02 4.06  3.49   .71  .03
CAL3      5.0        93.92      238.00
VEL3      5.0           0.00     0.00
VEL3      5.0    .58   .67   .75    .97   .89 1.25    1.24   1.38    1.41    2.21    2.39 2.75
VEL3      5.0  2.46 2.87 2.97 2.88  2.60   .57   0.00
VEL4      5.0
VEL4      5.0   0.00  0.00  0.20  .55  .77 1.45
VEL4      5.0  1.43 1.53  1.64 1.65  1.03 .41  0.00
XSEC      6.0    98.0 .50              92.00 .   .00250
           6.0-60.095.59-40.095.99-20.096.69    0.096.49  10.095.99  20.095.39
           6.0  32.094.98  35.0 94.8  40.0 94.7  45.0  94.5  50.0  94.3  55.0 94.1
           6.0  60.0 93.9  65.0 93.7  70.0 93.5  75.0  93.4  80.0  93.3  85.0 93.4
           6.0  90.0 93.1  95.0 93.3100.0  93.2105.0  93.1110.0  93.0115.0 92.9
           6.0120.0 92.8125.0 93.0130.0  93.0135.0  93.0140.0  93.1145.0 92.7
          6.0150.0 92.3155.0 92.2160.0 92.0165.0 92.4170.0 95.0176.096.49
NS        6.0      22.50          67.70          67.70          67.70               67.70    67.70
NS        6.0      67.70          67.70          67.60          67.60               67.60    67.60
NS        6.0      67.70          76.70          76.80          76.80               76.80    76.70
NS        6.0      76.70          76.70          76.90          76.90               76.90    78.90
NS        6.0      77.90          77.90          77.90          78.80               78.80    78.80
NS        6.0      78.90          77.90          77.90          77.90                 .10      .80
CAL1      6.0      94.98          658.00
VEL1      6.0                                            .14   .34  1.40  1.38 2.00
VEL1      6.0  2.07 1.97  2.49 2.90  2.05 3.04  3.22  3.04  3.13  3.20  3.33 2.86
VEL1      6.0  3.02 3.35  3.05 2.97  3.18 3.22  3.57  3.44  3.30  3.43 i.4
CAL2      6.0       94.55      380.00
VEL2      6.0                                                     0.00   .42   .72
VEL2      6.0  1.13 1.27  1.48 1.80  1.96 2.04  2.41  2.39  2.29  2.53  2.28 2.47
VEL2      6.0  1.89 2.32  2.09 2.10  2.17 2.25  2.66  2.36  2.74  2.55
CAL3      6.0        94.21      238.00
VEL3      6.0                                                                 0.00
VEL3      6.0          .63  1.05 1.33  1.24 1.77  1.12  1.77  1.62  2.06  2.04 2.09
VEL3      6.0  1.71 1.66  1.78 1.50  2.04 2.06  1.97  2.23  2.28  2.69
CAL4      6.0       93.53        79.00
VEL4      6.0
VELA      6.0            0.00 0.00  .22 .56  .34  .85  .64  .60  .59 .79
VEL4      6.0  .57 .77  .78    .49  .45 1.46  1.70  1.81  2.11  2.55
XSEC      7.0 247.0  .50 92.00 .00250
          7.0-40.097.19-20.097.39  0.096.69   10.096.19   20.095.69  29.195.24
          7.0  30.095.14  35.0 95.3  40.0 94.9  45.0  94.8  50.0  94.5  55.0 94.4
          7.0  60.0 94.2  65.0 93.8  70.0 93.5  75.0  93.2  80.0  93.0  85.0 92.4
          7.0  90.0 92.4  92.5 92.0  95.0 92.3  97.5  92.3100.0  92.4102.5 92.3
          7.0105.0 92.2107.5 92.0110.0 91.8112.5  91.9115.0  92.0117.5 91.7
          7.0120.0 91.5122.5 91.2125.0 91.6127.5  91.6130.0  92.3135.0 93.2
          7.0140.0 94.2142.395.24147.299.49151.2101.7
NS        7.0          .80        67.50         67.50          67.50      67.50      67.70
```

NS	7.0	67.70	76.70	76.80	76.90	76.90	76.90
NS	7.0	76.90	76.80	76.80	78.70	78.70	77.90
NS	7.0	77.90	77.90	77.90	77.90	77.90	77.90
NS	7.0	77.90	77.90	77.90	77.90	77.90	87.90
NS	7.0	87.90	87.80	78.70	77.90	78.80	78.80
NS	7.0	78.80	78.70	.80	.80		
CAL1	7.0	95.24	658.00				
VEL1	7.0				0.00	.08 .58	.82 1.89
VEL1	7.0	2.13 2.27	2.60 2.77	3.75 4.24	4.58 5.10	4.10 3.40	4.09 5.26
VEL1	7.0	4.27 3.38	3.90 4.11	4.04 3.18	2.31 1.88	1.62 1.34	1.27 .99
VEL1	7.0	.17					
CAL2	7.0	94.77	380.00				
VEL2	7.0						0.00 .68
VEL2	7.0	.82 1.30	1.97 2.14	2.49 3.01	2.20 3.10	2.42 2.43	2.37 2.55
VEL2	7.0	2.75 2.46	2.24 2.18	2.11 1.72	.41 .23	.80 .57	.91 .60
VEL2	7.0	.21					
CAL3	7.0	94.39	238.00				
VEL3	7.0						
VEL3	7.0	.33 .60	1.01 1.16	1.67 1.83	1.92 2.24	1.95 1.81	1.47 1.74
VEL3	7.0	2.07 1.86	1.99 1.76	1.36 1.33	.91 .60	.88 .47	.99 .70
VEL3	7.0	0.00					
CAL4	7.0	93.78	79.00				
VELA	7.0						
VEL4	7.0		0.00 .23	.49 .93	1.06 1.07	.90 1.05	.89 .81
VELA	7.0	.91 .87	1.12 1.02	.67 .66	.31 .29	.39 .36	.77 .36
VELA	7.0						
XSEC	8.0	238.0	.50 92.20 .00250				
	8.0-30.098.79 0.098.69 10.098.49 20.098.19 30.097.59 40.096.59						
	8.0 47.595.99 50.0 95.955.0 95.8 60.0 95.6 65.0 95.6 70.0 95.5						
	8.0 75.0 95.5 80.0 95.4 85.0 95.3 90.0 95.1 95.0 94.9100.0 94.9						
	8.0105.0 94.7110.0 94.6115.0 94.4120.0 94.0125.0 93.4127.5 93.1						
	8.0130.0 93.3132.5 93.2135.0 93.0137.5 92.7140.0 92.8142.5 92.2						
	8.0145.0 93.0147.5 93.3150.0 93.6152.5 94.4155.0 95.2157.3 96.0						
	8.0160.3 97.9165.3101.7						
NS	8.0	27.50	27.50	27.50	27.50	27.50	76.70
NS	8.0	76.70	76.70	75.70	76.80	76.70	76.70
NS	8.0	65.70	65.70	76.80	76.80	76.70	87.60
NS	8.0	76.80	76.80	76.70	76.60	76.80	76.80
NS	8.0	76.90	76.90	87.60	87.60	87.60	87.60
NS	8.0	87.70	87.70	87.60	87.80	87.90	87.90
NS	8.0	88.90	88.90				
CAL1	8.0	95.99	658.00				
VEL1	8.0				0.00	0.00 .53	.43 .26
VEL1	8.0	1.88 1.26	2.42 2.51	2.82 2.89	3.58 4.04	4.97 4.26	5.69 6.62
VEL1	8.0	5.92 6.71	6.42 5.13	5.53 3.61	4.75 2.79	1.79 .63	.18
VELl	8.0						
CAL2	8.0	95.46	380.00				
VELZ	8.						
VEL2	8.0		.79 1.22	1.59 1.49	2.64 3.52	3.92 4.29 4.79 4.86	
VEL2	8.0	5.39 4.56	5.01 4.63	4.14 3.21	3.77 1.97	.83 .26	
VEL2	8.0						
CAL3	8.0	95.06	238.00				

```
VEL3      8.0
VEL3      8.0                      0.00   .58  1.68 2.28  2.98 2.76  2.18 4.17
VEL3      8.0  4.19 4.58  4.19 3.85  3.87 3.25  3.03 1.44    .76 0.00
VEL3      8.0
CAL4      8.0        94.22        79.00
VEL4      8.0
VELA       8.0                                              .54  2.03 1.97
VELA      8.0  2.99 3.23  2.42 2.49  2.88 2.28  .94 .30
VELA      8.0
ENDJ


METHOW RIVER - WEEMAN SITE (RM 59) SIDECHANNEL, RIGHT SIDE
Measured 5.4  cfs 8/3/91, 0.8 on 8/16, 0.3  on 8/27,  0.01 on 9/26
10C       0000000200000000000000
QARD      0.13
QARD      0.25
QARD      0.63
QARD      5.4
QARD      16.5
XSEC      1.0 0.0  .50 95.40 .00250
          1.0-10.097.49  0.096.99  2.596.58  5.0 95.9  7.0 95.4  9.0  95.4
          1.0  11.0 95.5  13.0 95.5  15.0 95.5  17.0 95.7  19.0 95.8  21.0  95.8 F;"
          1.0  23.0 95.9  25.0 95.9  27.0 96.0  29.0 96.2  31.0 96.1  33.0  95.9
          1.0  34.2 96.6  35.6 96.8  45.6 96.8
 NS       1.0          .80      .80     .80 22.90 32.80 32.70
 NS       1.0        32.70  32.60 23.60 23.60 23.70 23.90 i
 NS       1.0        23.90  23.90 23.90 22.90 22.90.22.90
NS        1.0 .80 .80 .80
CAL1      1.0 96.58 5.40
VEL1      1.0  0.00 .27 .18 .27 .33 .32 .34 .26 .26
VEL1      1.0  .24 .11  .01 0.00  0.00 0.00    b
CAL2      1.0 96.30  0.80
VEL2      1.0  .02 .09 .08  .07 .13  .15 .11  .15 .10
VEL2      1.0  .05 0.00  0.00 0.00  0.00 0.00
CAL3      1.0 96.23 0.30
VEL3      1.0  .01  .01 .03  .03 .05  .03 .03  .02 .02
VEL3       1.0  .02 .01  0.00 0.00
XSEC      2.0 241.0  .50 96.10 .00250
          2.0 -25.097.99  0.097.79  5.297.24  6.0 96.7  7.0 97.1  8.0 96.9
          2.0  9.0 96.8  10.0 96.5  10.5 96.4  11.0 96.3  11.5 96.2  12.0 96.2
          2.0  12.5 96.1  13.0 96.2  14.0 96.4  15.0 96.7  16.0 97.1  16.3  97.2
          2.0  17.7 97.7  37.7 99.5
NS        2.0      54.50   54.50      43.80     43.80  43.80      54.60
NS        2.0      33.90   43.80      43.70     33.90  34.80      23.70
NS        2.0      23.70   22.90      22.90     22.90  22.90      22.90
NS        2.0      12.80   12.80
CAL1      2.0      97.24     5.40
VEL1      2.0                0.00       .33        .77      .97        1.16          1.53  1.76  1.89  1.62
VEL1      2.0   1.35  1.07  .26  .05   0.00
```

```
CAL2    2.0 96.99  0.80
VEL2    2.0     0.00  0.00  .20 .51  .O1 .63
VEL2    2.0  0.00 .05  0.00  0.00
CAL3    2.0 96.90  0.30
VEL3    2.0     .O1  .32  .24 .23  .29 .42
VEL3    2.0  .36 .19 .05  0.00
XSEC    3.0 132.0  .50  96.70 .00250
        3.0  -1.099.49   0.098.29  1.797.57  2.0  97.2  3.0 97.0  4.0 97.1
        3.0  5.0 97.0  6.0  97.0  7.0 97.0  8.0  96.9  9.0 96.8  10.0 96.7
        3.0  11.0 96.7  12.0  96.7  13.0 96.8  14.0  96.9  15.0 97.1  16.0 97.2
        3.0  17.0 97.5  18.0  97.4  19.0 97.4  20.0  97.3  21.0 97.2  22.0 97.2
        3.0  23.0 97.3  24.0  97.5  24.2 97.6  27.7  99.6
NS      3.0 .80  .80 65.60  65.60 55.90 55.90
NS      3.0 54.80  54.70 65.60  65.60 65.60 65.60
NS      3.0 65.60  65.80 65.70  65.70 65.70 54.60
NS      3.0 44.90  44.90 45.90  .50 22.90 22.90
NS      3.0 22.90  .80 .80  .80
CAL1    3.0 97.57  5.40
VEL1    3.0   0.00 .09 .35 .52  .69 .69 .83 .76 .71
VEL1    3.0  .48 .35 .22  .41 .37 .04 .56  .31 .27 .35 .18 .06
VEL1    3.0 0.00 0.00
CAL2    3.0 97.40  0.80
VEL2    3.0   0.00  0.00 0.00  .12  .12  .11 .20 .16 0.00
VEL2    3.0  .18 .19  .13 .14  0.00 0.00    0.00 0.00
VEL2    3.0  0.00
CAL3    3.0 97.33  0.30
VEL3    3.0    0.00 .O1  .03  .03  .03 .03 .03 .03
VEL3    3.0  .03 .02 .02  .02 .02 .O1    .03 0.00
VEL3    3.0 .03
XSEC    4.0 227.0  .50  98.70 .00250
        4.0-10.0101.0   0.0101.0  4.9 99.6  5.0  99.5  6.0 99.4  7.0 99.1
        4.0  8.0 98.9  9.0  99.0  10.0 98.7  11.0  98.8  12.0 98.9  13.0 98.9
        4.0  14.0 99.1  15.0  99.2  16.0 99.1  17.0  99.3  18.0 99.2  19.0 99.1
        4.0  20.0 99.1  21.0  99.1  22.0 99.4  23.0  99.5  23.4 99.6  24.9 99.9
        4.0  31.9101.0
NS      4.0 .80  .80 45.70 45.70 45.70 76.80
NS      4.0 76.80  67.80 67.80  76.80 76.80 66.90
NS      4.0 66.90  66.90 66.90  66.90 66.90 67.90
NS      4.0 65.60  76.60 76.70  76.70 76.70 76.50
NS      4.0 76.50
CALL    4.0 99.56  5.40
VEL1    4.0   0.00  .O1 .37  .91  1.02  .93 1.04  .85 .59
VEL1    4.0  .52 .62  .44 .26  .12 .20  .30 .32  0.00 0.00
VEL1    4.0
CAL2    4.0 99.31  0.80
VEL2    4.0    0.00  .16  .21  .23 .30  .18 .02
VEL2    4.0  0.00 .35 .03  0.00  .02 0.00  .05  .39
VEL2    4.0
CAL3    4.0 99.16  0.30
VEL3    4.0     0.00  .O1  0.00 .03  .01 .01
VEL3    4.0  0.00 .O1   .10  .68
VEL3    4.0
ENDJ
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Appendix D2 - Summary of Calibration Details, Weeman Site

METHOW RIVER - WEEMAN SITE
Calibration Information for Calculated Discharge

Transect Number	1	2	3	4	5	6	7
Discharge							
672	684	648	693	651	670	684	619
412	402	410	378	408	372	320	362
251	275	233	257	241	236	201	220
79	90	83	69	77	70	68	68
Stage							
94.89	95.54	96.52	94.15	94.56	94.98	95.24	95.99
94.34	95.04	96.21	93.76	94.22	94.55	94.77	95.46
93.84	94.66	95.89	93.44	93.92	94.21	94.39	95.06
93.11	94.03	95.36	92.91	93.34	93.53	93.78	94.22
Plotting Stage							
3.79	3.34	2.62	2.45	2.86	2.98	3.24	3.79
3.24	2.84	2.31	2.06	2.52	2.55	2.77	3.26
2.74	2.46	1.99	1.74	2.22	2.21	2.39	2.86
2.01	1.83	1.46	1.21	1.64	1.53	1.78	2.02
Ratio of measured versus predicted discharge							
0.963	0.970	1.017	. 0.990	0.997	1.033	1.076	1.013
1.002	0.984	1.002	0.945	1.017	0.967	0.909 1.007 '	
1.077	1.090	0.965	1.107	0.982	0.988	0.995	0.968
0.962	0.961	1.016	0.965	1.004	1.013	1.028	1.013
Mean error of stage/discharge relationship for calculated							
3.78	4.25	1.78	5.03	1.07	2.26	5.06	1.62
Mean error of stage/discharge relationship for given							
2.75	2.06	2.91	1.19	2.79	2.88	2.14 2.67	
Stage/discharge relationship (S vs Q) S=A*Q**B+SZF							
A=	0.4746	0.4178	0.3223	0.5325	0.4313	0.5828	0.6101
0.5472							
B=	0.2975	0.2843	0.3096	0.2594	0.2985	0.2658	0.2847
0.2955							
SZF=	92.20	93.90	91.70	91.70	92.00	92.00	92.20
91.1							
Beta coefficient log/log discharge/stage relationship							
3.38	3.36	3.51	3.23	3.86	3.35	3.76	3.51

Appendix D2 - Summary of Calibration Details, Weeman Site (continued)

METHOW RIVER - WEEMAN SITE (Side Channel)
Calibration Information for Calculated Discharge

Transect Number	1	2	3	4
Discharge				
	4.87	6.44	4.77	4.96
	1.28	0.52	0.74	0.62
	0.32	0.71	0.14	0.05
Stage				
	96.58	97.24	97.57	99.56
	96.30	96.99	97.40	99.31
	96.23	96.90	97.33	99.16
Plotting Stage				
	1.18	1.14	0.87	0.86
	0.90	0.89	0.70	0.61
	0.83	0.80	0.63	0.46
Ratio of measured versus predicted discharge				
	0.898	1.202	0.899	0.865
	1.592	0.542	1.384	1.380
	0.699	1.530	0.803	0.838
Mean error of stage/discharge relationship for calculated Q				
	30.53	45.38	21.15	20.83
Mean error of stage/discharge relationship for given Q				
	12.63	4.65	1.59	14.76
Stage/discharge relationship (S vs Q) S=A*QB+SZF**				
A=	0.9286	0.8945	0.7432	0.6791
B =	0.1416	0.1444	0.9444	0.1352
SZF=	95.40	96.10	96.70	98.70
Beta coefficient log/log discharge/stage relationship				
	7.06	6.92	10.59	7.40

Appendix D3 Data Changes for Calibration, Weeman Site

TRANSECT	VERTICAL	VEL	CHANGE
1	7	4	0.15 TO 0.00
1	19	4	0.13 TO 0.33
1	23	3	0.50 TO 0.70
2	31	4	0.00 TO 0.20
2	36	4	0.04 TO 0.00
3	9	4	0.10 TO 0.30
4	16	4	0.05 TO 0.00
4	17	4	0.03 TO 0.00
4	32	4	0.66 TO 0.86
4	36	1	3.17 TO 2.97
4	36	2	0.41 TO 0.61
4	36	3	0.37 TO 0.57
5	11	1	0.21 TO 0.00
5	12	3	0.22 TO 0.00
5	20	4	0.00 TO 0.20
5	21	4	0.23 TO 0.00
5	22	4	0.35 TO 0.55
5	26	4	1.73 TO 1.53
5	27	4	1.84 TO 1.64
5	28	4	1.85 TO 1.65
6	11	2	0.22 TO 0.42
6	12	2	0.52 TO 0.72
6	13	3	0.11 TO 0.00
6	29	4	0.25 TO 0.45
8	15	1	2.62 TO 2.42
8	15	2	0.59 TO 0.79
8	16	1	2.71 TO 2.51
8	16	2	1.02 TO 1.22
8	32	4	0.10 TO 0.30
8	34	4	0.03 TO 0.00

Appendix D4 – Velocity Adjustment Factors, Weeman Site

Transect	Discharge	VAF
1.00	45.0	0.887
1.00	80.0	0.957
1.00	250.0	1.046
1.00	400.0	1.029
1.00	650.0	0.957
1.00	1300.0	0.787
2.00	45.0	0.937
2.00	80.0	1.017
2.00	250.0	1.016
2.00	400.0	1.005
2.00	650.0	0.982
2.00	1300.0	0.918
3.00	45.0	0.985
3.00	80.0	0.998
3.00	250.0	1.008
3.00	400.0	1.005
3.00	650.0	0.994
3.00	1300.0	0.958
4.00	45.0	0.914
4.00	80.0	0.999
4.00	250.0	1.038
4.00	400.0	1.016
4.00	650.0	0.970
4.00	1300.0	0.843
5.00	45.0	0.792
5.00	80.0	0.918
5.00	250.0	1.045
5.00	400.0	1.019
5.00	650.0	0.950
5.00	1300.0	0.786
6.00	45.0	0.961
6.00	80.0	1.011
6.00	250.0	1.034
6.00	400.0	1.009
6.00	650.0	0.959
6.00	1300.0	0.844
7.00	45.0	0.962
7.00	80.0	0.994
7.00	250.0	1.021
7.00	400.0	1.015
7.00	650.0	0.992
7.00	1300.0	0.935
8.00	45.0	0.927
8.00	80.0	0.990
8.00	250.0	1.041
8.00	400.0	1.021
8.00	650.0	0.959
8.00	1300.0	0.812

APPENDIX E

CHOKECHERRY SITE CALIBRATION INFORMATION

Appendix E1 – IFG4 Input File, Chokecherry Site

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METHOW RIVER - CHOKECHERRY SITE at river mile 66.5       WRIA 48
measured on 8/4/1991-640 cfs, 8/16-349 cfs, 8/27-207 cfs, 9/26-41 cfs
I0c                 0000000200000000000000
QARD 16.0
QARD 50.0
QARD 200.0
QARD 250.0
QARD 350.0
QARD 650.0
QARD1600.0
XSEC      1.0                0.0 .50              92.50          .00250
          1.0-40.098.65 0.096.35 17.794.94 20.0 95.0 25.0 94.5 30.0 94.5
          1.0  35.0 94.1 40.0 93.8 45.0 93.8 50.0 93.6 55.0 93.8 60.0 93.8
          1.0  65.0 93.6 70.0 93.4 75.0 93.3 80.0 93.0 85.0 92.9 90.0 92.7
          1.0  95.0 92.6100.0 92.5105.0 93.0110.0 93.0115.0 92.9120.0 92.8
          1.0125.0 93.4130.0 93.4135.0 93.5140.0 94.2143.7 95.0152.897.95
          1.0352.
NS        1.0       66.90       .80      28.80        78.90        78.80     78.90
NS        1.0       78.70       78.80    78.70        78.60        78.60     76.80
NS        1.0       76.70       78.80    76.70        76.80        7660      78.80
NS        1.0       78.80       78.70    78.70        78.80        77.90     77.90
NS        1.0       78.80       78.80    78.80        78.80        78.80       .80
NS        1.0         .80
CAL1      1.0       94.94   640.00
VEL1      1.0                           .    84    .42  2.57  2.90 2.50  3.21  2.98  4.24
VEL1      1.0  3.39 3.40  3.75  2.91  4.58  4.97  5.35  4.57  2.52  3.59  3.74  2.82
VEL1      1.0  2.96 2.38  2.25  1.58
CAL2      1.0       94.49      349.00
VEL2      1.0                                   1.03 1.66 1.35 3.05 2.82 2.74
VEL2      1.0 2.61 3.03 2.87 2.68 4.02 3.85 4.83 2.88 3.38 3.59 2.95 1.55
VEL2      1.0 2.34 1.84 1.88    .70
CAL3      1.0 94.21          207.00
VEL3      1.0                                  0.00    93   .90 1.70 1.98 2.18
VEL3      1.0 1.59 2.07 1.75 1.99 3.84 3.55 3.98 2.81  .87 2.82 2.01 1.72
VEL3      1.0 1.79 1.44   .94
CAL4      1.0      93.47      41.00
VEL4      1.0
VEL4      1.0                 .76 .87 2.18 2.50 2.07 2.21 1.90 .60 1.42 1.43 .73
VEL4      1.0.7 5
XSEC      2.0           293.0 .50                94.30          .00250
          2.0 -5.0101.8 0.0100.3 26.097.31 30.0 97.1 35.0 97.0 40.0 96.8
          2.0 45.0 96.6 50.0 96.4 55.0 96.1 60.0 96.1 65.0 96.2 70.0 96.2
          2.0 75.0 95.8 80.0 95.6 85.0 95.7 90.0 95.7 95.0 95.9100.0 95.6
          2.0105.0 95.6110.0 96.0115.0 95.8120.0 95.8125..0 96.0130.0 96.1
          2.0135.0 96.2140.0 96.1145.0 96.2150.0 96.1155.0 96.2160.0 96.6
          2.0165.0 96.8170.0 96.5175.0 96.0180.0 94.8185.0 93.5190.0 94.3
          2.0195.0 96.8196.497.31209.799.65229.7100.3
NS        2.0             .80          .80        77.90       76.80      76.80        76.80
NS        2.0           76.60        76.60        78.70       76.80      78.70        87.80
NS        2.0           78.90        87.70        88.90       78.80      87.80        77.90
NS        2.0           87.90        76.70        76.60       77.90      87.80        76.80
NS        2.0           78.80        87.60        87.70       78.70      78.80        78.80
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NS      2.0     78.80     77.90      77.90     77.90     78.70     78.90
NS      2.0     78.90     78.90        .80       .80
CAL1    2.0     97.31     640.00
VEL1    2.0               0.00 .40 1.47  1.65 3.28 3.46 2.70 4.29 3.52
VEL1    2.0 3.47 2.71 4.16 4.21  4.63 4.31  2.83 3.93 2.33 3.02 3.91 2.48
VEL1    2.0 2.85 3.14 2.31 3.05  2.92 2.69  1.94 1.48 .  54   .49   .13 1.01
VEL1    2.0 .72
CAL2    2.0     97.14     349.00
VEL2    2.0                 0.00  .52   .84 1.92 1.66 2.18 2.78 3.19
VEL2    2.0 2.16 2.71 3.13 3.60 3.53 2.73 1.34 3.32 1.29 2.43   .58 2.74
VEL2    2.0 1.96 2.36 1.22 2.32 2.13 2.03   .13   .05  .04   .21   .20   .51
VEL2    2.0 .27
CAL3    2.0     96.82     207.00
VEL3    2.0                           .52 1.59 1.86 1.38 2.20 2.37
VEL3    2.0   .42 2.06 3.03 3.07 3.35 3.12 1.84 2.86 1.18 1.99   .77 1.30
VEL3    2.0 1.96 1.99    .40 1.72 1.40 2.04 1.04   .85   .03   0.3 0.00 0.00
VEL3    2.0
CAL4    2.0     96.48  41.00
VEL4    2.0                              0.00   .42    .13 1.01 1.40
VEL4    2.0   .22 1.19 2.30 1.21 2.52 1.11   .19 1.36 1.18   .89    .60   .75
VEL4    2.0   .30    .51   .15  .48   .25
VEL4    2.0
XSEC    3.0    222.0   .50     94.30     .00250
        3.0 -8.099.27 0.096.67 10.096.35 15.0 95.6 20.0    94.7 25.0 95.1
        3.0 30.0 94.7 35.0 94.5 40.0 94.9 45.0 94.4 50.0     94.3 55.0 94.6
        3.0 60.0 94.3 65.0 94.4 70.0 94.5 75.0 94.4 80.0     94.4 85.0 94.4
        3.0 90.0 94.5 95.0 94.4100.0 94.6105.0 94.6110.0 94.8115.0 94.7
        3.0120.0 94.9125.0 94.7130.0 94.7135.0 94.5140.0 95.0145.0 94.9
        3.0150.0 94.7155.0 95.6158.496.35161.796.87164.799.87
NS      3.0       .80       .80     87.60     87.70     78.80     78.70
NS      3.0     76.70     76.70     87.70     76.70     76.70     78.80
NS      3.0     87.60     77.90     76.70     76.70     76.70     76.60
NS      3.0     76.80     87.60     76.60     76.70     77.90     78.80
NS      3.0     78.90     77.90     76.70     78.70     77.90     77.90
NS      3.0     76.70     77.90     45.80     12.50       .80
CAL1    3.0     96.35     640.00
VEL1    3.0               .16 1.31 2.02 2.49 2.50 3.10 2.68 3.01 1.67
VEL1    3.0 2.51 2.42 2.43 2.54 2.72 1.91 2.51 2.60 2.43 2.26 2.96 2.28
VEL1    3.0 2.68 2.86 2.44 2.61 2.19 1.16 1.31  ..55
CAL2    3.0     95.98     349.00
VEL2    3.0               0.00 1.13 2.32 1.82 1.75 2.50 1.79 2.00 1.62
VEL2    3.0 1.82 2.07 2.33 2.41 2.18 1.57 1.53 1.97 1.64 1.46 2.51 1.76
VEL2    3.0 2.17 1.77 2.07 1.46 1.58 1.23   .92  .44
CAL3    3.0     95.71     207.00
VEL3    3.0               0.00 1.11 1.65 1.21 1.40 2.04 1.98 1.51 1.18
VEL3    3.0 1.27 1.66 1.54 1.99 1.28    .99 1.11 1.12 1.10 1.36 1.59 1.24
VEL3    3.0 1.93 1.27 1.54 1.06   .90    .60   .74 0.00
CAL4    3.0     96.48     41.00
VEL4    3.0                .25   .49   .57 .49 1.06 .42 .81 .35
VEL4    3.0   .85 .62 .85 .71   .38   .09   .30 .76   .15 .52 .40 .84
VEL4    3.0   .51 .39 .25 .50 0.00 0.00 0.00
XSEC    4.0     176.0 .50       94.50      .00250
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        4.0-13.0101.2 0.098.57 12.595.24 15.0    97.0 20.0 97.0 25.0 96.3 95.3 50.0
        4.0 30.0 96.4 35.0 95.6 40.0 95.5 45.0   95.3 55.0 95.1
        4.0 60.0 94.9 65.0 94.9 70.0 94.8 75.0   94.5 80.0 94.4 85.0 94.7
        4.0 90.0 94.2 95.0 94.2 97.5 94.2100.0   94.2102.5 94.0105.0 93.9
        4.0107.5 93.9110.0 93.7112.5 93.6115.0   93.7117.5 93.3120.0 93.2
        4.0122.5 93.1125.0 93.1127.5 93.0130.0   93.6132.5 93.8135.0 94.2
        4.0137.295.24141.497.77148.4101.2

        4.0          .80         .80        87.50      87.50      87.70      87.70
NS      4.0        87.70       87.70        87.70      87.70      87.70      87.70
NS      4.0        87.50       87.50        86.50      86.50      86.50      86.50
NS      4.0        86.50       87.50        87.50      87.50      87.50      87.50
NS      4.0        87.50       87.36        87.60      87.60      87.60      87.60
NS      4.0        87.60       87.60        87.60      87.60      87.60      87.60
NS      4.0          .10         .80          .80
CAL1    4.0        96.67      640.00
VEL1    4.0                      .54   .44   .36 1.43 1.50 1.56 2.21
VEL1    4.0 2.60 2.58 2.62 2.23 2.81 2.82 2.56 2.74 2.84 2.20 3.15 2.76
VEL1    4.0 3.18 3.21 3.03 3.74 3.35 3.11 3.95 2.68 3.38 3.66 2.50 1.85
VELl    4.0
CAL2    4.0       96.20       349.00
VEL2    4.0                                33   .74 1.00  .79 1.35
VEL2    4.0 1.61 1.79 1.60 1.38 1.58 2.09 1.82 1.99 1.74 1.62 2.23 2.04
VEL2    4.0 2.28 2.20 2.31 2.70 2.07 2.51 2.79 1.66 1.82 2.54 1.38   .98
VEL2    4.0
CAL3    4.0       95.88       207.00
VEL3    4.0                                                  .00 .19 .00.56
VEL3    4.0 .90 .80 1.20 .96 .82 1.33 1.25 1.26 1.26 1.06 1.73
VEL3    4.0 1.76 1.75 1.65 2.16 1.54 1.88 2.15 1.34 1.53 1.79 .72
VEL3    4.0
CAL4    4.0       95.24          41.00
VEL4    4.0                                     0.00
VELA    4.0 0.00 0.00 .00.11 .22 .36 .37 .35 .34 .43 .44   .42
VELA    4.0   .52   .57 .54 .75 .51 .54 .70 .35 .67 .64 .06 0.00
VELA    4.0
XSEC    5.0       158.0 .50           94.50        .00250
        5.0 -7.0101.2 0.099.77 16.2 96.9 20.0 96.5 25.0 96.3 30.0 95.7
        5.0 35.0 95.6 40.0 95.6 45.0 95.1 50.0 95.2 55.0 95.1 60.0 95.2
        5.0 65.0 94.9 70.0 94.9 75.0 95.0 80.0 95.0 85.0 94.9 90.0 94.9
        5.0 92.5 94.9 95.0 94.9 97.5 94.9100.0 95.0102.5 94.9105.0 94.8
        5.0107.5 94.8110.0 94.8112.5 94.7115.0 94.8117.5 94.8120.0 94.6
        5.0122.5 94.5125.0 94.5127.5 94.6130.0 94.8132.5135.0 95.6
        5.0137.196.92142.999.27146.9101.2
NS      5.0          .80       22.90        22.90      22.90      87.50      87.50
NS      5.0        87.50       86.50        86.50      86.70      78.70      78.70
NS      5.0        78.70       78.70        68.50      76.50      76.50      76.50
NS      5.0        76.50       76.60        76.50      76.50      76.60      76.70
NS      5.0        78.70       78.70        78.70      78.60      78.50      78.50
NS      5.0        78.50       78.50        78.50      78.50      78.50      78.50
NS      5.0          .10         .80          .80
CAL1    5.0        96.92      640.00
VEL1    5.0               0.00  .41   .10 2.08 2.63 2.68 2.82 3.04 2.90
VEL1    5.0 3.02 3.24 3.65 3.66 3.47 3.29 3.38 3.26 3.53 3.43 3.49 3.61
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        VEL1   5.0 3.32 3.63 3.47 3.25 3.27 3.13 .88 2.09 1.86 1.95 .83 1.29
        VEL1   5.0
        CAL2   5.0        96.50        349.00
        VEL2   5.0                                0.00     .07 1.41 1.66 2.12 2.30 2.44 2.07
        VEL2   5.0 2.00 2.42 2.74 2.89 2.80 2.60 2.93 2.31 2.76 2.50 2.89 3.14
        VEL2   5.0 2.47 2.60 3.06 2.88 2.48 3.13 .37 2.62 2.20 1.63 1.16 .73
        VEL2   5.0
        CAL3   5.0        96.14        207.00
        VEL3   5.0                                         .01 .92 1.26 1.48 1.76 2.24 2.01
        VEL3   5.0 1.62 2.34 2.06 1.99 2.34 1.87 2.07 2.16 2.21 1.93 2.30 2.36
        VEL3   5.0 2.13 2.08 2.29 2.50 2.20 2.96 .24 .53 1.83 1.48 1.05 .42
        VEL3   5.0
        CAM    5.0         95.50        41.00
        VEM    5.0                                                        .54 .68 .97 1.15
        VELA   5.0.98 1.45 .49 .43 1.58 1.04 .74 1.31                                .83 1.35 1.30 1.41
        VEM    5.0 1.53 1.19 .86 1.74 1.69 1.30 .56 .24 1.01 .80
        VEM    5 . 0
        XSEC   6.0        189.0 .50          94.50        .00250 -
               6.0 -1.0101.2 0.099.37 7.297.25 10.0 96.6 15.0 95.2 20.0 94.9
               6.0 25.0 94.7 30.0 94.7 35.0 94.9 40.0 94.8 45.0 95.0 50.0 94.8
               6.0 55.0 95.1 60.0 95.1 65.0 95.1 67.5 95.0 70.0 94.9 72.5 94.9
               6.0 75.0 94.9 77.5 94.6 80.0 94.4 82.5 94.3 85.0 94.3 87.5 94.0
               6.0 90.0 93.8 92.5 93.6 95.0 93.8 97.5 93.8100.0 93.9102.5 94.3
               6.0105.0 95.6107.5 95.9110.397.25110.6100.3111.6101.2
NS             6.0          .80          .80      27.60      27.90      78.80      71.90
NS             6.0        71.90        76.90      78.90      78.90      78.90      76.90
NS             6.0        56.60        56.70      56.70      56.50      56.60      65.60
NS             6.0        57.50        57.50      57.50      56.50      56.50      57.60
NS             6.0        78.60        78.50      87.60      87.70      87.70      87.70
NS             6.0        87.80        87.80      88.90        .80        .80
CAL1           6.0        97.25       640.00
        VEL1   6.0                      .03.46 1.31 1.29 1.13 1.88 1.79 2.35 2.97
        VEL1   6.03.14 3.30 3.68 3.41 3.49 3.98 3.66 4.02 4.40 4.27 3.44 4.30
        VEL1   6.04.62 3.47 1.76 2.26 1.91 1.22   .10   .46
        CAL2   6.0 96.66        349.00
        VEL2   6.0                  .01   .22  .45   .44   .72   .94 1.27 1.66 1.75
        VEL2   6.02.27 2.55 2.43 3.07 3.10 3.15 3.51 3.65 3.99 3.18 3.16 3.74
        VEL2   6.03.31 1.64 1.38 1.07    .47   .05 -.43 -.20
        CAL3   6.0     96.33    207.00
        VEL3   6.0                      09   .31   29    .47  .79   .78 1.08 1.32
        VEL3   6.01.56 1.82 2.38 2.44 2.37 2.57  3.03 3.33 3.11 2.86 3.25 3.06
        VEL3   6.02.42 1.08   .71   .32   .05 -21 -.28 0.00
        CAM    6.0     95.66      41.00
        VEL4   6.0                  0.00 0.00 0.00 0.00 0.00 0.00 .23 0.00
        VEL4   6.0   .42 .69 .77 .68 1.00 .76 1.11 1.53 1.41 1.18 1.42 1.17
        VEL4   6.0 1.16 .26 .12 .01 .01 -01 0.00
        XSEC   7.0     125.0 .50  94.50    .00250
               7.0 -1.0101.2 0.099.77 7.197.35 10.0 96.7 15.0 96.5 20.0   96.3
               7.0  25.0 96.6 30.0 96.6 35.0 96.5 40.0 96.6 45.0 96.2 50.0  96.5
               7.0  55.0 95.9 60.0 96.3 65.0 95.8 70.0 95.9 75.0 95.8 80.0  95.8
               7.0  82.5 95.7 85.0 95.4 87.5 95.4 90.0 95.3 92.5 95.2 95.0  95.1
               7.0 97.5 95.1100.0 95.0102.5 94.7105.0 94.5107.5 94.3110.0 94.1
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        7.0112.5 94.0115.0 95.2117.5 95.5120.0 95.4122.5 95.9125.0 96.8
        7.0126.397.35127.699.97128.6101.2
NS      7.0      12.50      12.50      22.90      22.90      57.60      75.90
NS      7.0      78.80      77.90      77.90      77.90      77.90      77.90
NS      7.0      78.60      78.60      78.60      67.60      67.60      79.60
NS      7.0      78.70      78.70      77.90      75.50      75.05      57.70
NS      7.0      65.70      65.70      65.70      65.70      87.70      87.70
NS      7.0      88.90      88.90      88.90      88.90      88.90      88.90
NS      7.0        .30        .80        .80
CAL1    7.0      97.35     640.00
VEL1    7.0                .47 1.53 1.18 1.82 2.46 2.86 3.89 2.79 2.69
VEL1    7.0 2.69 3.40 2.94 3.80 3.20 3.99 3.61 3.80 4.19 4.16 4.22 4.21
VEL1    7.0 4.11 4.70 4.47 4.68 5.09 4.90 4.75 5.41 3.99 2.63 2.85  .86
VEL1    7.0
CAL2    7.0   96.89    349.00
VEL2    7.0               0.00  .49  .76   .68  .90 1.01 2.23 1.51 2.61
VEL2    7.0 2.03 3.01 2.01 2.23 2.43 3.12 2.95 2.95 3.47 2.92 3.30 3.58
VEL2    7.0 3.39 3.88 3.56 4.06 3.67 3.03 3.86 2.71  .33 3.14 1.83 0.00
VEL2    7.0
CAL3    7.0   96.58  207.00
VEL3    7.0               0.00  .40 0.00 0.00  .50  1.21 1.36 1.35
VEL3    7.0 1.51 2.16 2.12 1.09 1.76 2.11 2.14 2.43 2.47 2.76 1.92 3.31
VEL3    7.0 3.09 3.80 3.36 4.08 3.86 3.36 3.48 1.88 0.53 1.13 1.89
VEL3    7.0
CAL4    7.0     95.76     41.00
VEL4    7.0
VEL4    7.0             .95  .77  .20  .43         .72  .71 .55 .76
VEL4    7.0 1.17 1.93 2.38 1.81 2.60 1.57 .89  .39  .20  .80
VEL4    7.0
XSEC    8.0        191.0 .50            96.50         .00250
        8.0 -1.0101.2 0.099.57 9.298.45   10.0 98.4 15.0 97.5 20.0 97.3
        8.0  25.0 97.0 30.0 96.7 35.0 96.5  40.0 96.7 45.0 97.0 50.0 96.6
        8.0  55.0 97.0 60.0 96.8 65.0 96.7  70.0 96.5 75.0 96.8 80.0 96.8
        8.0  85.0 96.8 90.0 96.8 95.0 97.0100.0 96.9105.0 96.9110.0 96.9
        8.0115.0 96.6120.0 96.6125.0 97.1130.0 97.5135.0 97.7140.0 97.9
        8.0145.0 98.3150.0 98.5152.598.45161.999.67181.9101.2
NS      8.0      21.50      21.50      22.90      22.90      45.80      67.70
NS      8.0      87.60      87.80      78.80      78.80      87.70      87.70
NS      8.0      87.80      87.60      87.60      78.70      78.70      78.70
NS      8.0      78.80      87.70      77.90      76.80      76.80      76.70
NS      8.0      67.70      87.70      87.60      87.70      87.70      77.90
NS      8.0      76.80      66.90      66.90      22.90      22.90
CAL1    8.0      98.45     640.00
VEL1    8.0               0.00 1.37  .69 1.88 3.25 2.10 3.22 3.85 3.11
VEL1    8.0 3.40 4.33 4.56 3.88 3.94 3.29 2.77 3.67 3.49 3.44 3.15 3.52
VEL1    8.0 3.25 3.38 3.59 2.18 1.46 1.33  .99  .22
CAL2    8.0      98.12     349.00
VEL2    8.0                    .65  .45 1.21 2.19 1.87 2.46 2.90 2.40
VEL2    8.0 3.40 2.65 3.26 2.96 2.60 2.29 2.10 2.77 2.56 3.03 2.70 2.64
VEL2    8.0 2.83 3.01 2.49 1.18  .83  .49
CAL3    8.0     97.85    207.00
VEL3    8.0                    .58  .20  1.20 2.11 1.09 2.01 1.21 2.02
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Appendix E1 - IFG4 Input File, Chokecherry Site (continued)

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VEL3    8.0 2.29 2.05 2.12 2.59 2.12 2.62 2.23 2.62 1.51 1.92 2.02 2.49
VEL3    8.0 2.32 2.25 2.72 1.31  .52
CAL4    8.0      97.35      41.00
VELA    8.0                           0.00 .22  .60  .15  .88 1.00  .38
VELA    8.0  .83 1.18 .50 1.42 1.31 1.13 .78 1.22 1.31  .59 0.00 1.03
VELA    8.0 1.03 0.00 .49 0.00
ENDJ
```

Appendix E2 - Summary of Calibration Details, Chokecherry Site

METHOW RIVER - CHOKECHERRY SITE
Calibration Information for Calculated Discharge

Transect Number								
	1	2	3	4	5	6	7	8
Discharge								
	621	556	555	630	586	622	645	616
	371	326	338	338	365	333	340	368
	220	191	199	195	221	212	224	232
	50	58	34	37	53	42	42	45
Stage								
	94.94	97.31	96.35	96.67	96.92	97.25	97.35	98.45
	94.49	97.14	95.98	96.20	96.50	96.66	96.89	98.12
	94.21	96.82	95.71	95.88	96.14	96.33	96.58	97.85
	93.47	96.48	95.12	95.24	95.50	95.66	95.76	97.35
Plotting Stage								
	2.44	3.01	2.05	2.17	2.42	2.75	2.85	1.95
	1.99	2.84	1.68	1.70	2.00	2.16	2.39	1.62
	1.71-	2.52	1.41	1.38	1.64	1.83	2.08	1.35
	0.97	2.18	0.82	0.74	1.00	1.16	1.26	0.85
Ratio of measured versus predicted discharge								
	1.002	1.027	0.929	0.986	0.965	0.910	1.020	0.931
	1.046	0.890	1.049	1.010	1.011	1.046	0.967	1.004
	0.940	1.165	1.063	1.011	1.050	1.124	1.010	1.130
	1.014	0.939	0.965	0.993	0.977	0.935	1.003	0.946
Mean error of stage/discharge relationship for calculated 0								
	3.09	8.91	5.45	1.06	2.95	8.06	1.67	6.25
Mean error of stage/discharge relationship for given Q								
	2.65	14.59	0.37	1.06	3.17	8.04	2.41	3.18
Stage/discharge relationship (S vs Q) S=A*Q**B+SZF								
A=	0.2327	0.1182	0.2614	0.1891	0.2305	0.3472	0.4110	0.2533
B=	0.3655	0.1486	0.3220	0.3770	0.3669	0.3171	0.3002	0.3142
SZF=	92.5	94.30	94.30	94.50	94.50	94.50	94.50	96.50
Beta coefficient log/log discharge/stage relationship								
	2.74	6.73	3.10	2.65	2.73	3.15	3.33	3.18

Appendix E3 - Data Changes for Calibration, Chokecherry Site

TRANSECT	VERTICAL	VEL	CHANGE
1	7	1	2.77 TO 2.57
2	6	3	0.32 TO 0.52
2	25	4	0.10 TO 0.30
4	10	3	0.16 TO 0.00
4	15	4	0.12 TO 0.00
4	17	4	0.02 TO 0.22
4	29	4	0.71 TO 0.51
4	30	4	0.74 TO 0.54
4	31	4	0.90 TO 0.70
4	32	4	0.55 TO 0.35
7	8	1	0.10 TO 0.00
7	9	3	0.30 TO 0.50
7	28	4	2.01 TO 1.81
7	29	4	2.80 TO 2.60
7	30	4	1.77 TO 1.57
7	33	3	0.33 TO 0.53
7	33	4	0.00 TO 0.20
8	15	4	0.30 TO 0.50
8	23	4	0.11 TO 0.00
8	30	3	0.29 TO 0.49

Appendix E4 - Velocity Adjustment Factors, Chokecherry Site

Transect	Discharge	VAF
1.00	1600.0	0.916
1.00	640.0	0.995
1.00	349.0	1.010
1.00	207.0	1.014
1.00	41.0	0.998
1.00	16.0	0.982
2.00	1600.0	0.926
2.00	640.0	0.998
2.00	349.0	1.013
2.00	207.0	1.014
2.00	41.0	1.018
2.00	16.0	1.073
3.00	1600.0	0.992
3.00	640.0	1.003
3.00	349.0	0.999
3.00	207.0	0.994
3.00	41.0	0.999
3.00	16.0	1:156
4.00	1600.0	0.826
4.00	640.0	0.960
4.00	349.0	1.010
4.00	207.0	1.026
4.00	41.0	0.936
4.00	16.0	0.803
5.00	1600.0	0.996
5.00	640.0	1.005
5.00	349.0	1.000
5.00	207.0	0.993
5.00	41.0	1.020
5.00	16.0	1.104
6.00	1600.0	0.859
6.00	640.0	0.989
6.00	349.0	1.017
6.00	207.0	1.017
6.00	41.0	0.937
6.00	16.-0	0.861
7.00	1600.0	0.811
7.00	640.0	0.967
7.00	349.0	1.027
7.00	207.0	1.063
7.00	41.0	0.963
7.00	16.0	0.769
8.00	1600.0	1.002
8.00	640.0	1.018
8.00	349.0	0.999
8.00	207.0	0.975
8.00	41.0	0.912
8.00	16.0	0.913

APPENDIX F

TWISP RIVER SITE CALIBRATION INFORMATION

Appendix F1 - IFG4 Input File, Twisp River Site

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TWISP RIVER at river mile 1.8 - WRIA 48
measured on 8/5/91- 300 cfs, 8/17- 163 cfs, 8/29- 92 cfs, 9/25- 33 cfs
10C        000000020000000000000
QARD    13.0
QARD    30.0
QARD    90.0
QARD    175.0
QARD    300.0
QARD    750.0
XSEC    1.0          0.0 .50          91.75        .00250
        1.0-50.099.66 0.097.66 10.193.93 12.592.88 15.092.52 17.592.46
        1.0 20.092.49 22.5 92.5 25.092.93 27.5 92.3 30.092.08 32.592.52
        1.0 35.092.05 37.591.89 40.091.75 42.591.86 45.0 92.0 47.592.84
        1.0 50.0 92.1 52.592.17 55.092.02 57.592.35 60.092.35 62.592.32
        1.0 65.092.46 67.592.16 70.092.34 75.092.52 80.092.31 85.092.55
        1.0 90.092.61.95.092.98100.093.93107.794.36147.7101.9
NS      1.0          .80          .80       77.90       16.80       67.70       67.70
NS      1.0        87.70        87.70       87.80       87.90       87.80       87.80
NS      1.0        87.70        87.70       87.70       87.70       87.70       87.70
NS      1.0        87.60        87.80       87.80       87.80       78.70       87.80
NS      1.0        87.80        87.70       87.80       67.70       86.80       86.70
NS      1.0        87.60        87.60       28.90         .80         .80
CAL1    1.0        93.93       300.00
VEL1    1.0              .82 2.19 2.10 2.00 1.97 2.90 2.33 2.59 3.46
VEL1    1.03.15 1.99 2.56 3.19 2.90 3.19 2.42 1.92  .97  .44 3.40 2.94
VEL1    1.02.80 1.89 2.25 1.44 2.23 2.71 1.61  .17
CAL2    1.0        93.69       162.70
VEL2    1.0             0.00 1.17 1.25 1.28 1.59 1.44 1.32 1.32 2.06
VEL2    1.02.54 1.12  .93 1.74 1.27 1.34 1.67 1.68 2.33 2.57  .30 1.89
VEL2    1.01.03 1.16 1.38 1.68 1.46 1.80 1.39  .29
CAM     1.0        93.41        91.90
VEL3    1.0              .05  .86  .98  .81 1.02  .56  .68  .89 1.56
VEL3    1.0 1.49  .55  .55 1.38 1.25 1.16  .97  .57 1.04  .68  .30 1.72
VEL3    1.01.28 1.72 1.48 1.34 1.22 1.67 1.47 .13
CAL4    1.0        93.12        33.00
VELA    1.0             0.00  .29  .09  .34  .28 0.00  .18  .32  .72
VEL4    1.0  .61  .20  .07  .54  .12  .68  .63  .51  .25  .15  .21 1.10
VEL4    1.0  .64  .48  .51  .59  .63  1.66 1.61
XSEC    2.0 151.0 .50 91.90  .00250
        2.0 0.0101.0 14.494.35 15.0 94.3 17.593.39 20.092.92 22.592.23
        2.0 25.092.87 27.592.57 30.091.96 32.592.12 35.091.88 37.5 92.4
        2.0 40.092.23 42.592.13 45.092.08 47.592.47 50.0 92.4 52.592.87
        2.0 55.092.86 57.5 92.7 60.092.93 62.5 92.4 65.0 93.2 67.5 93.4
        2.0 70.0 94.0 72.5 93.9 75.0 94.1 78.394.35 88.095.66123.0101.7
NS      2.0          .80        87.90       87.90       87.90       87.90       87.90
NS      2.0        87.80        87.80       87.80       86.70       87.90       87.70
NS      2.0        86.80        86.80       87.70       86.70       86.70       87.70
NS      2.0        76.80        76.70       87.70       87.70       76.80       76.80
NS      2.0        87.70        87.80       87.90       87.90         .80         .80
CAL1    2.0        94.35       300.00
VEL1    2.0         0.00 1.00 2.45 2.42 2.89 3.93 3.17 4.19 4.72 4.47
VEL1    2.0 5.45 3.71 3.69 3.76 3.25 3.21 3.13 2.54 2.78 1.75 1.60  .89
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VEL1    2.0   .71  .31  0.000
CAL2    2.0
VEL2    2.0
VEL2    2.0
VEL2    2.0
CAL3    2.0
VEL3    2.0
VEL3    2.0
VEL3    2.0
CAL4    2.0        93.26       33.00
VEL4    2.0                              0.00 .20.47 1.13 1.29 1.37 1.56 1.79
VEL4    2.0 2.04 .16 .34 1.21 0.00 .38 0.00 .22 .47                              0.00
VELA    2.0
XSEC    3.0        219.0 .50          95.60       .00250
        3.0-50.0102.9 0.098.76 6.097.42 10.0 96.0 12.5 96.5 15.0 95.7
        3.0 17.5 96.2 20.0 95.6 22.5 95.7 25.0 96.0 27.5 95.7 30.0 95.6
        3.0 32.5 95.8 35.0 96.0 37.5 95.8 40.0 95.8 42.5 96.3 45.0 96.7
        3.0 47.5 96.8 50.0 96.3 52.5 96.1 55.0 96.5 57.5 96.8 60.0 96.3
        3.0 65.0 96.1 70.0 96.3 75.0 96.7 80.0 96.9 85.0 96.1 87.897.42
        3.0 89.099.76114.0103.3
NS      3.0          .80         .80        .80        87.60      87.60        87.50
NS      3.0        87.80       87.80      87.70        87.70      87.70        87.70
NS      3.0        87.90       97.90      86.50        87.70      87.70        87.80
NS      3.0        87.80       87.70      87.60        87.70      87.70        87.70
NS      3.0        87.70       87.70      87.70        87.70      87.70          .10
NS      3.0          .80         .80
CAL1    3.0        97.42      300.00
VEL1    3.0            3.35 4.47 4.28 4.87 5.86 1.13 4.60 3.80 3.98
VEL1    3.0 1.60 4.70 3.11 2.81 4.55 4.51 2.35 1.50 4.13 3.84 4.11 3.95
VEL1    3.0 1.82 2.93 1.46 3.26 2.30
CAL2    3.0     97.14     162.70
VEL2    3.0            2.78 4.12 3.96 3.72 4.55  .53 4.15 3.70 3.15
VEL2.   3.0 2.68 3.83 2.46  .44 2.35 4.01 1.30 1.18 3.15 2.62 2.94 3.43
VEL2    3.0 1.61 1.29   .85 1.66 1.83
CAL3    3.0     96.83     91.90
VEL3    3.0           2.35 2.77 3.12 3.22 2.98 .56 4.00 2.24 2.15
VEL3    3.0 2.62 3.25 2.06 .32 1.23    .71      .75 2.20 1.23     2.00
VEL3    3.0 1.61 0.40   .66 .20 .66
CAL4    3.0     96.46        33.00
VEL4    3.0                        1.62       2.61 .82                .07 2.45      .99 1.51
VEL4    3.0 .27 2.81 1.60           .19       .46 1.00          .52   .55           .52 .43
VEL4    3.0 .69 0.20               .20.09
XSEC    4.0          92.0 .50          93.20       .00250
        4.0-20.099.690.096.69 10.795.33 12.5 94.7 15.0 94.0 20.0 93.9
        4.0   25.0 93.927.5 93.8 30.0 93.8 32.5 93.7 35.0 93.7 37.5 93.6
        4.0   40.0 94.042.5 94.0 45.0 93.8 47.5 93.8 50.0 93.3 52.5 93.3
        4.0   55.0 93.357.5 93.3 60.0 93.7 62.5 93.3 65.0 93.4 67.5 93.5
        4.0   70.0 93.872.5 93.2 75.0 93.4 77.5 93.4 80.0 94.2 82.5 94.4
        4.0    83.495.3387.297.09 95.2100.1
NS      4.0          .80         .80      87.80        86.70      76.80        87.60
NS      4.0        76.80       76.90      76.70        87.70      87.60        87.60
NS      4.0        87.80       76.60      86.70        87.80      78.70        78.70
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NS      4.0        76.80       86.60       87.80       87.80       87.70       78.70
NS      4.0        87.90       87.80       87.80       78.70       78.70       76.70
NS      4.0          .10         .80         .80
CAL1    4.0        95.33      300.00
VELl    4.0               .78 2.21 2.11 3.10 4.07 2.88 2.57 3.13 3.99
VEL1    4.0 3.76 2.74 2.99 2.67 2.64 2.53 2.45 2.00 2.15 2.15 3.06 2.91
VEL1    4.0  2.44 2.27 2.87 2.17 2.05 1.31
CAL2    4.0     95.12    162.70
VEL2    4.0               .37 1.03 1.18 1.77 3.12 2.19 2.01 1.89 2.51
VEL2    4.0 2.18 1.74 2.32 1.77  1.32 1.96 2.08 2.02   .97   .94 1.40 1.67
VEL2    4.0 2.03 1.84 1.91 1.69 1.51 .90
CAL3    4.0     94.73     91.90
VEL3    4.0              0.00 .55 1.33 1.53 1.76 1.71 1.71   .82 .96
VEL3    4.0 1.08 1.21 1.21 1.19 .86 1.40 1.34 1.14   .53    .21 1.02 .90
VEL3    4.0 1.69 1.45 1.14 1.36 1.08 .62
CAL4    4.0       94.38        33.00
VEL4    4.0                            0.00 .23 .60 0.00 1.28 1.31 .87.80
VEL4    4.0 .43 .28 .53 .69 .29 1.02 .86 0.00 .46 .13 1.20 .53
VEL4    4.0 .91 :98 .35 .67 .48 -.01
XSEC    5.0         79.0 .50          93.30       .00250
        5.0-22.099.59 0.097.09 8.595.79 10.0 95.5 15.0 94.8 20.0 94.4
        5.0 25.0 94.0 30.0 94.0 32.5 93.8 35.0 93.9 37.5 94.0 40.0 94.0
        5.0 42.5 93.8 45.0 93.9 47.5 93.7 50.0 93.4 52.5 93.5 55.0 93.7
        5.0 57.5 93.5 60.0 93.6 62.5 93.7 65.0 93.3 67.5 93.5 70.0 95.3
        5.0 72.5 94.4 73.295.79 78.298.89 85.2100.5
NS      5.0          .80         .80       88.90       87.80       87.80       87.80
NS      5.0        87.80       87.60       86.60       86.60       87.60       87.60
NS      5.0        86.70       86'.80      86.90       86.90       87.90       87.90
NS      5.0        87.90       87.90       87.90       87.90       87.90       87.90
NS      5.0        87.90       87.90         .80         .80
CALL    5.0        95.79      300.00
VEL1    5.0              1:15 2.65 2.52 2.55 3.02 3.51 4.38 4.16 3.81
VEL1    5.0 4.43 4.10 2.45 1.88   .64 4.16 2.25 2.47 2.50 1.68   .12   .35
VEL1    5.0 0.00
CAL2    5.0       95.48       162.70
VEL2    5.0              0.00 1.53 1.64 1.42 2.57 2.47 2.70 3.14 3.84
VEL2    5.0 4.02 3.18 1.64   .86   .22 2.19 2.39 1.69 1.72 1.36   .15   .13
VEL2    5.0  -.01
CAL3    5.0     95.02      91.90
VEL3    5.0                 .58 1.28 1.30 1.52 2.21 2.53 1.23 2.46
VEL3    5.0 3.13 2.83 1.69  .91  .28 1.43 2.00 1.47 1.16  .88   .09
VEL3    5.0 0.00
CAL4    5.0     94.6      33.00
VEL4    5.0                   .00  .22  .75  .94 1.13 1.96  .00 2.02
VEL4    5.0 2.84 1.70 1.36 0.00 .01  .42 2.29  .46 1.36   .98  .01
VEL4    5.0
XSEC    6.0     123.0  .50    93.30  .00250
        6.0-25.0100.1  0.097.49  5.796.24  7.5  96.0 10.0 95.4 12.5 94.8
        6.0  15.0 94.7 17.5 94.5 20.0 94.1 22.5 93.9 25.0 94.0 27.5 93.8
        6.0 30.0 93.9 32.5 93.4 35.0 93.3 37.5 93.5 40.0 93.6 42.5 93.6
        6.0 45.0 93.7 47.5 93.9 50.0 94.0 52.5 94.4 55.0 95.0 57.5 95.0
        6.0 60.0 95.6 62.396.24 65.697.89 75.6102.9
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NS	6.0	.80	.80	87.80	87.80	87.80	87.80
NS	6.0	87.80	87.70	87.70	86.50	86.50	87.80
NS	6.0	87.80	87.70	87.70	87.70	87.80	87.80
NS	6.0	87.80	87.90	87.90	87.90	87.90	87.90
NS	6.0	87.90	87.90	.80	.80		
CALL	6.0	96.24	300.00				
VEL1	6.0 .05 2.34 1.88 2.64 2.78 3.37 3.89 3.38 4.01						
VEL1	6.0 4.303.29 3.62 3.06 1.85 2.80 3.89 3.68 1.89 2.11 .96 .05						
VEL1~	6.0 0.00						
CAL2	6.0	95.88	162.70				
VEL2	6.0 .64 .11 1.62 2.43 2.65 2.67 2.82 3.42						
VEL2	6.0 3.462.45 3.09 2.01 1.01 1.34 2.21 .27 1.45 1.27 .62 .07						
VEL2	6.0 .01						
CAL3	6.0	95.41	91.90				
VEL3	6.0.00 .01 1.16 1.25 1.42 1.66 1.99 2.73						
VEL3	6.0 2.58 2.27 2.56 1.26.96 1.10 .92 .93 .21 .13 .38 0.00						
VEL3	6.0						
CAL4	6.0	94.96	33.00				
VEL4	6.0 .20 .01 0.00 .00 .39 1.05 1.56 1.79						
VEL4	6.0 1.71 1.32 1.36 .46 .44 .91 .59 -.01 0.00 .04						
VEL4	6.0						
XSEC	7.0	120.0 .50	94.70	.00250			
	7.0-30.099.89 0.098.89 5.097.01 7.5 95.4 10.0 95.1 12.5 94.9						
	7.0 15.0 94.8 17.5 94.8 20.0 94.9 22.5 95.0 25.0 95.0 27.5 94.9						
	7.0 30.0 94.7 32.5 94.8 35.0 95.1 37.5 95.4 40.0 95.2 42.5 95.7						
	7.0 45.0 96.1 47.5 95.9 50.0 96.2 52.5 96.5 55.0 96.5 57.5 96.3						
	7.0 60.0 96.6 62.5 96.7 64.897.01 66.997.39 71.9102.9						
NS	7.0	.80	.80	87.70	87.70	87.60	87.60
NS	7.0	87.60	87.70	87.80	87.70	87.90	87.60
NS	7.0	87.80	87:60	87.90	87.90	87.80	87.90
NS	7.0	87.80	87.70	87.60	87.70	87.80	87.70
NS	7.0	87.80	82.80	82.80	.80	.80	
CAL1	97.01	300.00					
VEL1	7.0 1.02 3.58 3.63 3.55 3.67 3.02 4.56 3.17 4.32						
VEL1	7.0 4.46 4.035.02 4.39 3.28 4.23 4.47 2.79 1.43 1.14 .96 .05						
VELl	7.0 -.10 0.00						
CAL2	7.0 96.70 162.70						
VEL2	7.0 .39 2.43 3.11 2.87 2.38 3.01 3.98 1.17 3.57						
VEL2	7.0 2.55 3.08 4.54 3.75 2.87 2.30 2.59 .20 1.54 .53 .30 0.00						
VEL2	7.0						
CAL3	7.0 96.27 91.90						
VEL3	7.0 1.83 2.26 2.35 1.72 2.65 3.28 .42 2.53						
VEL3	7.0 2.06 2.03 1.92 2.40 1.89 1.02 1.39 25 0.00						
VEL3	7.0						
CAL4	7.0 95.86 33.00						
VEL4	7.0 .91 1.43 1.50 1.47 1.49 1.90 .19.74						
VEL4	7.0 78 1.33 1.24 .67 1.48 .79 0.00						
VEL4	7.0						
XSEC	8.0 379.0 . 50 99.00 .00250						
	8.0 -7.5102.9 0.0100.9 11.4100.9 15.0 99.9 17.5 99.4 20.0 99.3						
	8.0 22.5 99.3 25.0 99.6 27.5 99.2 30.0 99.2 32.5 99.2 35.0 99.2						
	8.0 37.5 99.2 40.0 99.0 42.5 99.2 45.0 99.1 47.5 99.1 50.0 99.2						

Appendix F1 - IFG4 Input File, Twisp River Site (continued)

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          8.0 52.5 99.2 55.0 99.3 57.5 99.4 60.0 99.4 62.5  99.3 65.0 99.0
          8.0 67.5 99.3 70.0 99.4 72.5 99.9 75.0 99.9 77.5101.0 79.3100.9
          8.0 83.7101.8 87.2102.9
NS        8.0        .80        .80        .80      78.70      78.70      76.70
NS        8.0      78.80      87.80      78.80      87.80      87.80      87.80
NS        8.0      87.60      87:80      87.60      78.80      78.70      78.90
NS        8.0      76.80      76.80      87.90      87.90      78.80      76.70
NS        8.0      78.70      87.80      87.80      78.70      78.70      .80
NS        8.0        .80        .80
CAL1      8.0     100.92     300.00
VEL1      8.0                  .60   .98 3.31 4.26 2.98 3.12 3.87 3.32 3.36
VEL1      8.0 2.79 3.19 3.39 2.49 3.67 3.35 3.45 3.50 4.15 3.28 3.64 2.51
VEL1      8.0 2.57 2.05   .73   .45
CAL2      8.0     100.63     162.70
VEL2      8.0                  .27   .65 2.18 2.36 1.72 2.48 2.89  .28 2.53
VEL2      8.0 1.60 2.34 2.72 1.76 2.94 2.42 2.33 2.47 2.35 2.47 2.22 1.41
VEL2      8.0 165 1.55 0.00    .28
CAL3      8.0    100.24       91.90
VEL3      8.0                 0.00  .26 1.76 2.52 1.53 2.09 2.61   .20 1.90
VEL3      8.0 2.03 2.11 1.78 1.47 2.29 1.57 1.83 2.68 2.04 1.79 1.30 1.37
VEL3      8.0 1.03   .93 0.00 0.00
CAL4      8.0      99.89      33.00
VEL4      8.0                      0.00   .65   .75   .75 1.46 1.70  .19  .34
VELA      8.0 1.06   .73 2.04 1.19 1.49    .00 1.50 1.42   .77   .33  .83  .55
VELA      8.0   .93 1.05 0.00
ENDJ
```

Appendix F2 - Summary of Calibration Details, Twisp River Site

TWISP RIVER SITE

Calibration Information for Calculated Discharge

Transect Number	1	2	3	4	5	6	7	8
Discharge								
	292	309	313	303	290	313	298	293
	162	138	186	174	173	174	182	157
	94	89	91	83	93	92	91	92
	32	31	22	29	41	36	34	32
Stage								
	93.93	94.35	97.42	95.33	95.79	96.24	97.01	100.92
	93.69	93.94	97.14	95.12	95.48	95.88	96.70	100.63
	93.41	93.64	96.83	94.73	95.02	95.41	96.27	100.24
	93.12	93.26	96.46	94.38	94.64	94.96	95.86	99.89
Plotting Stage								
	2.18	2.45	1.82	2.13	2.49	2.94	2.31	1.92
	1.94	2.04	1.54	1.92	2.18	2.58	2.00	1.63
	1.66	1.74	1.23	1.53	1.72	2.11	1.57	1.24
	1.37	1.36	.0.86	1.18	1.34	1.66	1.16	0.89
Ratio of measured versus predicted discharge								
	0.991	1.020	0.947	1.062	1.041	1.035	1.011	1.051
	0.946	0.920	1.015	0.909	0.931	0.932	0.969	0.887
	1.131	1.093	1.095	1.042	1.039	1.048	1.032	1.107
	0.943	0.974	0.951	0.994	0.992	0.989	0.989	0.968
Mean error of stage/discharge relationship for calculated Q								
	6.05	5.46	5.25	5.11	3.97	4.08	2.15	7.64
Mean error of stage/discharge relationship for given Q								
	4.97	4.37	3.72	8.75	8.22	6.18	6.34	6.57
Stage/discharge relationship (S vs Q) S=A*Q**B+SZF								
A=	0.6434	0.5512	0.3510	0.4895	0.3397	0.6322	0.3758	0.2516
B=	0.2146	0.2610	.2837	0.2601	0.3249	0.2691	0.3193	0.3610
SZF=	91.7	91.90	95.60	93.20	93.30	93.30	94.70	99.00
Beta coefficient log/log discharge/stage relationship								
	4.66	3.83	3.52	3.84	3.08	3.72	3.13	2.77

Appendix F3 - Data Changes for Calibration - Twisp River Site

TRANSECT	VERTICAL	VEL	CHANGE
1	23	4	0.01 TO 0.21
1	23	3	0.10 TO 0.30
2	6	3	0.16 TO 0.36
2	6	4	0.00 TO 0.20
2	17	3	0.08 TO 0.00
3	10	4	2.65 TO 2.45
3	14	4	3.01 TO 2.81
3	15	4	1.80 TO 1.60
3	17	1	4.75 TO 4.55
3	17	4	0.26 TO 0.46
3	21	4	0.35 TO 0.55
3	26	3	0.20 TO 0.40
3	26	4	0.00 TO 0.20
3	28	3	0.00 TO 0.20
3	28	4	0.00 TO 0.20
4	4	2	0.17 TO 0.37
4	8	4	0.23 TO 0.00
4	13	4	0.23 TO 0.43
5	11	1	4.36 TO 4.16
5	11	3	1.03 OT 1.23
5	11	4	0.14 TO 0.00
6	5	1	2.54 TO 2.34
6	5	2	0.44 TO 0.64
6	5	4	0.00 TO 0.20
6	8	4	0.08 TO 0.00
7	16	4	0.47 TO 0.67
7	19	3	1.19 TO 1.39
7	22	1	0.33 TO 0.53
8	12	4	0.14 TO 0.34
8	18	4	0.08 TO 0.00

Appendix F4 - Velocity Adjustment Factors, Twisp River Site

Transect	Discharge	VAF
1.00	13.0	1.017
1.00	33.0	1.010
1.00	92.0	1.043
1.00	163.0	1.039
1.00	300.0	0.999
1.00	750.0	0.848
2.00	13.0	0.849
2.00	33.0	0.924
2.00	92.0	0.990
2.00	163.0	1.013
2.00	300.0	1.007
2.00	750.0	0.916
3.00	13.0	0.790
3.00	33.0	0.927
3.00	92.0	1.003
3.00	163.0	1.022
3.00	300.0	1.016
3.00	750.0	0.929
4.00	13.0	0.884
4.00	33.0	0.930
4.00	92.0	0.985
4.00	163.0	1.005
4.00	300.0	1.013
4.00	750.0	0.988
5.00	13.0	0.917
5.00	33.0	0.966
5.00	92.0	1.016
5.00	163.0	1.017
5.00	300.0	0.972
5.00	750.0	0.827
6.00	13.0	1.069
6.00	33.0	0.986
6.00	92.0	0.999
6.00	163.0	1.014
6.00	300.0	1.002
6.00	750.0	0.858
7.00	13.0	0.939
7.00	33.0	0.988
7.00	92.0	1.022
7.00	163.0	1.020
7.00	300.0	0.994
7.00	750.0	0.858
8.00	13.0	0.966
8.00	33.0	0.981
8.00	92.0	1.001
8.00	163.0	1.006
8.00	300.0	0.998
8.00	750.0	0.947

APPENDIX G

CHEWUCH RIVER SITE CALIBRATION INFORMATION

Appendix G1 - IFG4 Input File, Chewuch River Site

```
CHEWUCH RIVER at river mile 1.3                    WRIA 48
measured on 7/31/91- 290 cfs, 8/15- 236 cfs, 8/26- 121 cfs, 9/23- 60 cfs
I0c          000000020000000000000
QARD      25.0
QARD      60.0
QARD     125.0
QARD     250.0
QARD     300.0
QARD     725.0
XSEC     1.0          0.0 .50          89.70        .00250
         1.0-12.098.22 0.094.82 9.192.81 13.0 92.4 17.0 91.7 21.0 91.6
         1.0  25.0 91.6 29.0 91.2 33.0 91.6 37.0 91.5 41.0 91.6 45.0 91.0
         1.0  49.0 91.1 53.0 91.0 57.0 90.7 61.0 90.7 65.0 90.5 67.0 90.4
         1.0  69.0 90.5 71.0 90.4 73.0 90.0 75.0 89.9 77.0 89.8 79.0 90.4
         1.0  81.0 91.0 83.0 89.7 85.0 90.0 87.0 90.7 89.0 89:9 92.0 90.7
         1.0  95.0 90.9 98.0 91.2101.0 92.2102.092.81
NS       1.0          .80         .80        27.90       27.90      72.70      76.60
NS       1.0        76.80       67.60        76.80       65.50      67.70      86.90
NS       1.0        76.80       67.70        67.90       67.90      65.60      65.90
NS       1.0        65.80       76.70        76.90       65.60      69.90      99.90
NS       1.0        99.90       99.90        99.90       99.90      99.90      96.80
NS       1.0        27.60       29.60        92.90       97.70
CAL1     1.0        92.81      290.00
VEL1     1.0                .29  .42   .66   .71   .49 1.17   .89   .21 1.45
VEL1     1.0 1.46 1.15 1.43 1.55 1.78 1.76 2.06 2.18 2.91 3.17 3.03 3.63
VEL1     1.0 2.95 3.55 3.41 2.57 2.07 .89 .67
CAL2     1.0      92.62    236.00
VEL2     1.0                .16   .13   .44   .21   .34 1.10   .65   .33 1.19
VEL2     1.0 1.36   .97 1.33 1.43 1.98 1.76 2.05 2.37 2.91 3.02 3.11 3.43
VEL2     1.0 3.51 2.99 2.74 2.24 1.80   .34   .46  .75  0.00
CAL3     1.0     92.25     121.00
VEL3     1.0                  .06   .17    .22  .10   .66   .46   .32   .77
VEL3     1.0   .73   .66 1.03  . 95 1.34 1.21 1.65 1.90 2.32 2.47 2.25 2.45
VEL3     1.0 2.57 2.21 1.98 1.58 1.06   .31   .28   .20 0.00
CAL4     1.0     91.92      60.00
VEL4     1.0                         0.00 .07   .08 0.00 0.00   .22   .30
VEL4     1.0   .29   .33 .  45  .64 1.00  .80  .84 1.23 1.35 1.66 1.55 1.53
VELA     1.0 1.69 1.42 1.39  .93   .95  .29  .10 0.00 0.00
XSEC     2.0         71.0 .50          89.70        .00250
         2.0-15.098.32 0.093.62 6.092.93 10.0 92.6 14.0 92.1 18.0 92.0
         2.0 22.0 91.7 26.0 91.8 30.0 91.6 34.0 91.4 38.0 91.3  42.0 91.9
         2.0 46.0 91.9 50.0 92.2 54.0 92.0 58.0 92.0 62.0 92.1  66.0 91.6
         2.0 70.0 90.9 74.0 90.8 78.0 90.5 82.0 90.9 86.0 90.2  89.0 89.9
         2.0 92.0 89.9 95.0 89.3 98.0 89.4101.0 89.6104.0 90.4107.0 91.5
         2.0110.0 92.4111.292.93113.993.82119.096.62121.098.32
NS       2.0          .80         .80      28.60       28.60       65.60
NS       2.0        86.70       67.70      78.70       67.60       67.80
NS       2.0        87.60       87.70      67.60       87.70       76.80
NS       2.0        62.70       26.80      78.60       87.60       76.70
NS       2.0        67.70       67.70      67.70       76.80       65.70
NS       2.0        65.60       28.50      28.50       28.50       28.50
CAL1     2.0        92.93      290.00
```

```
VEL1    2.0                    .10  .37  .30 1.39 2.26 2.45 1.85 1.24 1.83
VEL1    2.0 1.75 1.84 1.15 0.00  .74  .34   .43  .73  1.38 1.63 1.96 2.16
VEL1    2.0 3.07 2.77 2.81 2.99 1.42 .40 0.00
CAL2    2.0      92.78    236.00
VEL2    2.0                   .07     .19   .25 1.30 1.93   .88 1.50   .98 2.21
VEL2    2.0 1.54 1.52   .43  .02     .11 0.00   .27   .23 1.00 1.27 1.53 2.01
VEL2    2.0 2.59 2.94 2.62 3.15 1.47    .27
CAD     2.0      92.36     121.00
VEL3    2.0.10 .37 1.37 .58 1.53 .27 1.55
VEL3    2.0 2.22 1.87 .39 .16 .16 0.00 -.03 -.14 .40 .58.94 1.33
VEL3    2.0 1.76 2.31 1.73 2.60 1.07 .12
CAL4    2.0      92.09      60.00
VEL4    2.0                     0 .00   .01  .14  .43  1.19  .49 1.20
VEL4    2.0 1.64                         0.00   .05  .02    .21  .46   .66
VEL4    2.0 1.37 2.20 1.26  .50  .12  .08
XSEC    3.0       127     . 50     091.20     .00250
        3.0-20.098.32-15.097.62  0.093.92 3.0 93.4 7.0 92.6 11.0 92.4
        3.0  15.0 92.2 19.0 91.7 23.0 91.7 27.0 91.8 31.0 92.1 35.0 91.8
        3.0  39.0 91.5 43.0 91.5 47.0 91.9 51.0 91.7 55.0 91.5 59.0 91.7
        3.0  63.0 91.7 67.0 91.9 69.0 91.3 71.0 91.7 73.0 91.6 75.0 91.4
        3.0  77.0 91.5 79.0 91.5 81.0 91.3 83.0 91.2 85.0 91.3 89.0 91.6
3.0  93.0 91.6 97.0 91.8101.0 92.1104.793.37
NS      3.0           .80          .80        .80          26.80        76.90        67.80
NS      3.0         76.80        86.70      86.70          68.90        68.90        96.70
NS      3.0         69.60        69.60      98.60          98.80        96.60        96.60
NS      3.0         98.60        89.80      97.70          98.70        97.70        97.60
NS      3.0         97.70        97.70      96.70          96.70        98.80        98.80
NS      3.0         96.70        96.70      96.60          26.90          .80
CAL1                  3.0         93.37          290.00
VEL1    3.0                   0.00  .12   .76 1.49   .93 1.09 1.55 1.23 1.63
VEL1    3.0 1.72 2.22 2.03 1.98 2.17 1.68 2.28 2.06 1.58 1.53 1.71 1.97
VEL1    3.0 2.39 2.27 2.59 2.59 2.07 2.13 1.94 1.48 1.06
CAL2    3.0      93.19     236.00
VEL2    3.0                        .10   .82 1.17   .91 1.76 2.01 1.69 1.30
VEL2    3.0 1.46 1.91 1.37 1.71 1.94 1.85 1.95 1.49 1.39 1.18 1.56 1.70
VEL2    3.0 2.18 2.19 2.13 2.95 3.12 1.88 2.16 1.44   .93
CAL3    3.0      92.91     121.00
VEL3    3.0                      0.00   .32   .67   .61   .98 1.35 1.64   .91
VEL3    3.0 1.04 1.10 1.45  .36    .99 1.33 1.49 1.27 1.31 1.27 1.16 1.48
VEL3    3.0 1.59 1.81 1.56 2.26 1.05 1.64 2.20 1.10   .69
CAL4    3.0      92.67      60.00
VE14    3.0                           0.00  .52  .48  .19   .51  .73   .52
VEL4    3.0   .19   .86   .60   .29   .49   .61  .65  .71  .79 1.05  .39 1.04
VEL4    3.0 1.01 1.40 1.57 1.34 1.60 1.73  .59  .56
XSEC    4.0       99.0 .50 91.20 .00250
        4.0-90.0 98.3 -8.0 98.3 0.0 95.1 2.8 93.6 6.0 92.4   9.0    92.1
        4.0 12.0 92.1 15.0 91.8 18.0 92.1 21.0 92.2 24.0 91.7 27.0 91.8
        4.0 30.0 92.1 33.0 91.5 36.0 91.6 39.0 91.5 42.0 91.4 45.0 91.6
        4.0 48.0 90.9 51.0 90.9 54.0 91.4 57.0 91.7 60.0 92.1 63.0 91.9
        4.0 66.0 91.9 69.0 91.6 72.0 92.3 75.0 92.1 78.0 92.3 81.0 91.9
        4.0 84.0 92.8 87.0 92.4 90.0 92.8 93.0 92.8 96.2 93.6 99.4 95.0
        4.0102.497.22
```

Appendix G1 - IFG4 Input File, Chewuch River Site (continued)

```
NS      4.0        .80        .80      .80        26.70      26.70      62.60
NS      4.0      62.60      96.80    96.70        96.80      96.70      96.80
NS      4.0      96.90      96.70    96.80        99.90      99.90      99.90
NS      4.0      96.70      96.70    96.80        99.90      99.90      99.90
NS      4.0      99.90      99.90    96.70        99.90      99.90      99.90
NS      4.0      99.90      99.90    99.90        99.90      96.90      96.90
NS      4.0      99.90
CAL1    4.0      93.64     290.00
VEL1    4.0                    .50 1.31 1.41 1.37 1.82 1.75 1.57 2.10
VEL1    4.0 2.19 2.48 2.56 2.15 2.24 1.62 1.88 2.29 1.32 1.52 1.99 2.15
VEL1    4.0 1.74 1.52 1.89 2.08 1.32 1.46 1.87 1.18 1.16  .85
VEL1    4.0
CAL2    4.0     93.48   236.00
VEL2    4.0                    .26   .69 1.06  .77 1.29 1.17 1.20 1.59
VEL2    4.0 1.89 1.73 1.96 1.85  .19 1.17 1.95 2.27  .78 1.82 1.63 1.82
VEL2    4.0 1.36 1.08 1.60 1.39 1.12  .71 1.16   .54  .60  .40
VEL2    4.0
CAL3    4.0      93.11      121.00
VEL3    4.0                    .21   .62   .63   .76   .91   .99 1.09 1.20
VEL3    4.0 1.63 1.18 1.60 1.74  .16 1.19 1.70 1.87 1.42 1.27 1.59 1.01
VEL3    4.0  .79    .70   .97  .73  .72   .18   .72   .18    .44  14
VEL3    4.0
CAL4    4.0     92.82       60.00
VEL4    4.0                    .05  .30   .44   .59  .63  .75  .75  .87
VELA    4.0 1.19  .92 1.03 1.23 1.14  .97 1.23 1.32  .90  .47  .65  .64
VEL4    4.0   .29  .27  .37  .31  .12  .10             .04
VELA    4.0
XSEC    5.0           101.0 .50       91.60    .00250
        5.0-80.0100.8 -9.0100.8 –2.0 9.8   0.0 96.9 14.993.74 16.0 93.5
        5.0 19.0 93.4 22.0 93.3  25.0 92.9 28.0 92.7 31.0 92.5 34.0 91.8
        5.0 37.0 92.0 40.0 92.2 43.0 92.4 46.0 92.4 49.0 92.3 52.0 92.3
        5.0 55.0 92.2 58.0 92.5 61.0 92.7 64.0 91.6 67.0 91.8 70.0 92.3
        5.0 73.0 92.2 76.0 92.3 79.0 92.3 82.0 91.9 85.0 92.2 88.0 92.7
        5.0 91.0 92.6 94.0 92.2 97.0 92.6100.0 93.0103.0 93.3106.193.74
        5.0110.7 96.0114.7 99.6
NS      5.0        .80        .80    28.50        28.50      76.60      76.60
NS      5.0      76.80      89.50    56.70        69.70      99.90      96.60
NS      5.0      96.50      99.90    99.90        96.80      96.70      96.74
NS      5.0      96.80      96.90    99.90        96.80      96.70      99.90
NS      5.0      96.80      99.90    99.90        96.60      97.60      97.60
NS      5.0      96.80      99.90    99.90        99.90      99.90      99.90
NS      5.0        .80      99.90
CAL1    5.0      93.74     290.00
VEL1    5.0                        .20 1.55 3.13 3.99 3.82 3.50 2.28
VEL1    5.0 2.88 4.10 3.00 2.61 3.13 2.61 2.39 2.81 3.67 2.82 2.41 3.29
VEL1    5.0 3.21 2.44 1.80 1.49 1.75 1.17  .48 1.11 1.12 2.03   .69
VEL1    5.0
CAL2     5.0         93.61     236.00
VEL2     5.0                        .43  .51 2.69 1.89 1.65 3.64 2.98
VEL2    5.0 2.28 2.39 2.87 2.79 3.13 2.99 2.08 2.43 2.75 2.67 2.31 3.32
VEL2    5.0 3.26 1.84 1.16 1.49 1.08 1.34   .62   .47   .91 1.26
VEL2 5  .0
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CAL3    5.0              93.33    121.00
VEL3    5.0                                   .30   .71 2.26 2.70 3.10 2.46
VEL3    5.0 2.56  .71 1.96 1.79 2.61 2.13 1.86 1.61 1.01 1.19 1.51 2.51
VEL3    5.0 2.05  .57 1.16 1.35 1.10   .60   .70 1.10   .80
VEL3    5.0
CAL4    5.0           93.01          60.00
VELA    5.0                                        0.00 -.03  .74 2.05
VEL4    5.0 1.96 2.91 2.16        .51 1.52 1.23  .87  .98  .66 1.44 1.85
VEL4    5.0 2.08   .62    .19 .96  .70 1.60    .38  .19  .10
VELA    5.0
XSEC    6.0       122.0   .50           92.50         .00250
        6.0-75.0101.1 -5.0101.1 0.0 96.9 18.594.28 22.0 93.6 26.0 93.6
        6.0 30.0 92.8 34.0 92.9 38.0 93.0 42.0 92.9    46.0 92.6 49.0 92.5
        6.0 52.092.8 55.0 92.8 58.0 92.7 61.0 92.7     64.0 92.7 67.0 92.9
        6.0 70.0 93.0 73.0 93.0 77.0 93.4 81.0 93.5     84.0 93.9 88.0 94.5
        6.0 90.0 94.2 93.594.28 99.494.28103.0 93.8106.0 93.8110.0 93.8
        6.0113.594.28118.4 96.1121.4100.3
'NS     6.0         .80         .80       24.70       82.50       87.50       82.50
NS      6.0       87.50       87.50       78.70       78.70       78.80       78.80
NS      6.0       78.50       78.50       78.70       78.80       97.60       79.60
NS      6.0       79.80       79.80       76.80       78.70       78.70       78.80
NS      6.0       78.80       78.80       78.80       78.90       79.60       79.60
NS      6.0       79.60         .80         .80
CAL1    6.0       94.28      290.00
VEL1    6.0      .16                .09 1.39 2.31 3.38 3.42 4.55 4.87
VEL1    6.0 4.99 5.24 5.08 5.24 5.49 3.82 4.75 3.73 3.92 1.15   .27
VEL1    6.0   .22           0.00 0.00   .03
CAL2    6.0         94.15         236.00
VEL2    6.0                        .22   .07  1.47 2.94 3.35 3.31 3.95 3.77
VEL2    6.0 5.17 4.57 4.21 4.96 3.90 4.37 4.40 4.12 3.03   .32   .17
VEL2    6.0                 0.00 0.00 0.00
CAM     6.0      93.89     121.00
VEL3    6.0                       0.00   .01   .76 2.30 1.94 2.46 2.52 1.64
VEL3    6.0 4.48 4.21 2.95 3.58 2.65 4.13 2.95 2.14 1.10   .36
VEL3    6.0
CAL4    6.0         93.64           60.00
VEL4    6.0                              .10   .15 1.11 1.23 1.87 1.66 2.07
VEL4    6.0 2.16 2.32 1.28 2.13 1.23 1.81 1.88 1.53 1.78   .33
VEL4    6.0
XSEC    7.0          127.0 .50             92.90          .00250
        7.0-80.0101.5 -5.0101.5 0.0 99.7 23.095.61 26.0 95.1 29.0 95.4
        7.0 32.0 94.6 35.0 94.3 38.0 94.1 41.0 93.8 44.0 93.8 47.0 93.4
        7.0 50.0 93.7 53.0 93.9 56.0 93.8 59.0 93.7 62.0 93.5 64.0 93.0
        7.0 66.0 93.1 68.0 93.0 70.0 92.9 72.0 93.1 74.0 92.9 76.0 93.6
        7.0 79.0 93.8 82.0 94.3 85.0 94.5 88.0 94.7 91.0 95.1 94.0 95.2
        7.0 97.0 95.3100.0 95.5103.0 95.8106.0 95.5106.5 95.6126.0 95.6
        7.0127.0 95.4129.0 95.2131.0 95.3132.4 95.6136.9 97.3142.0100.4
NS      7.0         .80         .80         .80       87.70       98.70       98.80
NS      7.0       99.50       98.90       99.90       98.80       98.90       98.50
NS      7.0       87.70       87.70       97.60       78.50       78.50       99.50
NS      7.0       99.50       99.50       99.50       97.90       98.90       98.80
NS      7.0       78.70       78.70       78.70       78.50       78.50       78.50
```

Appendix G1 - IFG4 Input File, Chewuch River Site (continued)

```
NS      7.0         78.50       7.850       78.50      78.50       99.00       97.50
NS      7.0         97.50       97.50       97.50      99.00       99.00       99.00
CAL1    7.0         95.61      290.00
VEL1    7.0                  .45 1.45 1.93 2.62 2.82 1.88 2.66 2.67
VELl    7.0 2.76 3.11 3.85 2.88 2.87 2.09 2.51 3.07 2.77 2.70 1.97 2.76
VEL1    7.0 1.86 2.26 1.73 1.51 1.03   .27 0.00 0.00      0.00
VEL1    7.0 0.00   .22 0.00
CAL2    7.0     95.43      2.36
VEL2    7.0                  .41 1.28 1.61 2.39 2.36 1.82 2.36 2.13
VEL2    7.0 2.78 3.03 3.03 2.69 1.45 2.23 2.13 2.57 2.49 2.24 1.63 2.20
VEL2    7.0 1.73 1.81 1.27 1.14   .51   .21 0.00
VEL2    7.0 0.00 0.00 0.00
CAL3    7.0     95.10     121.00
VEL3    7.0                           .67 1.59 1.47 1.49 1.23 1.73
VEL3    7.0 1.69 2.19 2.97 2.08 1.38 1.27 1.60 2.39 1.80 1.90 1.19 1.94
VEL3    7.0 1.15 1.52  .80
VEL3    7.0
CAL4    7.0     94.75      60.00
VEL4    7.0                        0.00   .62   .65   .90  .94   .99
VEL4    7.0  .88 1.75 1.41 1.36 1.19  .45 1.29 1.56 1.21 1.35  .68 1.32
VEL4    7.0  .77   .63   .22
VEL4    7.0
ENDJ
```

CHEWUCH RIVER SITE
Calibration Information for Calculated Discharge

Transect Number	1	2	3	4	5	6	7
Discharge							
	275	284	275	273	288	297	281
	232	224	238	184	222	248	215
	135	121	137	114	127	138	129
	68	57	63	61	61	63	61
Stage							
	92.81	92.93	93.37	93.64	93.74	94.28	95.61
	92.62	92.78	93.19	93.48	93.61	94.15	95.43
	92.25	92.36	92.91	93.11	93.33	93.89	95.10
	91.92	92.09	92.67	92.82	93.01	93.64	94.75
Plotting Stage							
	3.11	3.23	2.17	2.44	2.14	1.78	2.71
	2.92	3.08	1.99	2.28	2.01	1.65	2.53
	2.55	2.66	1.71	1.91	1.73	1.39	2.20
	2.22	2.39	1.47	1.62	1.41	1.14	1.85
Ratio of measured versus predicted discharge							
	0.946	0.973	0.900	1.064	1.016	0.950	0.986
	1.037	0.982	1.083	0.908	0.990	1.036	0.996
	1.067	1.127	1.116	1.047	0.984	1.051	1.039
	0.956	0.929	0.919	0.989	1.010	0.967	0.980
Mean error of stage/discharge relationship for calculated Q							
	5.05	5.87	9.50	5.43	1.27	4.27	1.91
Mean error of stage/discharge relationship for given Q							
	3.42	4.68	5.70. 3.03	2.96	1.96	2.84	2.84
Stage/discharge relationship (S vs Q) S=A*Q**B+SZF							
A=	0.8034	0.1073	0.4864	0.4945	0.4665	0.3478	0.6597
B=	0.2386	0.1941	0.2613	0.2876	0.2698	0.2482	0.2500
SZF=	89.7	89.70	91.20	91.20	91.60	92.50	92.90
Beta coefficient log/log discharge/stage relationship							
	4.19	5.15	3.83	3.48	3.71	3.52	4.00

Appendix G3 - Data Changes for Calibration, Chewuch River Site

TRANSECT	VERTICAL	VEL	CHANGE
2	21	4	0.30 TO 0.50
	7	1	1.75 TO 1.55
5	7	2	0.31 TO 0.51
5	7	3	0. 10 TO 0.30
5	8	2	3.33 TO 3.13
5	8	3	0.51 TO 0.71
5	11	2	3.70 TO 3.50
5	11	4	0.54 TO 0.74
5	16	4	0.21 TO 0.00
5	17	4	0.31 TO 0.51
5	34	3	0.15 TO 0.00
5	35	2	0.20 TO 0.00
7	28	3	0.14 TO 0.00

Appendix G4 Velocity Adjustment Factors, Chewuch River Site

Transect	Discharge	VAF
1.00	25.0	0.964
1.00	60.0	0.985
1.00	125.0	1.003
1.00	300.	1.001
1.00	725.0	0.921
2.00	25.0	0.916
2.00	60.0	1.007
2.00	125.0	1.017
2.00	225.0	1.004
2.00	325.0	0.970
2.00	725.0	0.805
3.00	25.0	0.860
3.00	60.0	0.948
3.00	125.0	0.997
3.00	225.0	1.008
3.00	300.0	1.002
3.00	725.0	0.928
4.00	25.0	0.923
4.00	60.0	1.011
4.00	125.0	1.042
4.00	225.0	1.024
4.00	300.0	0.997
4.00	725.0	0.830
5.00	25.0	0.963
5.00	60.0	1.001
5.00	125.0	1.025
5.00	225.0	1.015
5.00	300.0	0.996
5.00	725.0	0.846
6.00	25.0	1.049
6.00	60.0	1.009
6.00	70.0	1.006
6.00	125.0	1.004
6.00	225.0	1.003
6.00	300.0	1.001
6.00	725.0	0.971
7.00	25.0	0.977
7.00	60.0	0.998
7.00	125.0	1.012
7.00	225.0	1.002
7.00	300.0	0.989
7.00	725.0	0.888

APPENDIX H

EARLY WINTERS SITE CALIBRATION INFORMATION

Appendix H1 - IFG4 Input Files, Early Winters Creek Site

```
EARLY WINTERS CREEK at river mile 1.0                                      WRIA 48
measured on 8/5/91- 227 cfs, 8/17- 132 cfs, 8/30- 78 cfs, 9/27- 37 cfs
IOC             00000002000000000000
QARD   15.0
QARD   40.0
QARD   80.0
QARD   125.0
QARD   225.0
QARD   575.0
XSEC   3.0 0.0 .75 91.60 .00250
       3.0-10.0 99.7  0.0 96.6   2.1 94.6  5.0 93.5  7.5 93.8 10.0 94.0
       3.0  12.5 92.4 15.0 93.4 17.5 92.1 20.0 92.8 22.5 92.7.25.0 92.6
       3.0  27.5 92.7 30.0 92.6 32.5 92.2 35.0 92.1 37.5 92.5 40.0 91.6
       3.0  42.5 92.1 45.0 93.7 47.5 94.8 50.0 94.8 52.5 94.4 55.0 94.5
       3.0  56.3 94.6 59.8 98.3 69.8 99.7
NS     3.0        .80    88.90    87.60    87.70    87.80    88.90
NS     3.0      88.90    88.90    88.90    88.90    87.90    76.90
NS     3.0      87.80    87.80    88.90    88.90    88.90    88.90
NS     3.0      88.90    88.90    88.90    82.70    82.80    82.80
NS     3.0      88.90      .80      .80
CAL1   3.0 94.69 227.00
VEL1   3.0                1.45 .20 3.27 1.00 3.87 2.78 3.76 1.93 1.22
VEL1   3.0  .61 3.56 3.44 1.52 .72 2.28 5.20  .44              0.00 0.00
VELl   3.0
CAL2   3.0 94.52 132.00
VEL2   3.0                 .63  .36   .39 1.08 3.64 2.46 3.24 1.90 1.20
VEL2   3.0  .46 4.45 2.86  .46  .28 1.11 1.67 .51              0.00 -.01
VEL2   3.0
CAL3   3.0 9      4.20     78.00
VEL3   3.0                -.20 .62  .39   .11 1.91 1.59 2.12 1.22.66
VEL3   3.0 1.51 2.60  .88  .15  .25  .98 1.89 1.08
VEL3   3.0
CAL4   3.0      93.71      37.00
VEL4   3.0                  0.00  .12   .60  1.72 1.38.67 1.00
VEL4   3.0 1.83 1.15          .26  .50 1.81 -.14 0.00
VEL4   3.0
XSEC   4.0 45.0 .50 93.20  .00250
       4.0-12.0 96.7 0.0 94.9 2.5 94.6 5.0 94.8 7.5 94.9 10.0 94.9
       4.0 12.5 94.2 15.0 94.4 17.5 93.4 20.0 93.6 22.5 93.5 25.0 93.2
       4.0 27.5 93.3 30.0 93.8 32.5 94.0 35.0 93.7 37.5 93.6 40.0 93.3
       4.0 42.5 93.3 45.0 93.4 47.5 93.6 50.0 95.5 52.5 95.4 55.0 95.8
       4.0 57.3 95.7 65.0 99.3 75.0101.6
NS     4.0        .80      .10    27.70    27.70    68.70    78.80
NS     4.0      82.80    88.90    88.90    88.90    88.90    88.90
NS     4.0      88.90    88.90    88.90    88.90    88.90    88.90
NS     4.0      88.90    87.80    87.90    88.90    88.90    87.80
NS     4.0      78.70      .80      .80
CAL1   4.0      95.74  227.00
VEL1   4.0              .45   .08 2.44 1.94   .99 2.51 3.43 5.57 4.12 1.74
VEL1   4.0 1.36 1.99 2.35 5.23 4.89 2.85 2.01 1.84  .37 1.12    .65
VEL1   4.0
CAL2   4.0     95.41  132.00
```

```
VEL2    4.0           0.00   .13 1.34 1.70   .60 237 2.72 4.83 4.10 .34
VEL2    4.0  .33 1.55 1.12 3.92 4.88 3.48 1.53 2.15  .23   .47
VEL2    4.0
CAL3    4.0     95.12       78.00
VEL3    4.0           .18   .06   .95 1.25   .12 1.62 1.69 4.68 3.43 .36
VEL3    4.0  .27  .66  .54 3.29 3.24 2.19 1.83 1.44  .33          .18
VEL3    4.0
CAL4    4.0      94.65        37.00
VEL4    4.0 .                 06             .18   .48  .90 2.62 2.54  .46
VEL4    4.0  .64  .30          2.61 2.11 3.29 .95 1.31 .16
VEL4    4.0
XSEC    5.0    44.0   .50   93.60  .00250
        5.0 -4.0101.6 -1.5 97.5 0.0 96.4 2.5 94.8 5.0 94.7 7.5 94.8
        5.0 10.0 94.6 12.5 94.8 15.0 95.6 17.5 94.3 20.0 94.1 22.5 93.5
        5.0 25.0 93.5 27.5 93.2 30.0 94.0 32.5 93.4 35.0 94.2 37.5 94.7
        5.0 40.0 94.5 42.5 94.8 45.0 95.2 47.5 95.5 50.0 95.6 52.5 95.8
        5.0 54.2 96.4 62.6101.4
NS      5.0         .80       .10       .10     82.80     82.80     78.70
NS      5.0       78.80     87.80     88.90     88.90     88.90     88.90
NS      5.0       88.90     88.90     88.90     88.90     88.90     88.90
NS      5.0       82.80     82.80     82.80     28.80     78.70     78.70
NS      5.0       78.80       .80
CAL1    5.0 96.40 227.00
VEL1    5.0                 .50 1.53 1.50 1.46 4.32 4.01 1.79  2.87 3.40
VEL1    5.0 4.72 2.44 3.58 1.42 2.38 1.83   .60   .03 -.03 -.16 0.00 0.00
VEL1    5.0
CAL2    5.0 96.11  132.00
VEL2    5.0                .60 1.50 1.53 1.57 2.72 2.96 .33 2.94 2.26
VEL2    5.0 3.70 .38 3.05 1.15 2.09 2.02 .53 0.00 -.03 -.01 0.00  .01
VEL2    5.0
CAM     5.0 95.83  78.00
VEL3    5.0                .26   .96 1.30 1.09 1.92 2.84   .55 1.94 1.95
VEL3    5.0 3.07 1.01 2.06 .99 1.72 1.58 1.39 0.00   .12 0.00 0.00
VEL3    5.0
CAL4    5.0     95.41    37.00
VEL4    5.0              0.00       .41 .45    .89             .13  .70 1.01
VEL4    5.0 1.92  .17 1.26  .68  .36  .53  .50 0.00 0.00
VEL4    5.0
XSEC    6.0 29.0  50 93.60 .00250
        6.0-10.0100.9 0.0 98.0 1.1 96.6 2.5 96.4 5.0 96.1 7.5 95.8
        6.0 10.0 95.5 12.5 95.6 15.0 94.3 17.5 94.3 20.0 94.2 22.5 93.9
        6.0 25.0 93.5 27.5 93.9 30.0 93.4 32.5 94.2 35.0 94.6 37.5 93.6
        6.0 40.0 95.6 42.5 95.6 43.8 96.6 48.4 98.7 58.4101.6
NS      6.0         .80       .30     82.80     28.60     23.60     78.70
NS      6.0       87.80     87.80     88.90     88.90     82.90     88.90
NS      6.0       88.90     88.90     88.90     88.90     82.90     82.90
NS      6.0       82.90     82.90     82.90       .80       .80
CAL1    6.0       96.56   227.00
VEL1    6.0                 .09  .04   .38  1.18   2.17 3.88 3.55 4.35 3.36
VEL1     6.0 3.46 4.15 3.90 3.73 2.72 1.27    .25  -.08
CAL2    6.0      96.22      132.00
VEL2    6.0                     0.00  .26  .76 1.32 3.02 2.92 3  .12 2.55
```

```
VEL2    6.0 1.94 3.44 2.29 3.04 2.29  .78  .18
CAL3    6.0      95.92       78.00
VEL3    6.0                               .04  .56  .92  .29  .42 1.32 1.25
VEL3    6.0 2.79 2.97 1.52 2.37 1.87 .24
CAL4    6.0      95.44      37.00
VEL4    6.0                                              .50  .36        1.17
VEL4    6.0  .33 1.64 1.06 1.11 1.13 .45
XSEC    7.0       51.0   .50    93.90       .00250
        7.0 -8.0101.6 0.0 98.5 2.5 97.0  5.0 96.6 7.5 95.4 10.0 95.1
        7.0 12.5 95.2 15.0 95.2 17.5 94.1 20.0 93.9 22.5 94.1 25.0 94.3
        7.0 27.5 94.3 30.0 94.5 32.5 94.8 35.0 94.6 37.5 95.1 40.0 95.5
        7.0 42.5 96.6 44.5100.4 45.5101.6
NS      7.0          .80        .30     88.90     88.90     78.70     87.80
NS      7.0        87.70     88.90     88.90     88.90     88.90     88.90
NS      7.0        88.90     88.90     88.90     88.90     82.80     82.80
NS      7.0        88.90        .30        .80
CAL1    7.0        96.80     227.00
VEL1    7.0                          .37 2.04 3.61 2.43 4.02 4.05 2.71 3.16 2.35
VEL1    7.0 2.65 4.19 5.13 3.13     .65  .84    .83
CAL2    7.0       96.43    132.00
VEL2    7.0                            2.20 2.90 3.09 2.76 3.31 2.85 1.96 3.03
VEL2    7.0 2.07 2.02 2.44 1.76  .18   .31
CAL3    7.0      96.09       78.00
VEL3    7.0                            1.49  .96 2.33 1.85 1.56 3.31 2.73 1.10
VEL3    7.0 1.57  .54 1.62 1.34 0.00 0.00
CAL4    7.0      95.61      37.00
VELA    7.0                             .88 1.20 1.89 1.29 1.78 2.68 3.28
VEL4    7.0 2.03 2.12 1.43  .52 0.00
ENDJ
```

EARLY WINTERS CREEK - T8 CHANNEL 1
measured on 8/5/91 - 104.5 cfs, 8/17 - 54.5 cfs, 8/30 - 32 cfs, 9/27 -9.5 cfs

```
IOC             0000000200000000000000
QARD    4.0 QARD 10.0
QARD    33.0
QARD    52.0
 QARD   104.0
QARD    285.0
XSEC    81.0 0.0 .50 93.62 .00250
        81.0-10.0101.0 0.096.62 3.2 95.5 5.0 96.0 6.0 94.8 7.0 95.0
        81.0 8.0 95.2 9.0 95.1 10.0 95.0 12.0 94.8 14.0 94.3 16.0 94.3
        81.0 17.0 93.5 18.0 93.5 19.0 93.7 20.0 93.4 21.0 92.3 22.0 92.4
        81.0 24.0 92.2 25.0 92.5 26.0 93.8 27.0 94.2 29.0 94.5 31.0 94.9
        81.0 33.0 94.3 35.0 94.2 37.0 94.2 39.0 94.2 41.0 95.0 43.0 95.1
        81.0 43.5 95.5 50.295.52 60.297.12
NS      81.0         .80        .80     88.90     88.90     82.90     22.90
NS      81.0       22.90     22.90     22.90     22.90     27.70     72.90
```

```
NS      81.0    72.90   87.80   88.90   88.90   78.70   78.70
NS      81.0    87.80   88.90   88.90   88.90   88.90   88.90
NS      81.0    78.70   87.80   77.90   87.80   87.90   87.90
NS      81.0    87.70   75.50   .80
CAL1    81.0    95.50   104.50
VEL1    81.0                        .01 0.00 0.00 0.00 0.00  .18  .28  .18
VEL1    81.0  .02  .12 3.32 3.44 3.11 3.42 3.20 3.21 3.32 4.83 2.52 3.34
VEL1    81.0 2.06  .34  .13   .11 0.00 0.00
CAL2    81.0    95.30     54.50
VEL2    81.0                        0.00 0.00 0.00 0.00 0.00 .06 .17 0.00
VEL2    81.0 0.00 .10 2.52 2.45 2.03 2.51 1.91 2.11 2.09 3.20 .91 1.85
VEL2    81.0 1.35 .47   .02   .04 0.00 0.00
CAD     81.0    95.10     32.00
VEL3    81.0                                            0.00   .07 .02 .01
VEL3    81.0 0.00 0.00 1.65 1.58 1.42 1.61 1.27 1.34 1.73 2.21 .35
VEL3     81.0  .40   .20   .02 0.00
CAL4    81.0    94.74       9.50
VEL4    81.0 .01.01
VELA    81.0 0.00 0.00    .39  .61  .71  .71  .48  .34 1.03  .85  .04
VELA    81.0   .06 0.00 0.00 0.00
XSEC    82.0      50.0  .50     93.62     .00250
        82.0-10.0101.0 0.096.62 3.2 95.5 5.0 96.0 6.0 94.8 7.0 95.0
        82.0 8.0 95.2 9.0 95.1 10.0 95.0 12.0 94.8 14.0 94.3 16.0 94.3
        82.0 17.0 93.5 18.0 93.5 19.0 93.7 20.0 93.4 2 1.0 92.3 22.0 92.4
        82.0 24.0 92.2 25.0 92.5 26.0 93.8 27.0 94.2 29.0 94.5 31.0 94.9
        82.0 33.0 94.3 35.0 94.2 37.0 94.2 39.0 94.2 41.0 95.0 43.0 95.1
        82.0 43.5 95.5 50.295.52 60.297.12
NS      82.0       .80      .80   88.90   88.90   82.90   22.90
NS      82.0    22.90   22.90   22.90   22.90   27.70   72.90
NS      82.0    72.90   87.80   88.90   88.90   78.70   78.70
NS      82.0    87.80   88.90   88.90   88.90   88.90   88.90
NS      82.0    78.70   87.80   77.90   87.80   87.90   87.90
NS      82.0    87.70   75.50     .80
CAL1    82.0    95.50  104.50
VEL1    82.0                        .01 0.00 0.00 0.00 0.00   .18   .28  .18
VEL1    82.0  .02 .12 3.32 3.44 3.11 3.42 3.20 3.21 3.32 4.83 2.52 3.34
VEL1    82.0 2.06 34   .13   .11 0.00 0.00
CAL2    82.0   95.30     54.50
VEL2    82.0                        0.00 0.00 0.00 0.00 0.00   .06 .17 0.00
VEL2    82.0 0.00  .10 2.52 2.45 2.03 2.51 1.91 2.11 2.09 3.20 .91 1.85
VEL2     82.0 1.35  .47  .02   .04 0.00 0.00
CAL3    82.0    95.10     32.00
VEL3    82.0                                            0.00  .07  .02  .01
VEL3    82.0 0.00 0.00 1.65 1.58 1.42 1.61 1.27 1.34 1.73 2.21 .35
VEL3    82.0   .40  .20   .02 0.00
CAL4    82.0    94.74       9.50
VEL4    82.0                                                .01.01
VELA    82.0 0.00 0.00   .39   .61 .71 .71 .48 .34 1.03 .85 .04
VEL4    82.0   .06 0.00 0.00 0.00
ENDJ
```

```
EARLY WINTERS CREEK - T8 CHANNEL 2
measured, on 8/5/91 - 16 cfs, 8/17 - 6.7 cfs, 8/30 - 4.1 cfs, 9/27 - 0.5
cfs
IOC     00000002000000000000000
QARD    0.8
QARD    4.2
QARD    6.4
QARD    15.7
QARD    49.3
XSEC    82        .0 0.0 .50 97.00 .00250
        82.0-10.098.36 0.0 98.0 .998.17 1.0 98.1 3.0 98.0 5.0 97.9
        82.0 7.0 97.9 9.0 97.8 11.0 98.1 13.0 98.1 15.0 98.0 17.0 97.7
        82.0 18.0 97.7 19.0 97.5 20.0 97.2 21.0 97.1 22.0 97.0 23.0 97.2
        82.0 24.0 97.4 25.0 97.8 26.0 98.0 27.0 98.0 27.798.17 29.698.36
        82.0 34.698.76
NS      82.0    21:50   21.50   13.70   13.70   13.70   13.70
NS      82.0    13.70   13.70   13.70   .30       .30     .30
NS      82.0    62.90   62.90   62.70   62.70   62.60   26.60
NS      82.0    13.70   13.70   13.80   13.80   13.80   20.50
NS      82.0    20.50
CAL1    82.0    98.17   16.00   16.0
VEL1    82.0              .50 1.13 1.51 1.56 1.42          .22 .75
VEL1    82.0  .59 1.00 1.48 1.88 2.46 2.12 1.47 1.82 1.08.21
VEL1    82.0
CAL2    82.0   97.96    6.70    6.7
VEL2    82.0
VEL2    82.0
VEL2    82.0
CAM     82.0   97.80    4.10    4.1
VEL3    82.0
VEL3    82.0
VEL3    82.0
CAL4    82.0   97.52    .50     .5
VEL4    82.0
VEL4    82.0
VEL4    82.0
XSEC    83.0        50.0 .50    97.00    .00250
        83.0-10.098.36 0.0 98.0 .998.17 1.0 98.1 3.0 98.0 5.0 97.9
        83.0 7.0 97.9 9.0 97.8 11.0 98.1 13.0 98.1 15.0 98.0 17.0 97.7
        83.0 18.0 97.7 19.0 97.5 20.0 97.2 21.0 97.1 22.0 97.0 23.0 97.2
        83.0 24.0 97.4 25.0 97.8 26.0 98.0 27.0 98.0 27.798.17 29..698.36
        83.0 34.698.76
NS      83.0    21.50   21.50   13.70   13.70   13.70   13.70
NS      83.0    13.70   13.70   13.70   .30     .30     .30
NS      83.0    62.90   62.90   62.70   62.70   62.60   26.60
NS      83.0    13.70   13.70   13.80   13.80   13.80   20.50
NS      83.0    20.50
CAL1    83.0    98.17   16.00   16.0
VEL1    83.0              .50 1.13 1.51 1.56 1.42               .22   .75
VEL1    83.0  .59 1.00 1.48 1.88 2.46 2.12- 1.47 1.82 1.08.21
VEL1    83.0
CAL2 83.0     97.96    6.70     6.7
```

VEL2 83.0
Appendix H1 - IFG4 Input File, Early Winters Creek Site, (continued)

```
VEL2    83.0
VEL2    83.0
CAM     83.0    97.80     4.10     4.1
VEL3    83.0
VEL3    83.0
VEL3    83.0
CAL4     83.0    97.52      .50      .5
VEL4    83.0
VEL4    83.0
VEL4    83.0
ENDJ


EARLY WINTERS CREEK - T8 CHANNEL 3
measured on 8/5/91 - 16.8 cfs, 8/17 - 9.1 cfs, 8/30 - 2.9 cfs, 9/27 -0.01 cfs
IOC             0000000200000000000000
QARD   0.2
QARD   3.0
QARD   8.3
QARD   16.5
QARD   44.6
XSEC    83.0              0.0 .50    98.21       .00250
        83.0  -5.098.76 0.099.36 4.098.73 5.0 98.5 7.0 98.2       9.0 98.0
        83.0 11.0 97.3 13.0 97.4 15.0 98.3 17.0 98.518.898.73 19.998.86
        83.0 24.998.56
NS      83.0      12.50     12.50     13.80     13.80     13.80     13.70
NS      83.0      13.70     13.70     13.70     13.80     13.90     12.50
NS      83.0      12.50
CAL1    83.0      98.73     16.80
VEL1    83.0                  1.65 2.49 2.34 2.77 .09 1.57.03
VEL1    83.0
CAL2 83.0         98.60     9.10
VEL2 83.0                     .50 1.54 .50 2.34 .07 1.65 0.00
VEL2 83.0
CAL3 83.0         98.50     2.90
VEL3 83.0                          1.04 .29 1.21.-.25 .32
VEL3 83.0
XSEC 84.0          50.0 .50         98.21     .00250
        84.0 -5.098.76 0.099.36 4.098.73 5.0 98.5 7.0 98.2 9.0 98.0
        84.0 11.0 97.3 13.0 97.4 15.0 98.3 17.0 98.5 18.898.73 19.998.86
        84.0 24.998.56
NS      84.0      12.50     12.50     13.80     13.80     13.80     13.70
NS      84.0      13.70     13.70     13.70     13.80     13.90     12.5-0
NS      84.0      12.50
CAL1    84.0      98.73     16.80
VEL1    84.0                 1.65 2.49 2.34 2.77 .09 1.57.03
VEL1    84.0
CAL2    84.0      98.60     9.10
```

```
VEL2    84.0                    .50 1.54 .50 2.34.07 1.65 0.00
VEL2    84.0
CAM     84:0      98.50     2.90
VEL3    84.0                        1.04 .29 1.21 -.25 .32
VEL3    84.0
ENDJ


EARLY WINTERS CREEK - T8 CHANNEL 4
Measured on 8/5 - 50.9 cfs, 8/17-37.8 cfs, 8/30-20.1 cfs, 9/27-8 cfs.
IOC 0000000200000000000000
QARD   3.0
QARD   7.0
QARD   21.0
QARD   40.0
QARD   51.0
QARD   98.0
XSEC    84.0            0.0 .50             95.66         .00250
        84.0-10.097.96 0.097..66 4.696.69 6.0 96.3 8.0 96.1 10.0 96.3
        84.0 12.0 96.1 14.0 95.6 16.0 95.1 18.0 94.7 20.0 94.9 22.0 95.0
        84.0 24.0 94.9 26.0 95.5 28.0 96.1 30.0 96.6 32.0 96.6 34.0 96.1
        84.0 35.396.69 36.498.86
NS      84.0      12.50     12.50     13.60     40.70     65.80     67.60
NS      84.0      76.70     73.80     72.70     72.80     72.80     72.80
NS      84.0      78.80     78.80     72.80     32.80     32.80     32.80
NS      84.0      32.80     .30
CAL1    84.0      96.69     50.90
VEL1    84.0                   .25 2.72  .29 1.34 1.50 2.43 2.59 2.71 2.53
VEL1    84.0 1.57 .41 .11 .05 0.00 .17
CAL2    84.0      96.63     37.80
VEL2    84.0                        1.05 1.58 1.40 1.30 1.38 1.98 2.01 1.90 1.57
VEL2    84.0  .90 .46 .08 0.00 0.00 -.49
CAL3     84.0     96.55     20.10
VEL3    84.0                        .89 1.98 1.22 .62 .75 1.25 .47 1.20 1.08
VEL3    84.0 .72 .17 0.00 -.21
CAL4    84.0      96.37     8.00
VELA    84.0                            1.93 .20 .13 .29 .51 .64 .41 .55
VELA    84.0 .33 0.00 0.00
XSEC    85.0      50.0  .50        95.66         .00250
        85.0-10.097.96 0.097.66 4.696.69 6.0 96.3 8:0 96.1 10.0 96.3
        85.0 12.0 96.1 14.0 95.6 16.0 95.1 18.0 94.7 20.0 94.9 22.0 95.0
        85.0-24.0 94.9 26.0 95.5 28.0 96.1 30.0 96.6 32.0 96.6 34.0 96.1
        85.0 35.396.69 36.498.86
NS      85.0      12.50     12.50     13.60     40.70     65.80     67.60
NS      85.0      76.70     73.80     72.70     72.80     72.80     72.80
NS      85.0      78.80     78.80     72.80     32.80     32.80     32.80
NS      85.0      32.80     .30
CAL1    85.0      96.69     50.90
VEL1    85.0                      .25 2.72 .29 1.34 1.50 2.43 2.59 2.71 2.53
VEL1    85.0 1.57  .41  .11    .05 0.00 .17
CAL2    85.0      96.63     37.80
```

```
VEL2    85.0                  1.05 1.58 1.40 1.30 1.38 1.98 2.01 1.90 1.57
VEL2    85.0  .90  .46  .08 0.00 0.00 -.49
CAL3    85.0       96.55      20.10
VEL3    85.0 .                     89 1.98 1.22 .62 .75 1.25 .47 1.20 1.08
VEL3    85.0 .72 .17 0.00                 -.21
CAL4    85.0        96.37      8.00
VEL4    85.0                            1.93 .20 .13 .29 .51 .64 .41 .55
VEL4    85.0   .33 0.00 0.00
ENDJ


EARLY WINTERS CREEK - T8 CHANNEL 5
measured on 8/5/91 - 45.1 cfs, 8/17 - 36.1 cfs, 8/30 - 25.1 cfs, 9/27 - 13 cfs
IOC                 000000020000000000000
QARD     5.0
QARD    13.0
QARD    25.0
QARD    37.0
QARD    45.0
QARD    75.0
XSEC    85.0        0.0 .50       94.76       .00250
        85.0 -.396.23 0.096.26 1.0 95.4 2.0 95.2 3.0 95.0 4.0 94.8
        85.0 5.0 94.6. 6.0 94.5 7.0 94.3 8.0 94.1 9.0 93.9 10.0 93.9
        85.0 11.0 93.9 12.0 93.9 13.0 94.9 14.0 95.3 15.0 95.4 16.096.23
        85.0 16.796.23 16.897.86
NS      85.0         .30        .30     23.80     22.90     22.90     22.90
NS      85.0       23.80      37.70     37.60     73.60     78.60     73.60
NS      85.0       72.60        .30     .30         .30       .30       .30
NS      85.0         .30        .30
CAL1    85.0       96.23      45.10.    45.10
VEL1    85.0              0.00 0.00 0.00  .05  .37 1.84 2.36 3.50 4.44 3.18
VEL1    85.0 2.78 1.70  .41   .10   .05
CAL2    85.0       96.06      36.10     36.10
VEL2    85.0
VEL2    85.0
CAM     85.0       95.90      25.10     25.10
VEL3    85.0
VEL3    85.0
CAL4    85.0       95.64      13.00     13.00
VEL4    85.0
VEL4    85.0
XSEC    86.0       50.0 .50       94.76      .00250
        86.0 -.396.23 0.096.26 1.0 95.4 2.0 95.2 3.0 95.0 4.0 94.8
        86.0 5.0 94.6 6.0 94.5 7.0 94.3 8.0 94.1 9.0 93.9 10.0 93.9
        86.0 11.0 93.9 12.0 93.9 13.0 94.9 14.0 95.3 15.0 95.4 16.096.23
        86.0 16.796.23 16.897.86
NS      86.0         .30        .30     23.80     22.90     22.90     22.90
NS      86.0       23.80      37.70     37.60     73.60     78.60    .73.60
NS      86.0       72.60        .30       .30       .30       .30       .30
NS      86.0         .30        .30
```

Appendix Hl - IFG4 Input Files, Early Winters Creek Site (continued)

```
CAL1    86.0        96.23     45.10     45.10
VEL1    86.0                  0.00 0.00 0.00  .05  .37 1.84 2.36 3.50 4.44 3.18
VEL1    86.0 2.78 1.70  .41  .10    .05
CAL2    86.0        96.06     36.10     36.10
VEL2    86.0
VEL2    86.0
CAL3    86.0        95.90     25.10     25.10
VEL3    86.0
VEL3    86.0
CAL4    86.0        95.64     13.00     13.00
VELA    86.0
VEL4    86.0
ENDJ
```

Appendix H2 - Summary of Calibration Details, Early Winters Creek Site

EARLY WINTERS CREEK SITE
Calibration Information for Calculated Discharge

Transect Number					
	3	4	5	6	7
Discharge					
	189	233	209	227	219
	126	159	137	142	136
	69	101	98	77	77
	33	52	32	28	54
Stage					
	94.69	95.74	96.40	96.56	96.80
	94.52	95.41	96.11	96.22	96.43
	94.20	95.12	95.83	95.92	96.09
	93.71	94.65	95.41	95.44	95.61
Plotting Stage					
	3.09	2.54	2.80	2.96	2.90
	2.92	2.21	2.51	2.62	2.53
	2.60	1.92	2.23	2.32	2.19
	2.11	1.45	1.81	1.84	1.71
Ratio of measured versus predicted discharge					
	1.117	1.021	0.941	0.977	1.108
	0.955	1.014	0.981	1.049	0.987
	0.878	0.940	1.170	0.976	0.819
	1.068	1.028	0.926	1.000	1.116
Mean error of stage/discharge relationship for calculated Q					
	8.85	3.12	7.69	2.39	10.88
Mean error of stage/discharge relationship for given Q					
	12.04	6.32	5.17	5.36	4.39
Stage/discharge relationship (S vs Q) S=A*Q**B+SZF					
A=	0.9754	0.3389	0.7933	0.867	0.3972
B =	0.2247	0.3709	0.2333.	.2251	0.3761
SZF=	91.60	93.20	93.60	93.60	93.90
Beta coefficient log/log discharge/stage relationship					
	4.45	2.70	4.29	4.44	2.66

Appendix H2 - Summary of Calibration Details, Early Winters Creek Site (cont.)

EARLY WINTERS CREEK SITE (Transect 8 Channels)
Calibration Information for Calculated Discharge

Transect Number					
	8-1	8-2	8-3	8-4	8-5
Discharge					
	97.3	14.6	16.2	50.2	44.2
	56.7	6.7	8.9	36.3	36.1
	31.2	4.1	3.1	19.7	25.1
	9.8	0.5	8.1	13.0	
Stage					
	95.50	98.17	98.73	96.69	96.23
	95.30	97.96	98.60	96.63	96.06
	95.10	97.80	98.50	96.55	95.90
	94.70	97.52	96.37	95.64	
Plotting Stage					
	1.88	1.17	0.52	1.03	1.47
	1.68	0.96	0.39	0.97	1.30
	1.48	0.80	0.29	0.89	1.14
	1.12	0.52	0.71	0.88	
Ratio of measured versus predicted discharge					
	1.030	0.918	0.933	1.069	0.956
	0.990	0.958	1.147	1.035	1.054
	0.952	1.249	0.935	0.855	1.009
	1.025	0.910	1.058	0.983	
Mean error ofstage/dischargerelationship for calculatedQ					
	2.98	10.78	9.01	8.05	3.10
Mean error of stage/dischargerelationship for given Q					
	4.82	9.82	11.01	7.82	2.48
Stage/dischargerelationship (S vs Q)S=A*Q**B+SZF					
A=	0.6706	0.6008	0.1882	0.4672	0.3052
B=	0.2269	0.2409	0.3562	0..2053	0.4101
SZF=	93.62	97.00	98.21	95.66	94.76
Betacoefficient log/logdischarge/stagerelationship					
	4.41	4.15	2.81	4.87	2.44

Appendix H3 - Data Changes for Calibration, Early Winters Creek Site

TRANSECT	VERTICAL	VEL	CHANGE
3	8	1	4.07 TO3.87
3	8	4	0.40 TO 0.60
3	15	3	0.68 TO 0.88
3	15	4	0.22 TO 0.00
4	8	4	0.28 TO 0.48
4	15	3	0.34 TO 0.54
4	15	4	0.16 TO 0.00
5	5	3	0.76 TO 0.96
6	11	4	0.15 TO 0.00
6	13	4	0.13TO 0.33
7	6	1	3.81 TO 3.61
7	6	3	0.76 TO 0.96
7	9	1	4.25 TO 4.05
7	9	4	1.09 TO 1.29
7	15	1	5.33 TO 5.13
7	15	4	1.23 TO 1.43
8-1	24	4	0.13 TO 0.00
8-3	4	1	0.30 TO 0.50
8-3	6	4	0.09 TO 0.29
8-4	6	4	0.00 TO 0.20
8-4	7	4	0.07 TO 0.13

Appendix H4 - Velocity Adjustment Factors, Early Winters Creek Site

Transect	Discharge	VAF
3.00	15.0	1.011
3.00	40.0	0.989
3.00	80.0	1.028
3.00	125.0	1.029
3.00	225.0	0.988
3.00	575.0	0.805
4.00	15.0	0.913
4.00	40.0	1.007
4.00	80.0	1.033
4.00	125.0	1.029
4.00	225.0	0.982
4.00.	575.0	0.809
5.00	15.0	0.902
5.00	40.0	0.998
5.00	80.0	0.991
5.00	125.0	1.011
5.00	225.0	1.026
5.00	575.0	1.012
6.00	15.0	0.857
6.00	40.0	0.995
6.00	80.0	1.033
6.00	125.0	1.040
6.00	225.0	1.014
6.00	575.0	0.882
7.00	15.0	0.967
7.00	40.0	1.046
7.00	80.0	1.059
7.00	125.0	1.042
7.00	225.0	0.979
7.00	575.0	0.798

APPENDIX I

TRANSECT WEIGHTING

Appendix I Transect Weighting .

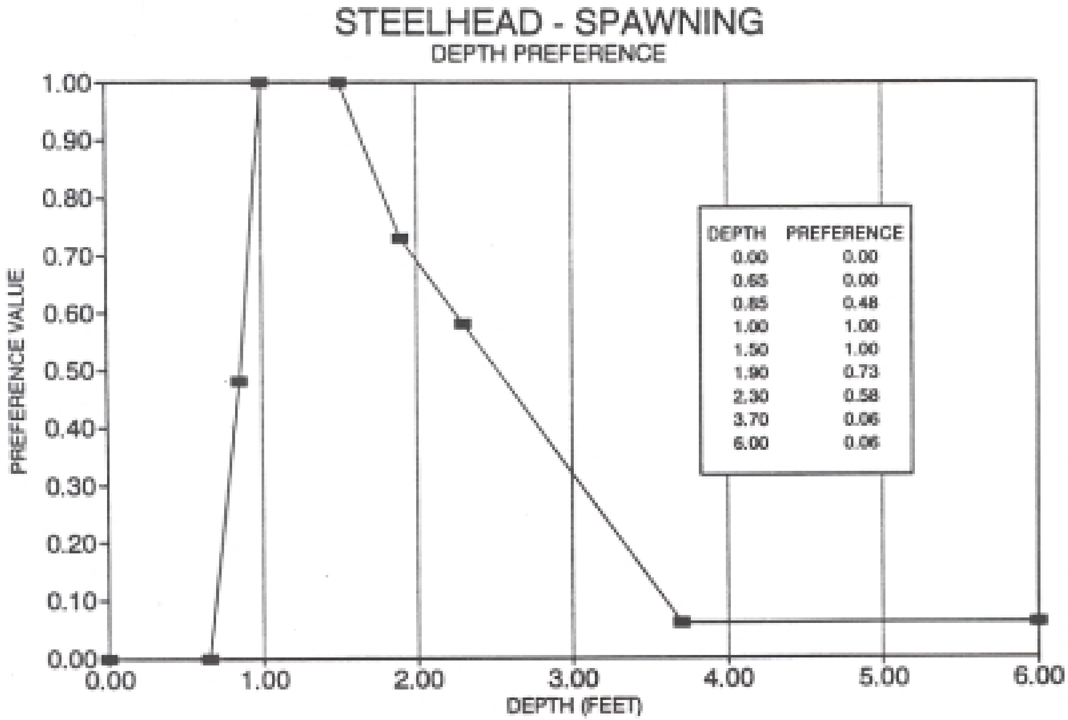
Transect Weighting as a Percent of the Total Site

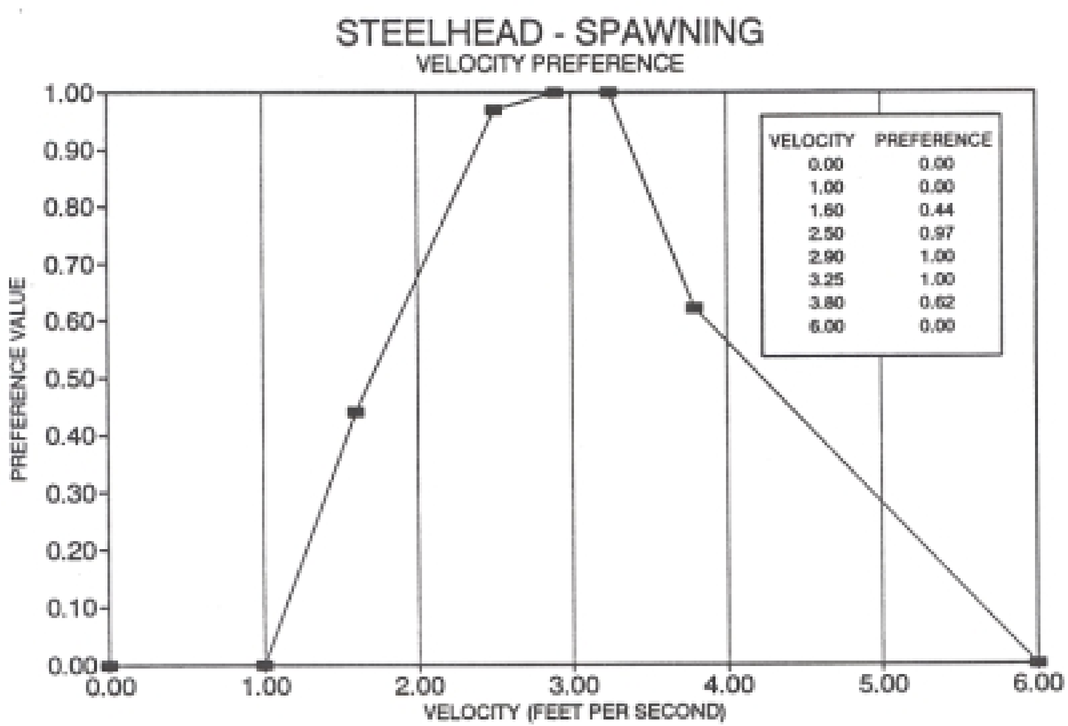
Site	Transect Number 1	2	3	4	5	6	7	8
Walsh	7.2	11.5	10.6	14.0	14.1	14.8	18.0	9.7
KOA	9.3	16.2	16.8	14.8	10.7	10.3	13.3	8.7
Weeman	10.3	17.8	14.9	13.9	9.6	10.8	15.2	7.5
Chokecherry	10.8	19.0	14.7	12.3	12.8	11.6	11.7	7.0
Twisp	6.5	15.9	13.4	7.3	8.7	10.5	21.5	16.3
Chewuch	5.5	15.3	17.5	15.5	17.2	19.2	9.8	
Early Winters			17.0	16.7	18.4	20.1	12.8	15.0

APPENDIX J

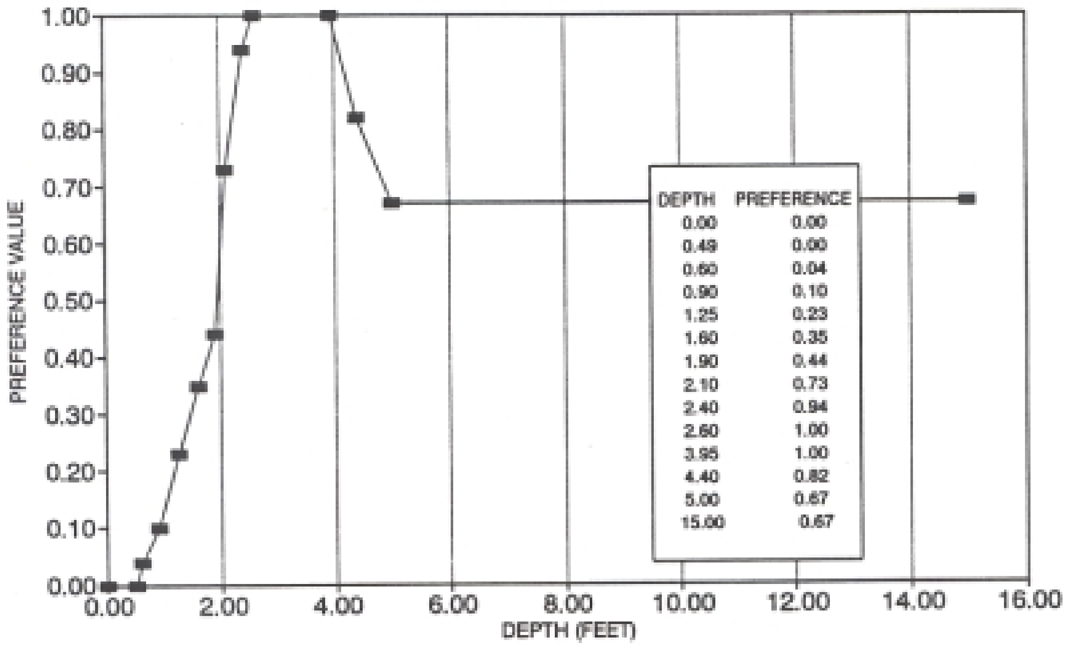
FISH HABITAT-USE CURVES AND SUBSTRATE CODE

Appendix J1 Depth and Velocity Habitat-Use Curves

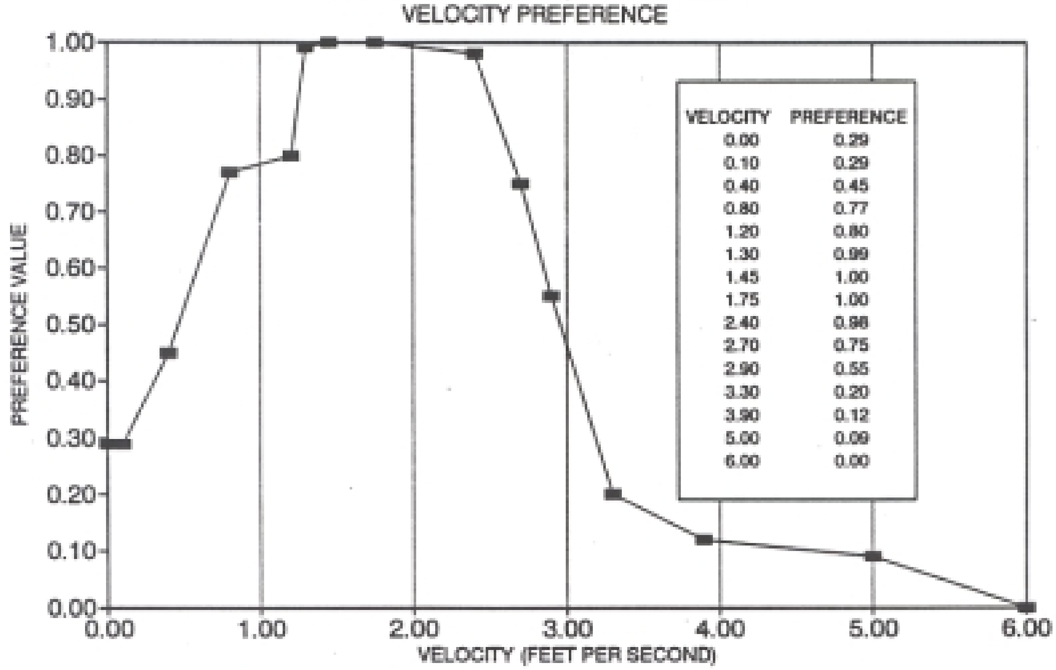


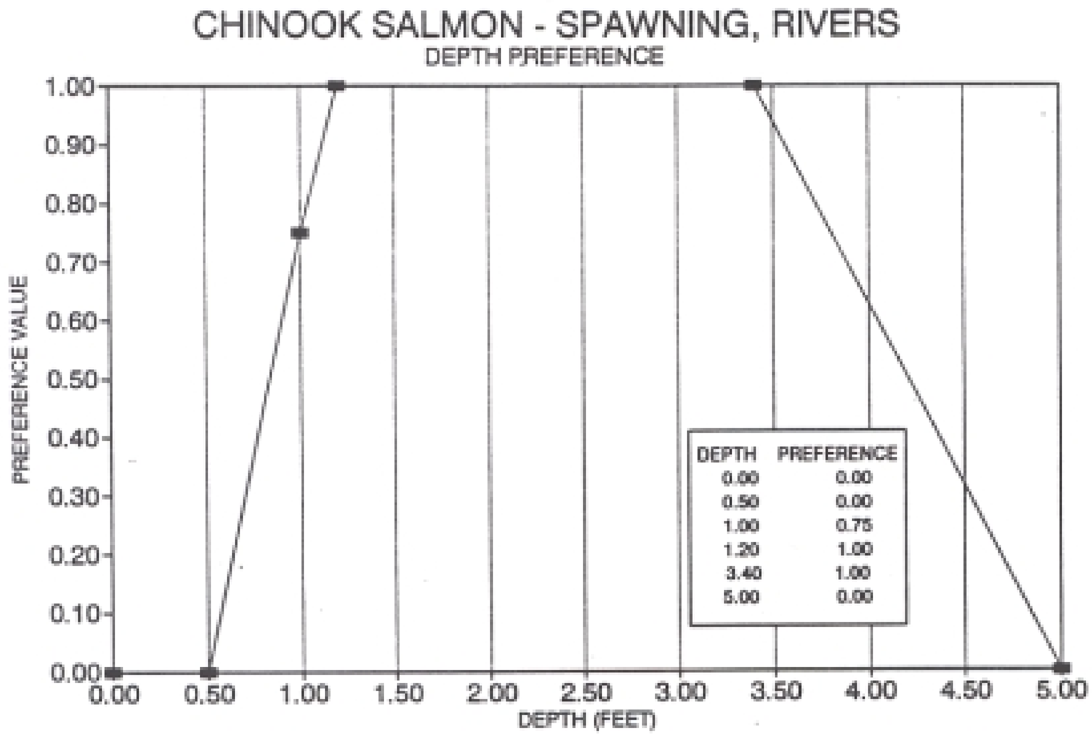


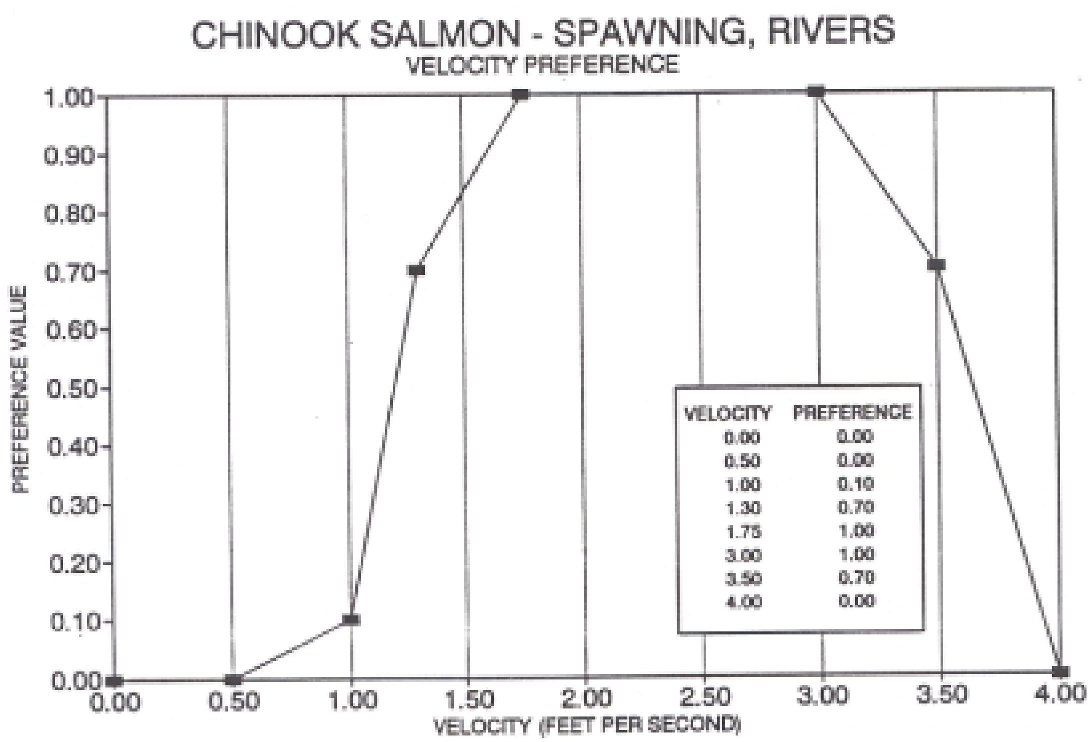
STEELHEAD - JUVENILE
DEPTH PREFERENCE

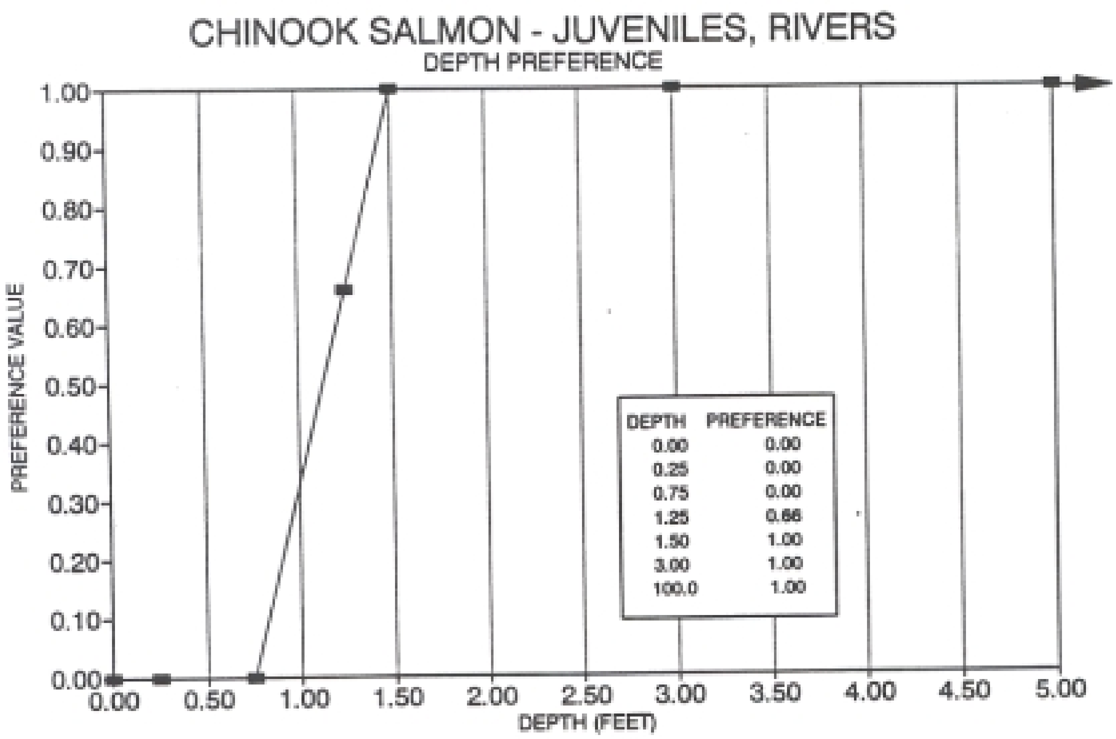


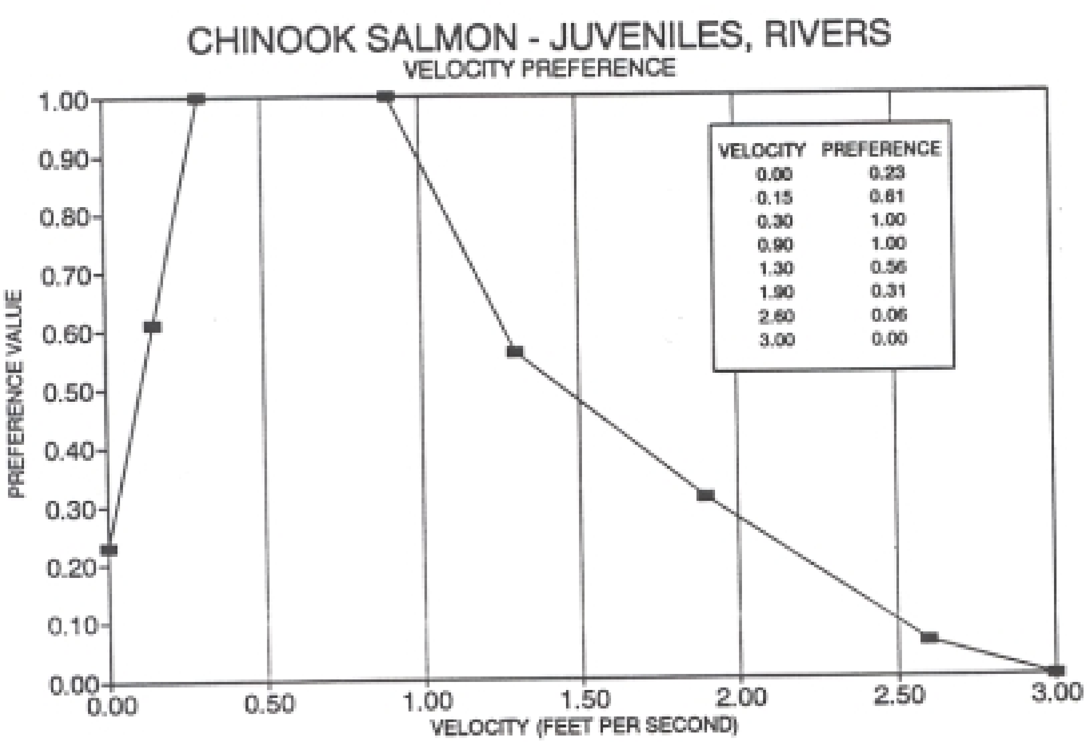
STEELHEAD - JUVENILE
VELOCITY PREFERENCE

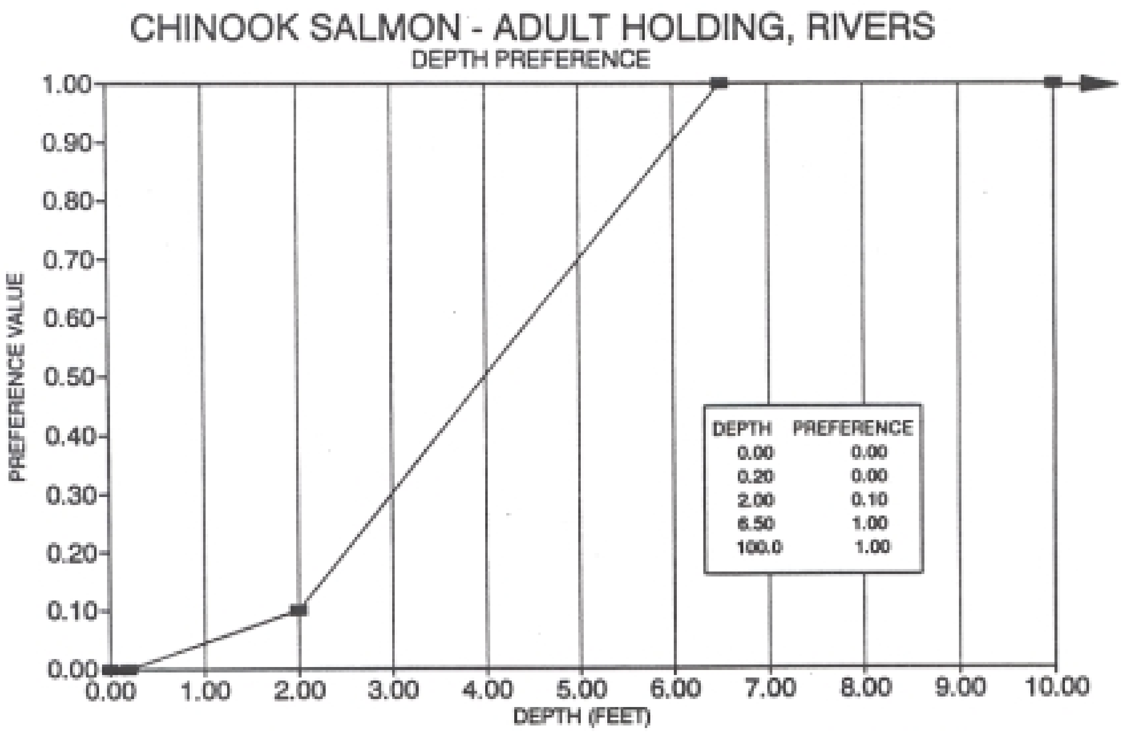



CHINOOK SALMON - SPAWNING, RIVERS
DEPTH PREFERENCE
PREFERENCE VALUE
DEPTH (FEET)
DEPTH PREFERENCE
0.00 0.00
0.50 0.00
1.00 0.75
1.20 1.00
3.40 1.00
5.00 0.00


CHINOOK SALMON - SPAWNING, RIVERS
VELOCITY PREFERENCE
PREFERENCE VALUE
VELOCITY (FEET PER SECOND)
VELOCITY PREFERENCE
0.00 0.00
0.50 0.00
1.00 0.10
1.30 0.70
1.75 1.00
3.00 1.00
3.50 0.70
4.00 0.00


CHINOOK SALMON - JUVENILES, RIVERS
DEPTH PREFERENCE
PREFERENCE VALUE
DEPTH (FEET)
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.00 0.50 1.00 1.50 2.00 2.50 3.00 3.50 4.00 4.50 5.00
DEPTH PREFERENCE
0.00 0.00
0.25 0.00
0.75 0.00
1.25 0.66
1.50 1.00
3.00 1.00
100.0 1.00


CHINOOK SALMON - JUVENILES, RIVERS
VELOCITY PREFERENCE
PREFERENCE VALUE
VELOCITY (FEET PER SECOND)
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.00 0.50 1.00 1.50 2.00 2.50 3.00
VELOCITY PREFERENCE
0.00 0.23
0.15 0.61
0.30 1.00
0.90 1.00
1.30 0.56
1.90 0.31
2.60 0.06
3.00 0.00


CHINOOK SALMON - ADULT HOLDING, RIVERS
DEPTH PREFERENCE
PREFERENCE VALUE
DEPTH (FEET)
DEPTH PREFERENCE
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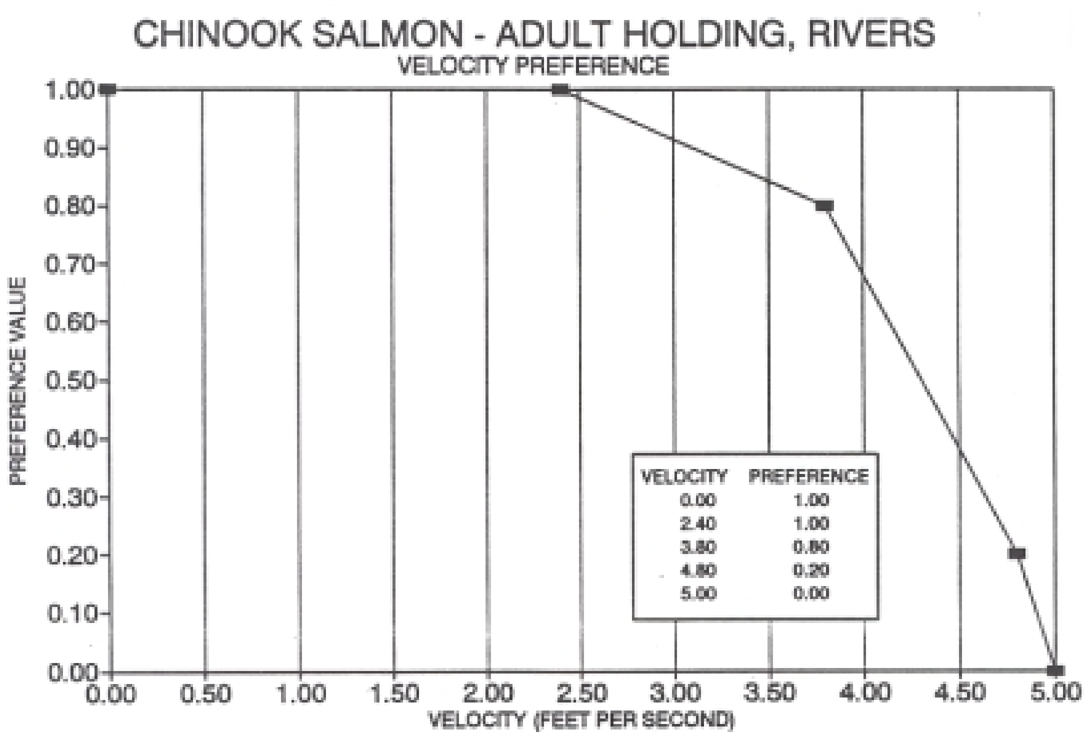
0.20 0.00
2.00 0.10
6.50 1.00
100.0 1.00


CHINOOK SALMON - ADULT HOLDING, RIVERS
VELOCITY PREFERENCE
PREFERENCE VALUE
VELOCITY (FEET PER SECOND)
VELOCITY PREFERENCE
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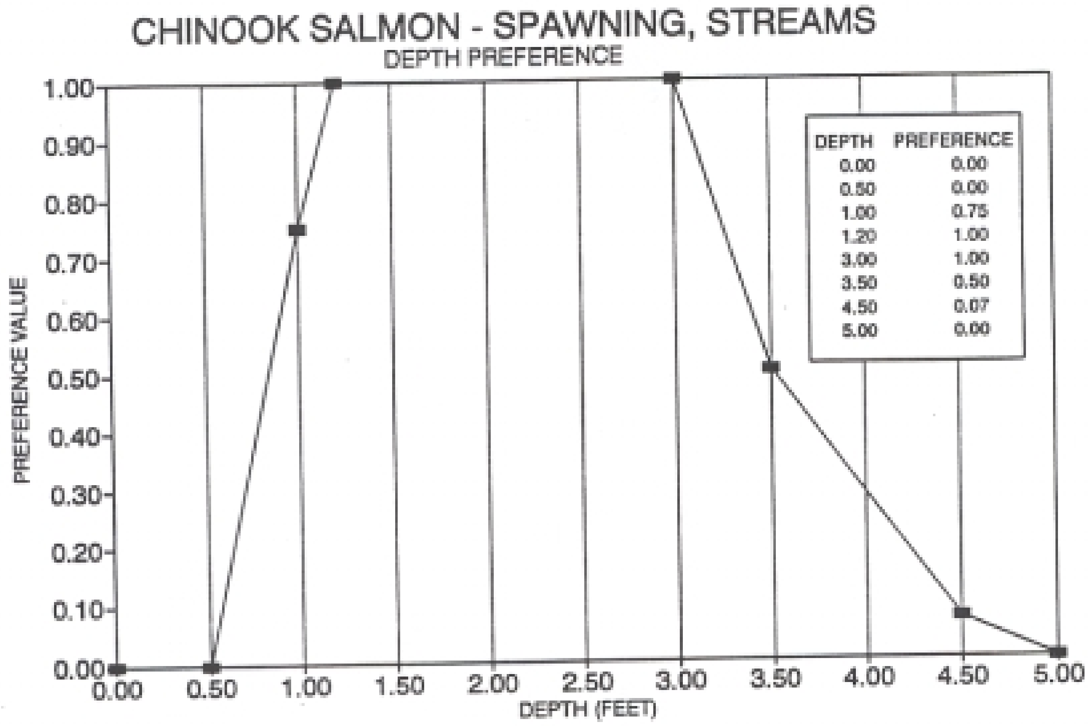
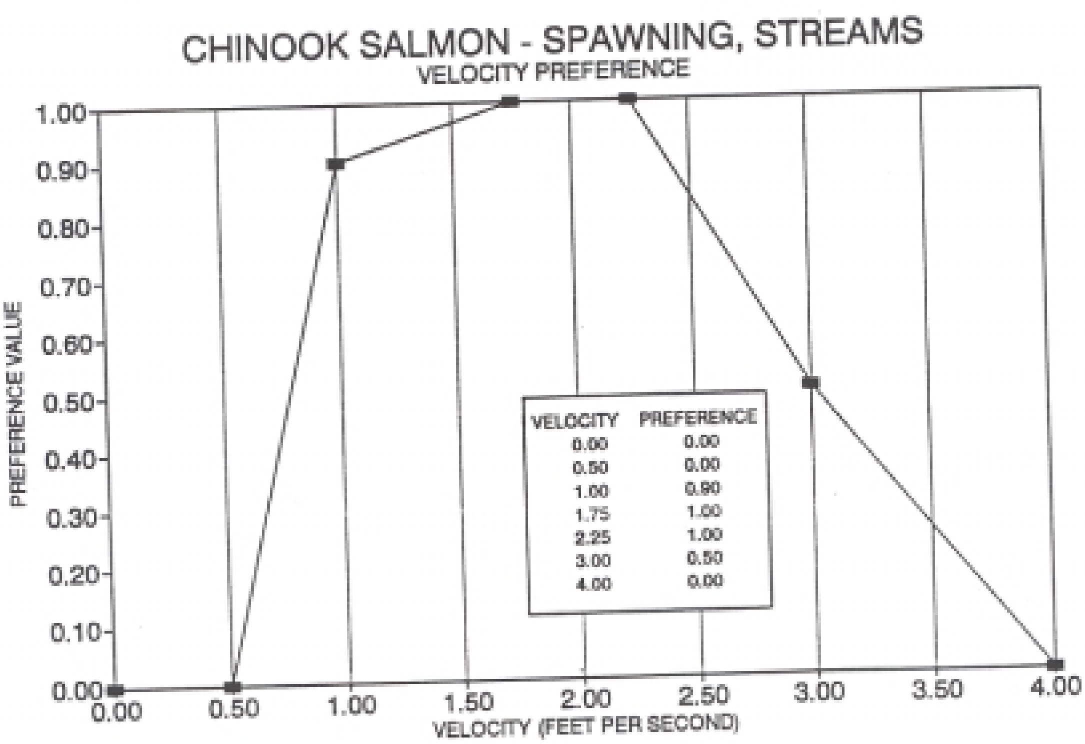
3.80 0.80
4.80 0.20
5.00 0.00


CHINOOK SALMON - SPAWNING, STREAMS
DEPTH PREFERENCE
PREFERENCE VALUE
DEPTH (FEET)
DEPTH PREFERENCE
0.00 0.00
0.50 0.00
1.00 0.75
1.20 1.00
3.00 1.00
3.50 0.50
4.50 0.07
5.00 0.00


CHINOOK SALMON - SPAWNING, STREAMS
VELOCITY PREFERENCE
PREFERENCE VALUE
VELOCITY (FEET PER SECOND)
VELOCITY PREFERENCE
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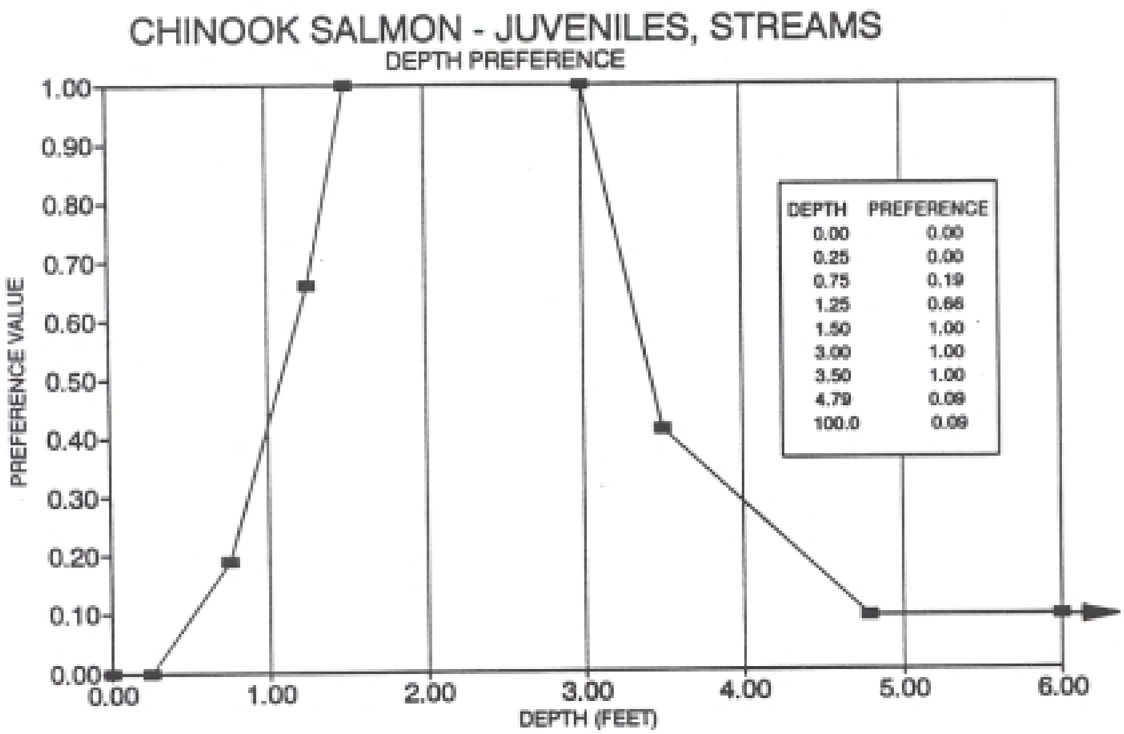
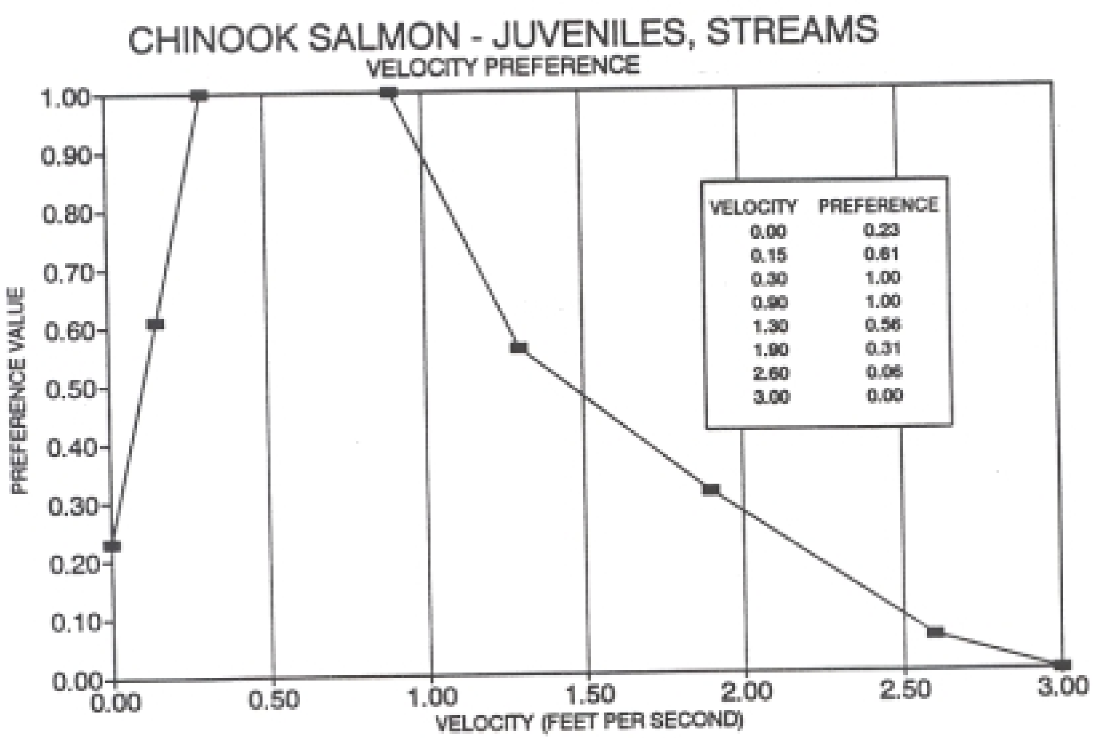
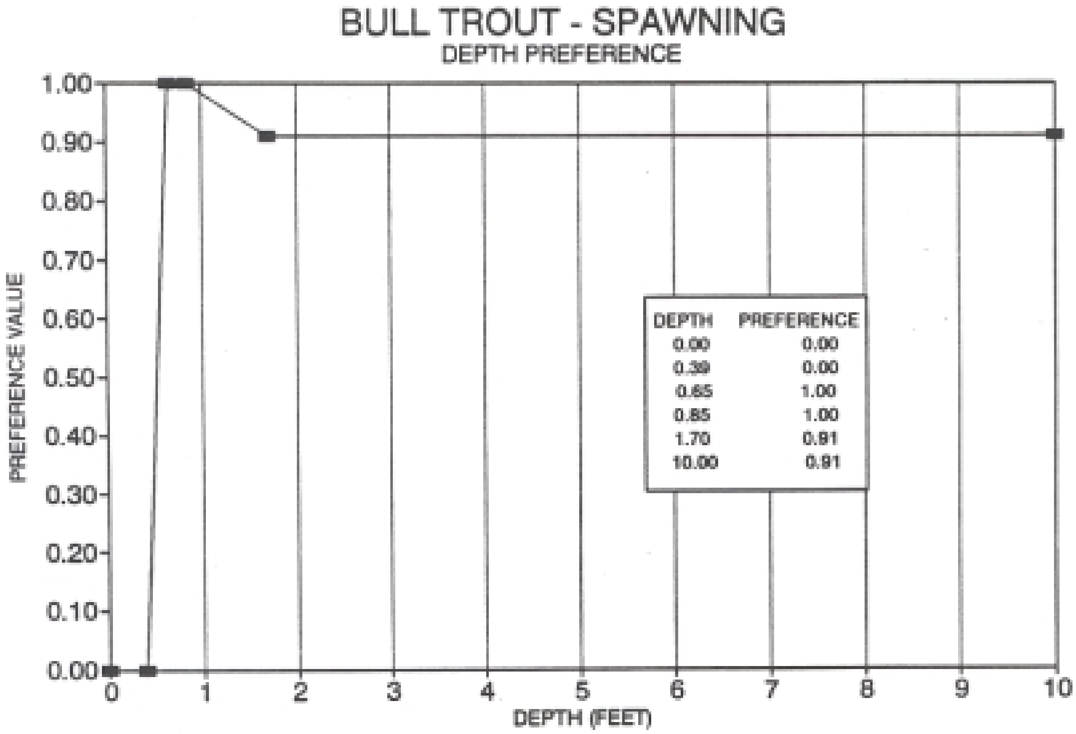
0.50 0.00
1.00 0.90
1.75 1.00
2.25 1.00
3.00 0.50
4.00 0.00


CHINOOK SALMON - JUVENILES, STREAMS
DEPTH PREFERENCE
PREFERENCE VALUE
DEPTH (FEET)
DEPTH PREFERENCE
0.00 0.00
0.25 0.00
0.75 0.19
1.25 0.66
1.50 1.00
3.00 1.00
3.50 1.00
4.79 0.09
100.0 0.09
0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00
0.00 1.00 2.00 3.00 4.00 5.00 6.00


CHINOOK SALMON - JUVENILES, STREAMS
VELOCITY PREFERENCE
PREFERENCE VALUE
VELOCITY (FEET PER SECOND)
VELOCITY PREFERENCE
0.00 0.23
0.15 0.61
0.30 1.00
0.90 1.00
1.30 0.56
1.90 0.31
2.60 0.06
3.00 0.00
0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00
0.00 0.50 1.00 1.50 2.00 2.50 3.00


BULL TROUT - SPAWNING
DEPTH PREFERENCE
PREFERENCE VALUE
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0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0 1 2 3 4 5 6 7 8 9 10
DEPTH (FEET)
DEPTH PREFERENCE
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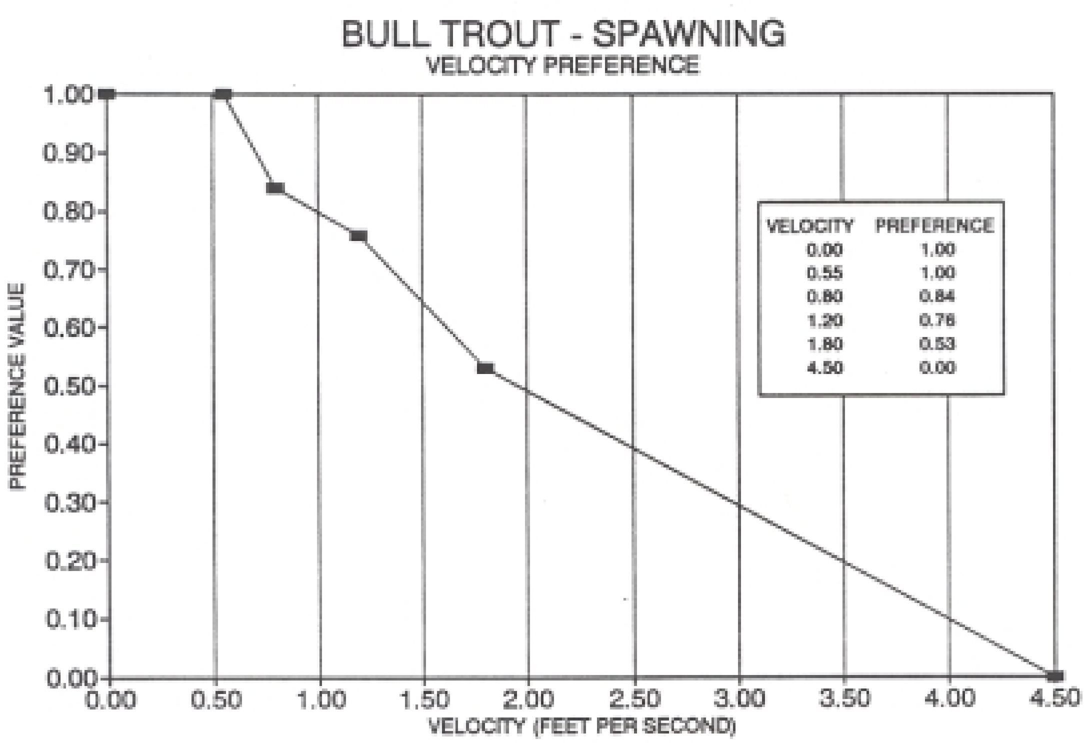
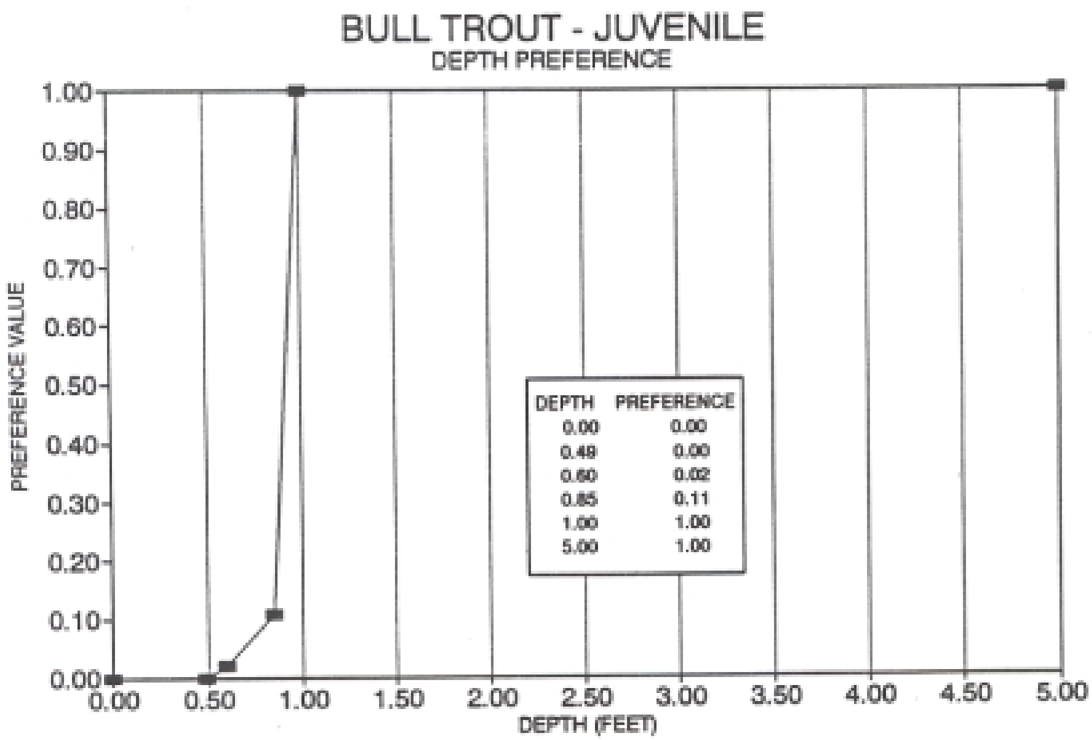
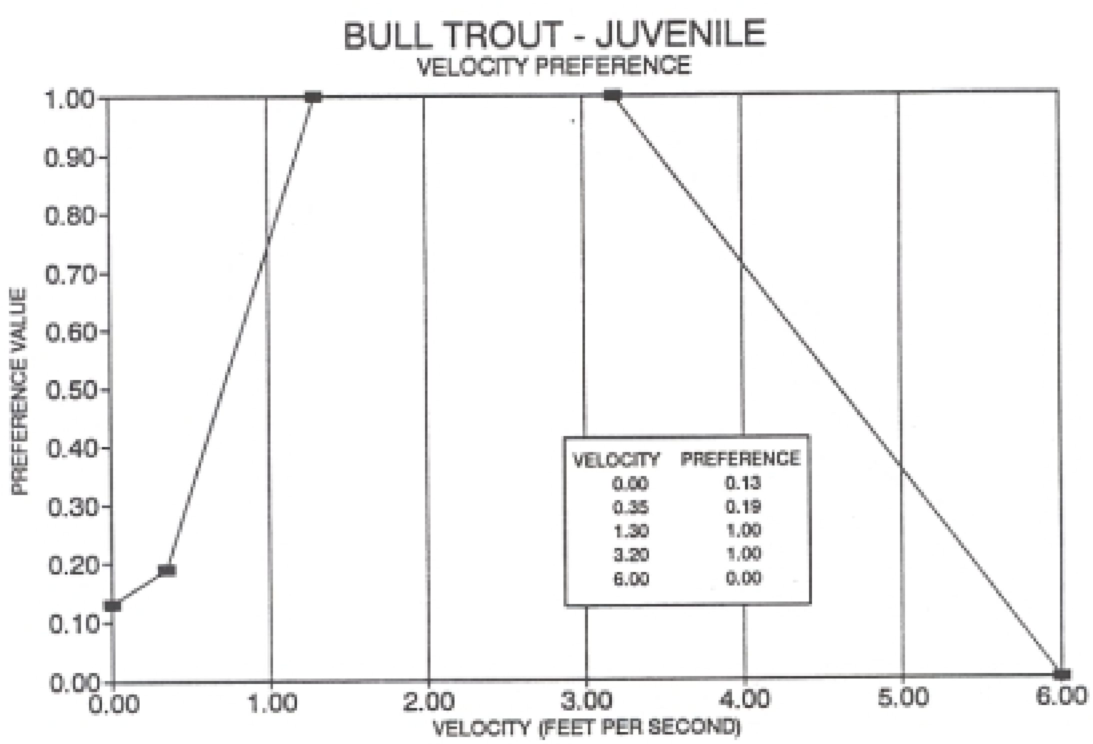
0.39 0.00
0.65 1.00
0.85 1.00
1.70 0.91
10.00 0.91


BULL TROUT - SPAWNING
VELOCITY PREFERENCE
PREFERENCE VALUE
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.00 0.50 1.00 1.50 2.00 2.50 3.00 3.50 4.00 4.50
VELOCITY (FEET PER SECOND)
VELOCITY PREFERENCE
0.00 1.00
0.55 1.00
0.80 0.84
1.20 0.76
1.80 0.53
4.50 0.00


BULL TROUT - JUVENILE
DEPTH PREFERENCE
PREFERENCE VALUE
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
DEPTH PREFERENCE
0.00 0.00
0.49 0.00
0.60 0.02
0.85 0.11
1.00 1.00
5.00 1.00
0.00 0.50 1.00 1.50 2.00 2.50 3.00 3.50 4.00 4.50 5.00
DEPTH (FEET)


BULL TROUT - JUVENILE
VELOCITY PREFERENCE
PREFERENCE VALUE
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
VELOCITY PREFERENCE
0.00 0.13
0.35 0.19
1.30 1.00
3.20 1.00
6.00 0.00
0.00 1.00 2.00 3.00 4.00 5.00 6.00
VELOCITY (FEET PER SECOND)

Appendix JS Substrate/Cover Code

DEPARTMENT OF FISHERIES & WILDLIFE
INSTREAM FLOW STUDIES SUBSTRATE AND COVER CODE APPLICATION 11/23/87

The three-digit code used describes the dominant substrate (the first number), the subdominant substrate (the second number), and the percent of only the dominant substrate (the third number). The percent of the subdominant substrate can be determined by subtraction. Dominant substrate is determined by the largest quantity of a certain substrate, not be the size of the substrate. The sum of the percent dominant and the percent subdominant will total 100 percent. The coding will not allow the dominant percent to be less than 50 percent, or greater than 90 percent. All other preference values are determined by using weighted averages. The value of the dominant substrate is multiplied by the percent of the dominant substrate, and the product is added to the product of the subdominant substrate times the percent of subdominant substrate. The sum of all the codes observed times their preference value will be a value between 0.0 and 1.0. The coding should also give a preference value of zero for the entire substrate observation when the code is class zero, one, or two, and is 50 percent of more of the observation. Where there is a situation where addition of two values could equal more than 1.0, the value will default the 1.0. Overhanging vegetation should be counted as cover if it is within 3 to 4 feet of the water surface. Cover values should be incorporated with the substrate values for both salmon and steelhead juvenile life stages and for chinook and steelhead adult holding.

LIFE STAGE AND VALUE OF SUBSTRATE

		SALMON			**STEELHEAD & TROUT**			
CODE	**Substate Size in inches**	**Juvenile Rearing**	**Spawning**	**Adult Holding**	**Steelhead**	**Trout**	**Juvenile & Adult**	**Steelhead Adult**
0 Detritus		.1	0	.1	0	0	.1	.1
1 Silt, Clay		.1	0	.1	0	0	.1	.1
2 Sand		.1	0	.1	0	0	.1	.1
3 Small Gravel	.1-0.5	.1	.3	.1	.5	1	.1	.1
4. Medium Gravel	.5-1.5	.3	1	.3	1.0	1	.3	.3
5 Large Gravel	1.5-3.0	.3	1	.3	1.0	1	.3	.3
6 Small Cobble	3.0-6.0	.5	1	.3	1.0	.5	.5	.3
7 Large Cobble	6.0-12.0	.7	.3	.3	3	0	.7	.3
8 Boulder		1.0	0	1.0	0	0	1.0	1.0
9 Bedrock		.3	0	.3	0	0	.3	.3
0.1 Undercut Bank		1.0	0	1.0	0	0	1.0	1.0
0.2 Overhanging Vegetation		1.0	0	1.0	0	0	1.0	1.0
0.3 Root Wad		1.0	0	1.0	0	0	1.0	1.0
0.4 Log Jam		1.0	0	1.0	0	0	1.0	1.0
0.5 Log Instream		.8	0	.8	0	0	.8	.3
0.6 Submerged Vegetation		1.0	0	.8	0	0	1.0	.8
0.8 Grass/Bushes Up on Bank		.1	0	.1	0	0	.1	.1
0.9 Fine Organic Substrate		.1	0	.1	0	0	.1	.1

(* 0.6 for chinook Spawing can be used, depending on river size)

APPENDIX K

IRRIGATION CANAL FLOWS AND RIVER FLOWS

Appendix K1 Flows Measured by Hpsey and Assoc. in Methow River in 1990.

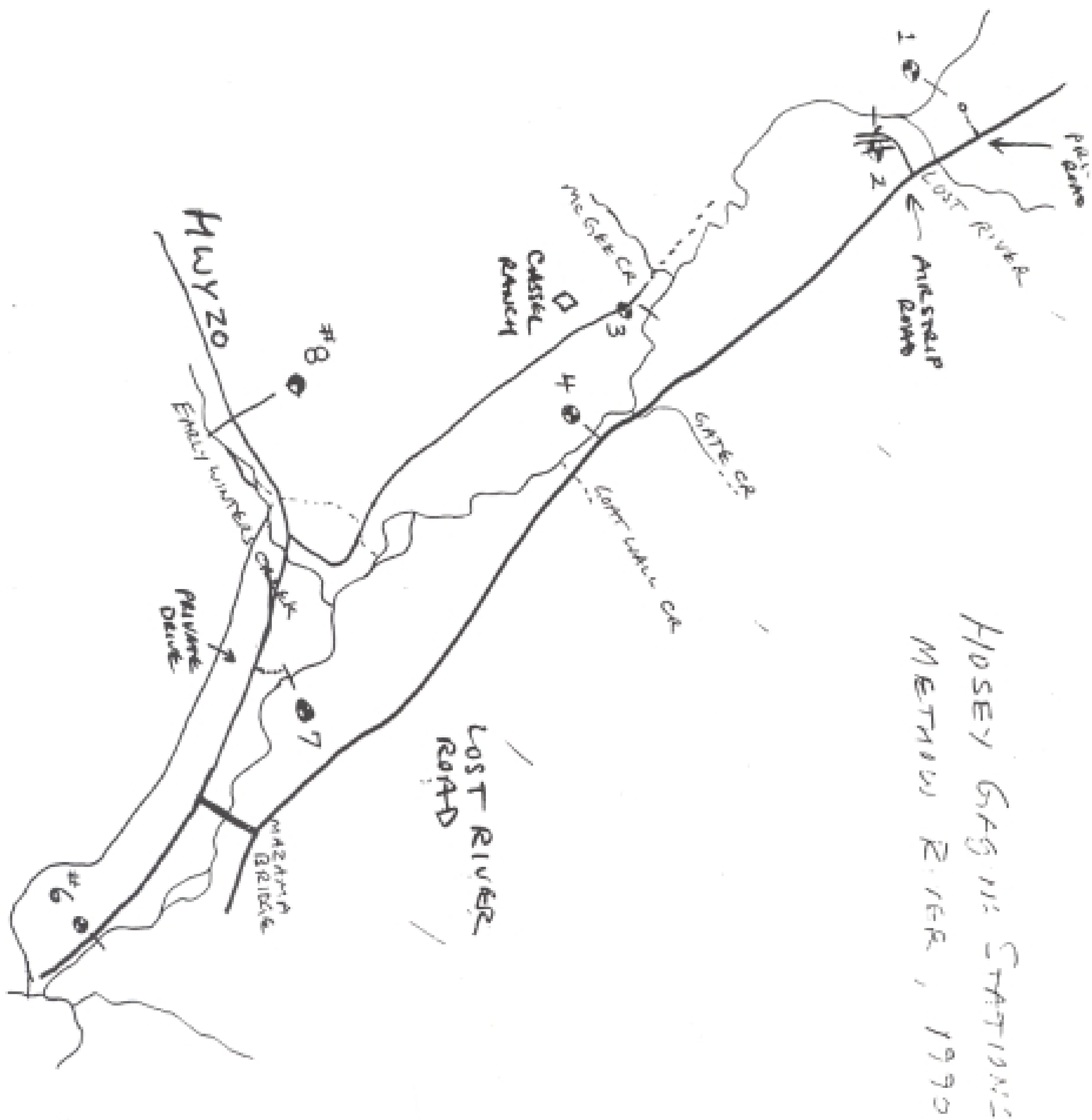
Hosey & Associates
ENGINEERING COMPANY

PROJECT: ______ BY: ______ DATE: __

JOB #: ______ CHKD. BY: ______ DATE: __

CLIENT: ______ PAGE: ______ OF ____

SUBJECT: ______



Appendix K1 Flows Measured by Hosey and Assoc. in Methow River in 1990 (continued)

Early Winters Staff Gauge Data. !!!PRELIMINARY!!! 13NOV90
1990

Month	**Day**	Methow Above Lost Gage1 River RM 73.1		Methow R. Below Gage2 Lost R. RM 72.9		Methow R. Above Gage 3 Gate Cr. RM 708	
		Staff	**Q1**	**Staff**	**Q2**	**Staff**	**Q3**
Jul	20-Jul	2.90	111	2.86	370	2.80	335
	21-Jul						
	27-Jul	2.62	72	2.68	300	2.66	2.80
Aug	3-Aug	2.37	44	2.29	177		
	4-Aug					2.24	152
	7-Aug	2.29	36	2.19	151	2.10	121
	10-Aug	2.20	28	2.10	1.31	1.98	98
	15-Aug	2.06	18	2.00	110	1.87	80
	17-Aug	2.12	22	1.95	100	1.79	68
	18-Aug						
	19-Aug			2.07	124		
	20-Aug					1.90	84
	22-Aug	2.60	69	2.40	207	2.36	183
	24-Aug	2.37	44	2.17	147	2.09	119
	25-Aug						
	27-Aug	2.26	33				
	28-Aug						
	29-Aug						
	30-Aug			2.00	110	1.86	78
Sep	4-Sep	2.12	22	1.92	94	1.71	58
	5-Sep						
	6-Sep						
	7-Sep						
	8-Sep						
	11-Sep	2.07	15	1.77	69	1.47	33
	12-Sep			1.74	65	1.45	32
	13-Sep						
	14-Sep						
	15-Sep	1.96	12	1.70	59	1.36	25
	16-Sep						
	17-Sep					1.34	24
	18-Sep			1.67	55		
	19-Sep						
	20-Sep	1.92	10	1.63	50	1.28	20
	21-Sep					1.17	14
	22-Sep						
	23-Sep	1.85	7	1.57	43	1.14	13
	24-Sep			1.56	42	1.10	11
	25-Sep	1.85	7	1.57	43	1.10	11
	27-Sep	1.82	5	1.53	39	0.97	7
Oct	1-Oct						
	2-Oct	1.82	5	1.48	34	0.77	3
	3-Oct						
	4-Oct	2.44	51	1.97	104	1.72	59
	5-Oct	2.42	49	195	100	1.71	58
	6-Oct						
	7-Oct						

Month	Day	Methow Above Lost Gage1 River RM 73.1		Methow R. Below Gage2 Lost R. RM 72.9		Methow R. Above Gage 3 Gate Cr. RM 708	
		Staff	**Q1**	**Staff**	**Q2**	**Staff**	**Q3**
	8-Oct						
	9-Oct	2.19	27	1.73	64	1.42	29
	12-Oct	2.19	27	1.72	62	1.40	28
	16-Oct	2.19	27	1.68	57	1.36	25
	22-Oct						
	31-Oct	2.37	44	1.84	81	1.58	43
Nov	9-Nov	2.85	103	2.27	171	1.97	96

Appendix K1 Flows Measured by Hosey and Assoc. in Methow River in 1990 (continued)

Early Winters Staff Gauge Data. !!!PRELIMINARY!!! 13NOV90
1990

Month	Day	Methow Below Gage4 Gate c. RM 69.3		Methow R. Below Gage7 Early Winters RM66.8		Methow R. Below Mazama Gage 6 Rm 63.8 same as USGS	
		Staff	**Q1**	**Staff**	**Q2**	**Staff**	**Q3**
Jul	20-Jul	3.60	335				
	21-Jul			2.41	450	3.10	495
	27-Jul	3.42	251	2.30	400	2.98	424
Aug	3-Aug			1.86	234	259	233
	4-Aug	3.09	133				
	7-Aug	3.00	109	1.67	1.78		
	10-Aug	2.87	79	1.50	136	2.30	129
	15-Aug	2.75	56	1.40	114	2.22	106
	17-Aug	2.77	60	1.32	98	2.17	93
	18-Aug			1.66	176		
	19-Aug	2.86	77				
	20-Aug						
	22-Aug	3.22	174	1.95	264	2.70	281
	24-Aug	2.98	104	1.65	173	2.46	182
	25-Aug					2.44	175
	27-Aug						
	28-Aug						
	29-Aug						
	30-Aug	2.79	63	1.50	1.36		
Sep	4-Sep	2.61	35	1.30	95	2.14	85
	5-Sep	2.59	33				
	6-Sep	2.52	25				
	7-Sep	2.49	22	1.18	74	2.06	67
	8-Sep			1.17	73		
	11-Sep	2.35	11	1.05	55	1.95	45
	12-Sep						
	13-Sep	2.24	5	1.02	51		
	14-Sep			1.00	49		
	15-Sep	2.18	3	0.91	38	1.84	28
	16-Sep	2.23	5	0.92	40		
	17-Sep	2.17	3				
	18-Sep	2.05	1	0.88	35		
	19-Sep						
	20-Sep	1.74	0	0.84	31	1.67	10
	21-Sep	1.04	0	0.82	30		
	22-Sep						
	23-Sep	0.29	0	0.80	28	1.71	13
	24-Sep	0.11	0				
	25-Sep	-0.14	0	0.79	27	1.68	11
	27-Sep	-0.84	0	0.76	24	1.65	9
Oct	1-Oct					1.58	4
	2-Oct	-2.34	0	0.70	20	1.59	5
	3-Oct			0.71	21		
	4-Oct	-2.76	0	1.01	50	1.88	34
	5-Oct	2.485	21	1.09	61	1.95	45
	6-Oct	2.32	9				
	7-Oct	2.27	7				

Appendix K1 Flows Measured by Hosey and Assoc. in Methow River in 1990 (continued)

Early Winters Staff Gauge Data. !!!PRELIMINARY!!! 13NOV90
1990

Month	Day	Early Winters				Gage 9	
		Gage8 Creek RM 1.2		MetBr		EWDIV Lower Diversion	
		Staff	**Q8**	**Staff**	**QMetbr**	**Staff**	**QEWdiv**
Jul	20-Jul						
	21-Jul						
	27-Jul			20.80	STAGE		STAGE
Aug	3-Aug			21.15	vs. Q		vs. Q
	4-Aug				RELATIONSHIP		RELATIONS
	7-Aug			21.40	NOT		NOT
	10-Aug			21.60	YET		YET
	15-Aug			21.60	COMPLETED		COMPLETED
	17-Aug			21.60			
	18-Aug						
	19-Aug						
	20-Aug						
	22-Aug			21.37			
	24-Aug			21.95			
	25-Aug						
	27-Aug						
	28-Aug	1.56	60				
	29-Aug						
	30-Aug						
Sep	4-Sep	1.47	47				
	5-Sep						
	6-Sep						
	7-Sep	1.40	39	21.75		1.03	
	8-Sep	1.37	35	21.90		0.97	
	11-Sep						
	12-Sep						
	13-Sep						
	14-Sep	1.35	33				
	15-Sep	1.32	30				
	16-Sep						
	17-Sep						
	18-Sep						
	19-Sep						
	20-Sep	1.29	28	22.05		0.99	
	21-Sep						
	22-Sep						
	23-Sep	1.27	26	22.00		0.93	
	24-Sep						
	25-Sep	1.27	26	22.10			
	27-Sep	1.25	24	22.16			
Oct	1-Oct						
	2-Oct	1.22	22	22.20			
	3-Oct						
	4-Oct	1.60	66	21.83			
	5-Oct	1.65	75	21.90			
	6-Oct						
	7-Oct						

Month	Day	Early Winters Gage8 Creek RM 1.2		MetBr		Gage 9 EWDIV Lower Diversion	
		Staff	**Q8**	**Staff**	**QMetbr**	**Staff**	**QEWdiv**
	8-Oct						
	9-Oct	1.45	44	21.90			
	12-Oct	1.44	43	21.90			
	16-Oct	1.42	41	21.90			
	22-Oct						
	31-Oct	1.58	63				
Nov	9-Nov	2.15	218				

Appendix K2 Flows Measured by Ecology in Methow Basin in 1991

Miscellaneous measurements of discharge in the Methow River basin during 1991. Original notes are on file in the WRIA 48 folders of the Water Resources Program Library. IFIM site measurements made by Brad Caldwell and crew, others by Art Larson

Walsh IFIM site at Methow River Mile 31.5		
Date	Time	Discharge (cfs)
08/01/91	1700	1437
08/28/91	1000	589
09/24/91	1500	311

KOA IFIM site at Methow River mile 49.0		
Date	Time	Discharge (cfs)
08/02/91	1300	1135
08/29/91	1000	457
09/25/91	1100	229

Weeman IFIM site at Methow River mile 59.0		
Date	Time	Discharge (cfs)
08/03/91	1300	658
08/16/91	1100	380
08/27/91	1600	238
09/26/91	1100	79

Chokecherry IFIM site at Methow River mile 66.5		
Date	Time	Discharge (cfs)
08/04/91	1000	640
08/16/91	1600	349
08/27/91	1000	207
09/26/91	1400	41

Appendix K2 Flows Measured by Ecology in Methow Basin in 1991 (continued)

Methow River above Early Winter cr. at Methow River mile 67.5		
Date	Time	Discharge (cfs)
08/27/91	1330	122
09/26/91	1550	11
10/23/91	1245	2.1

Methow River below Gate Creek at Methow River mile 69.7		
Date	Time	Discharge (cfs)
08/27/91	1100	117
09/26/91	1445	5.5
10/23/91	1200	dry

Methow River below Lost River at Methow River mile 72.9		
Date	Time	Discharge (cfs)
08/27/91	1000	149
09/26/91	1410	45
10/23/91	1045	20

Twisp River near Highway bridge at Twisp River mile 0.3		
Date	Time	Discharge (cfs)
08/29/91	1345	85

Twisp IFIM site at Twisp River mile 1.8		
Date	Time	Discharge (cfs)
08/05/91	0900	308
08/17/91	0900	166
08/29/91	1200	90
09/25/91	1500	35

Appendix K2 Flows Measured by Ecology in Methow Basin in 1991 (continued)

Twisp River below Buttermilk Cr. at Twisp River mile 11.8		
Date	Time	Discharge (cfs)
08/29/91	0945	111
09/25/91	1030	52

Chewack River at Highway bridge at Chewack River mile 0.2		
Date	Time	Discharge (cfs)
08/28/91	1050	115

Chewack IFIM site at Chewack River mile 1.3		
Date	Time	Discharge (cfs)
07/31/91	1500	290
08/15/91	1600	236
08/26/91	1500	121
09/23/91	1600	60

Chewack River near MacPherson bridge at Chewack River mile 7.9		
Date	Time	Discharge (cfs)
0/4/25/91	1130	445

Appendix K2 Flows Measured by Ecology in Methow Basin in 1991 (continued)

Early Winters Creek below bridge at Creek mile 0.2		
Date	Time	Discharge (cfs)
07/18/91	1245	565*
08/27/91	1230	74
09/26/91	1640	23
10/23/91	1200	19

*USGS measurement at staff = 7.93

Early Winters IFIM site at Early Winters Creek mile 1.0		
Date	Time	Discharge (cfs)
08/05/91	1600	227
08/17/91	1300	132
08/30/91	1000	78
09/27/91	1000	37

Lost River at bridg at Lost River mile 0.5		
Date	Time	Discharge (cfs)
04/25/91	1630	494*
07/18/91	1100	565*
08/27/91	0900	116
09/26/91	1330	60
10/23/91	1000	40

*AT STAFF = 1.75 FT
*USGS measurement

Appendix K3 Flows Measured by USGS in Methow in 1991 and 1992

STATION NUMBER 12447383 METHOW RIVER ABOVE GOAT CR NEAR MAZAMA, WA RM 63.8 SOURCE AGENCY USGS
DISCHARGE, CUBIC FEET PER SECOND, YEAR MARCH 1991 TO FEBRUARY 1992
DAILY MEAN VALUES

DAY	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB
1	---	---	985	2870	3330	677	170	22	5.1	18	e.00	e.00
2	---	---	1060	3160	3450	673	156	20	3.8	7.0	e.00	e.00
3	---	---	1180	3030	4170	631	142	18	3.6	4.6	e.00	e.00
4	---	---	1260	2580	4150	629	132	17	2.7	4.3	e.00	e.00
5	---	---	1380	2310	3470	633	125	17	3.6	4.7	e.00	e.00
6	---	---	1450	2470	2870	596	120	15	4.7	7.5	e.00	e.00
7	---	---	1480	2660	2370	646	115	14	3.3	5.8	e.00	e.00
8	---	---	1490	2830	2270	595	111	13	3.4	5.0	e.00	e.00
9	---	---	1410	3010	2340	572	104	12	5.6	5.0	e.00	.00
10	---	---	1310	3410	2420	534	96	11	3.7	7.2	e.00	.00
11	---	---	1420	3750	2350	468	88	9.7	5.4	6.6	e.00	.00
12	---	---	1780	3320	2220	424	80	8.5	50	e.00	e.00	.00
13	---	---	2020	2620	2370	396	75	7.9	36	e.00	e.00	.00
14	---	---	2110	2150	2100	361	74	10	22	e.00	e.00	.00
15	---	---	2070	1860	1740	346	67	12	16	e.00	e.00	7.6
16	---	---	2070	1770	1560	336	61	12	18	e.00	e.00	.02
17	---	---	2220	1650	1420	346	56	11	18	e.00	e.00	4.9
18	---	---	3500	1660	1290	345	51	7.5	14	e.00	e.00	96
19	---	---	4940	1860	1240	326	46	6.8	14	e.00	e.00	136
20	---	785	5450	2570	1190	300	43	6.2	15	e.00	e.00	78
21	---	1000	5460	3440	1190	282	40	6.0	15	e.00	e.00	69
22	---	1370	4690	3350	1250	259	38	7.6	19	e.00	e.00	34
23	---	1580	3930	3270	1280	239	34	7.1	13	e.00	e.00	2.8
24	---	1630	3360	3170	1330	222	30	6.9	8.4	e.00	e.00	2.3
25	---	1510	2860	3230	1400	199	29	6.1	7.8	e.00	e.00	2.6
26	---	1350	2410	3380	1180	180	29	5.8	7.1	e.00	e.00	3.5
27	---	1200	2150	3380	1020	181	27	6.5	7.9	e.00	e.00	5.3
28	---	1080	2140	3460	934	180	26	11	11	e.00	e.00	8.7
29	---	1000	2420	4220	881	177	25	6.0	5.4	e.00	e.00	14
30	---	961	2710	3830	788	180	24	7.3	6.5	e.00	e.00	---
31	---	---	2630	---	711	174	---	7.0	---	e.00	e.00	---
MEAN	---	---	2430	2876	1945	391	73.8	10.6	11.6	2.44	.000	16.0
MAX	---	---	5460	4220	4170	677	170	22	50	18	.00	136
MIN	---	---	985	1650	711	174	24	5.8	2.7	.00	.00	.00

STATION NUMBER 12448500 METHOW RIVER AT WINTHROP, WASH. RM 49.8 SOURCE AGENCY USGS
DISCHARGE, CUBIC FEET PER SECOND, YEAR MARCH 1991 TO FEBRUARY 1992
DAILY MEAN VALUES

DAY	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB
1	540	590	1690	5410	5600	1090	444	227	236	228	223	234
2	535	692	1780	5960	5450	1060	428	229	236	236	223	227
3	540	720	1920	5930	6120	1010	406	226	233	232	221	226
4	529	759	2000	5140	6180	973	388	225	231	226	220	225
5	501	887	2150	4570	5290	966	373	230	235	229	212	220
6	490	947	2280	4870	4500	928	360	234	236	240	214	219
7	480	904	2340	5060	3780	1000	348	232	236	234	189	220
8	474	861	2400	5200	3510	969	341	229	236	233	203	233
9	468	843	2300	5490	3490	916	335	225	236	233	218	225
10	467	807	2160	6100	3560	886	323	229	234	229	224	226
11	461	773	2340	6570	3480	876	314	241	236	227	218	229
12	455	761	2900	6090	3210	854	305	245	273	233	212	230
13	443	781	e3400	4980	3330	846	292	242	292	225	214	236
14	438	840	e3450	4120	3060	790	291	241	269	215	209	243
15	433	903	e3500	3590	2630	750	284	239	254	204	211	279
16	430	930	e3600	3440	2430	710	276	236	253	212	211	282
17	421	957	e3700	3230	2280	698	271	236	258	215	195	268
18	424	1020	e5000	3110	2040	703	269	239	252	223	203	267
19	435	1130	e8000	3280	1920	674	260	243	253	222	214	261
20	458	1330	e9400	4570	1820	635	250	243	271	214	213	259
21	468	1640	9560	6400	1760	606	247	241	259	214	211	264
22	477	2130	8610	6230	1790	572	246	239	239	217	206	267
23	480	2480	7420	6160	1770	544	244	239	241	217	213	267
24	478	2600	6580	5900	1800	524	240	246	239	217	211	266
25	477	2450	5770	5840	1960	494	236	248	239	217	211	266
26	466	2190	4820	5970	1750	468	236	244	237	217	211	271
27	462	2010	4290	5860	1550	455	231	241	236	220	213	282
28	463	1880	4190	5700	1440	467	229	228	233	218	217	290
29	466	1730	4580	6650	1360	459	229	225	235	225	217	302
30	478	1670	5110	6490	1250	464	228	231	213	223	220	---
31	516	---	4990	---	1150	457	---	237	---	223	230	---
MEAN	473	1274	4265	5264	2944	737	297	236	244	223	213	251
MAX	540	2600	9560	6650	6180	1090	444	248	292	240	230	302
MIN	421	590	1690	3110	1150	455	228	225	213	204	189	219

Appendix K3 Flows Measured by USGS in Methow Basin in 1991 and 1992 (continued)

STATION NUMBER 12448998 TWISP RIVER NEAR TWISP, WASH. RM 1.6 SOURCE AGENCY USGS
DISCHARGE, CUBIC FEET PER SECOND, YEAR MARCH 1991 TO FEBRUARY 1992
DAILY MEAN VALUES

DAY	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB
1	183	182	485	1240	1410	289	85	48	52	70	e55	e64
2	184	206	506	1360	1470	297	82	58	52	55	e55	e62
3	185	212	537	1350	1760	277	80	58	52	52	e54	e62
4	187	227	570	1160	1760	267	74	58	52	52	e54	62
5	184	261	625	1040	1470	267	69	58	52	52	e53	61
6	183	277	664	1140	1250	254	65	57	57	52	e52	60
7	178	274	670	1290	1050	275	61	57	57	52	e51	59
8	173	267	673	1320	1010	248	61	56	56	52	e51	58
9	172	263	636	1360	1040	235	61	56	55	53	e51	58
10	172	255	585	1440	1060	229	61	55	55	54	e50	58
11	169	249	603	1570	1060	207	58	55	55	53	e49	58
12	166	245	736	1420	980	187	55	53	66	54	e45	58
13	163	245	869	1130	1040	178	53	52	77	56	e41	59
14	161	249	979	927	954	163	53	50	69	e52	e44	60
15	156	268	982	835	804	155	53	50	63	e50	e47	72
16	155	282	991	799	731	148	53	50	60	e49	e49	72
17	155	294	1060	777	668	148	51	53	60	e50	e50	66
18	151	307	2180	807	601	151	47	53	60	e52	e52	65
19	151	334	3200	815	583	147	42	52	60	e50	e54	65
20	155	385	2860	1500	563	138	42	52	61	e52	e55	62
21	155	485	2600	2060	551	132	42	52	62	e54	e54	64
22	155	619	2180	1620	579	124	40	52	56	e54	e55	64
23	155	720	1860	1510	569	116	40	52	52	e54	e58	64
24	155	758	1560	1460	584	111	40	52	55	e54	e60	64
25	155	720	1310	1430	609	104	39	52	55	e51	e57	64
26	155	659	1120	1430	532	97	39	52	55	e54	e56	64
27	155	607	1000	1350	462	91	38	52	55	e55	e57	65
28	155	560	984	1330	419	90	38	52	54	e53	e58	68
29	155	521	1070	1680	388	89	38	48	53	e53	e61	73
30	156	489	1110	1570	349	89	37	48	58	e54	e63	---
31	165	---	1110	---	309	85	---	51	---	e56	e65	---
MEAN	164	381	1171	1291	859	174	53.2	53.0	57.5	53.4	53.4	63.1
MAX	187	758	3200	2060	1760	297	85	58	77	70	65	73
MIN	151	182	485	777	309	85	37	48	52	49	41	58

STATION NUMBER 12449500 METHOW RIVER AT TWISP, WA RM 40 SOURCE AGENCY USGS
DISCHARGE, CUBIC FEET PER SECOND, YEAR MARCH 1991 TO FEBRUARY 1992
DAILY MEAN VALUES

DAY	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB
1	---	---	2200	6790	7200	1440	525	289	318	299	277	303
2	---	---	2280	7420	7040	1410	505	325	312	315	277	297
3	---	---	2480	7430	7790	1340	486	323	307	302	277	290
4	---	---	2600	6570	7950	1300	463	323	306	297	277	288
5	---	---	2800	5910	6870	1290	440	326	312	301	265	282
6	---	---	2960	6280	5970	1240	421	327	316	318	269	276
7	---	---	3040	6620	5100	1330	409	321	313	308	243	277
8	---	---	3120	6740	4770	1280	405	315	313	305	251	289
9	---	---	2990	6990	4750	1210	395	312	318	305	274	281
10	---	1060	2780	7590	4830	1160	381	308	314	302	282	282
11	---	1010	2940	8150	4770	1140	368	316	319	303	274	284
12	---	994	3610	7620	4400	1110	357	322	364	311	261	288
13	---	1010	4200	6430	4590	1080	346	319	402	291	265	298
14	---	1090	4450	5440	4270	1000	345	315	370	272	259	309
15	---	1170	4460	4750	3650	942	337	315	345	256	266	369
16	---	1200	4480	4540	3360	896	330	313	349	259	267	349
17	---	1240	4730	4290	3130	873	322	322	352	267	237	334
18	---	1310	7560	4140	2800	877	314	322	342	282	245	333
19	---	1440	10800	4370	2640	843	301	324	343	280	270	320
20	---	1670	11800	6090	2500	785	293	330	372	268	266	322
21	---	2060	11900	8420	2420	746	287	329	353	277	263	330
22	---	2680	10700	7960	2480	700	284	330	321	278	253	325
23	---	3200	9180	7760	2440	665	284	330	320	278	264	323
24	---	3370	8180	7480	2490	636	281	334	324	281	268	324
25	---	3210	7310	7370	2660	603	273	334	320	284	264	329
26	---	2910	6290	7510	2400	569	270	329	317	278	263	337
27	---	2660	5680	7350	2120	549	264	325	317	277	268	349
28	---	2470	5500	7140	1950	558	264	311	308	273	275	362
29	---	2280	5940	8260	1840	547	259	293	308	279	280	383
30	---	2170	6440	8070	1680	553	258	299	278	282	284	---
31	---	---	6330	---	1530	540	---	320	---	277	293	---
MEAN	---	---	5475	6716	3948	942	349	319	328	287	267	316
MAX	---	---	11900	8420	7950	1440	525	334	402	318	293	383
MIN	---	---	2200	4140	1530	540	258	289	278	256	237	276

Appendix K3 Flows Measured in Methow Basin in 1991 and 1992 (continued)

STATION NUMBER 12449950 METHOW RIVER NR PATEROS, WASH. RM 6.7 SOURCE AGENCY USGS
DISCHARGE, CUBIC FEET PER SECOND, YEAR MARCH 1991 TO FEBRUARY 1992
DAILY MEAN VALUES

DAY	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB
1	741	741	2270	6790	7490	1620	636	336	368	323	322	340
2	760	853	2330	7390	7110	1570	620	372	361	349	321	346
3	766	945	2480	7520	7730	1500	596	377	356	352	323	337
4	777	987	2610	6810	8180	1440	571	377	355	346	327	334
5	758	1080	2760	6120	7170	1420	543	377	355	342	319	329
6	723	1230	2940	6260	6350	1400	526	377	360	351	314	322
7	711	1240	3030	6690	5540	1460	510	376	363	356	283	319
8	699	1190	3130	6810	5080	1450	497	371	359	348	292	327
9	692	1160	3070	7000	4990	1360	494	368	359	346	353	330
10	692	1130	2880	7470	5030	1310	481	364	359	346	349	325
11	681	1080	2920	8130	5050	1290	470	365	357	343	331	325
12	673	1050	3400	7920	4680	1250	455	368	386	352	313	327
13	661	1050	4110	6780	4760	1230	444	368	413	344	306	335
14	650	1100	4440	5820	4600	1170	433	364	419	324	308	341
15	642	1200	4640	5100	3980	1100	431	364	396	314	304	375
16	635	1240	4580	4770	3650	1040	422	359	387	370	311	413
17	627	1270	4740	4550	3440	1000	411	360	403	418	296	396
18	620	1320	7360	4310	3110	991	401	364	386	453	281	385
19	621	1420	11400	4430	2890	975	395	364	386	423	300	380
20	649	1610	12700	5820	2740	921	387	364	401	361	311	366
21	656	1930	13000	8930	2620	872	381	363	406	333	308	375
22	665	2460	11800	8250	2650	831	378	364	381	321	301	378
23	674	3050	9950	8130	2610	788	378	364	358	321	299	369
24	681	3310	8640	7720	2630	754	379	371	366	321	309	368
25	679	3270	7680	7520	2800	724	371	377	366	325	309	368
26	674	3020	6700	7600	2650	695	364	374	364	325	309	369
27	662	2770	6040	7550	2360	665	359	371	367	324	312	374
28	656	2690	5780	7300	2170	658	355	365	361	321	328	384
29	655	2420	6030	8190	2030	657	358	349	357	320	325	396
30	663	2290	6520	8310	1900	655	351	344	341	327	325	---
31	686	---	6510	---	1730	648	---	356	---	327	327	---
MEAN	682	1667	5688	6866	4185	1079	447	366	373	346	313	356
MAX	777	3310	13000	8930	8180	1620	636	377	419	453	353	413
MIN	620	741	2270	4310	1730	648	351	336	341	314	281	319

Appendix K4 Flows Measured by Ecology in Methow Basin Irrigation Ditches in 1991

Miscellaneous measurements of irrigation canal discharge during the 1991 irrigation season. Measurements by Art Larson and Jim Peterson. Original note son file in the WRIA 48 Folders of the Water Resources Program Library

MVID Methow River canal (below fish screen) Diversion from left bank at Methow River mile 44.8			
Date	Time	Staff (ft.) Rt/Lt	Discharge (CFS)
05/14/91	1550		36
07/19/91	0947		38
08/28/91	1600	0.65/0.68	38
09/25/91	1415	0.60/0.64	36
10/22/91	1200		dry

Barclay canal – Methow River (below fish screen) Diversion from left bank at Methow River mile 48.3			
Date	Time	Staff (ft.) Rt/Lt	Discharge (CFS)
05/21/91	1630		12
07/19/91	1030		18
08/28/91	1530		15
09/25/91	1500		8.8
10/22/91	1000		dry

Appendix K4 Flows Measured by Ecology in Methow Basin Irrigation Ditches in 1991 (continued)

Foghorn canal – Methow River (below fish screen at hatchery) Diversion from right bank at Methow River mile 51.5			
Date	Time	Staff (ft.) Rt/Lt	Discharge (CFS)
05/14/91	1205		14
07/18/91	1610		15
08/28/91	1500		13
09/24/91	1330		10
10/23/91	1500		2.85

Rockview (heath) canal – Methow River (below fish screen) Divesion from left bank at Methow River mile 59.6			
Date	Time	Staff (ft.) Rt/Lt	Discharge (CFS)
07/18/91	1436		39
08/28/91	1300		13
09/24/91	1245		4.2
10/23/91	1400		2.4

McKinney Mt. ditch – Methow River Diversion from right bank at Methow River mile 60.7			
Date	Time	Staff (ft.) Rt/Lt	Discharge (CFS)
04/26/91	1000		4.8
05/15/91	1640		5.7
07/18/91	1355		2.4
08/27/91	1630		3.2
09.27/91	0900		0.8

Appendix K4 Flows Measured by Ecology in Methow Basin Irrigation Ditches in 1991(continued)

Kumm-Holloway ditch – Methow River (below fish screen Diversion from right bank at Methow River mile 61.4			
Date	Time	Staff (ft.) Rt/Lt	Discharge (CFS)
04/26/91	1100		1.9
07/18/91	1317		0.6
08/27/91	1600		0.1
09/27/91			dry

Airey ditch – Twisp River (below fish screen) Diversion from righ bank at Twisp River mile 0.4			
Date	Time	Staff (ft.) Rt/Lt	Discharge (CFS)
08/29/91	1300		1.8
10/21/91	1500		dry

MVID Twisp River canal (below fish screen) Diversion from right bank at Twisp River mile 4.0			
Date	Time	Staff (ft.) Rt/Lt	Discharge (CFS)
05/14/91	1730	0.51	30
07/19/91	0824		22
08/29/91	1200	0.48/0.53	30
09/25/91	1330	0.47/0.53	29
10/24/91	1000		dry

Appendix K4 Flows Measured by Ecology in Methow Basin Irrigation Ditches in 1991 (continued)

Brown-Gilliham dtich – Twisp River (below fish screen) Diversion from left bank at Twisp River mile 4.6			
Date	Time	Staff (ft.) Rt/Lt	Discharge (CFS)
08/29/91	1130		dry
09/25/91	1300		dry

Twisp Powers canal – Twisp River (below fish screen) Diversion from left bank at Twisp River mile 7.0			
Date	Time	Staff (ft.) Rt/Lt	Discharge (CFS)
08/29/91	1035		9.3
09/25/91	1145		7.9
10/24/91	1100		dry

Ray Libby ditch – Twisp River (below fish screen) Diversion from left bank at Twisp River mile 11.6			
Date	Time	Staff (ft.) Rt/Lt	Discharge (CFS)
08/29/91	0900		1.1
09/25/91	1015		0.06
10/24/91	1130		dry

Appendix K4 Flows Measured by Ecology in Methow Basin Irrigation Ditches in 1991 (continued)

Fulton canal – Chewack River (below fish screen) Diversion from right bank at Chewack River mile 0.9			
Date	Time	Staff (ft.) Rt/Lt	Discharge (CFS)
04/25/91	1315		20
05/14/91	1050		27
07/18/91	1630		24
08/28/91	1200		23
09/24/91	1115		17
10/22/91	0900		dry

Chewack canal – Chewack River (below fish screen) Diversion from left bank at Chewack River mile 8.1			
Date	Time	Staff (ft.) Rt/Lt	Discharge (CFS)
04/25/91	0935		17
05/14/91	0830		30
07/18/91	1654		29
08/28/91	1000		26
09/24/91	1030		25
10/22/91	1000		dry

Skyline canal – Chewack River (below fish screen and return) Diversion from right bank at Chewack River mile 8.9			
Date	Time	Staff (ft.) Rt/Lt	Discharge (CFS)
05/14/91	0915		22
07/18/91	1730		17
08/28/91	0920		20
09/24/91	1000		15
10/22/91	1030		dry

Appendix K4 Flows Measured by Ecology in Methow Basin Irrigation Ditches in 1991 (continued)

Eightmile ditch – Chewack River (below fish screen) Diversion from right bank of Eightmile Creek at road bridge near Chewack River mile 11.5			
Date	Time	Staff (ft.) Rt/Lt	Discharge (CFS)
08/28/91	0845		6.6
09/24/91	0845		7.2
11/22/91	1100		dry

Early Winters canal – Early Winters Creek (below fish screen) Diversion from right bank at Early Winters Creek mile 0.6			
Date	Time	Staff (ft.) Rt/Lt	Discharge (CFS)
05/15/91	1245		14
07/18/91	1230		15
08/27/91	1530	1.08	14
09/27/91	0945	1.07	13
10/23/91	1330	0.97	7

Willis ditch – Early Winters Creek (below fish screen) Diversion from left bank at Early Winters Creek mile 1.0			
Date	Time	Staff (ft.) Rt/Lt	Discharge (CFS)
05/21/91	1400		dry
07/18/91	1200		2.4
08/27/91	1420		1.1
09/27/91	1030		0.2
10.23/91	1145		0.1

Appendix K4 Flows Measured by Ecology in Methow Basin Irrigation Ditches in 1991 (continued)

Wolf Creek ditch – Wolf Creek (no fish screen) Diversion from left bank at Wolf Creek mile 1.2			
Date	Time	Staff (ft.) Rt/Lt	Discharge (CFS)
08/28/91			dry
09/24/91			dry
evidence of early season use of canal			

Appendix K5 Flow Statistics for Exceedence-Frequency Hydrographs.
Chewuch statistics are 10-day averages synthesized from USGS Pateros gage on Methow River and 1991 and 1992 USGS data from Chewuch River gage.

PATEROS				**CHEWUCH**				
1.0%	**50%**	**90%**	**CONVERSION**	**10%**	**50%**	**90%**		
706.4	375.7	248.7	0.182	128.6	68.4	45.3	JAN.	1-10
637.0	404.5	288.4	0.194	123.6	78.5	55.9		11-20
630.3	390.2	285.1	0.193	121.6	75.3	55.0		21-31
622.1	385.9	284.5	0.193	120.1	74.5	54.9	FEB.	1-10
605.6	390.3	285.2	0.194	117.5	75.7	55.3		11-20
633.8	404.4	284.4	0.193	122.3	78.0	54.9		21-29
745.9	412.3	290.9	0.186	138.7	76.7	54.1	MAR.	1-10
918.4	469.4	307.0	0.145	133.2	68.1	44.5		11-20
1266.4	616.4	342.2	0.150	190.0	92.5	51.3		21-31
1810.2	897.8	419.4	0.164	296.9	147.2	68.8	APR.	1-10
2295.1	1415.8	618.7	0.184	422.3	260.5.	113.8		11-20
3548.7	1866.5	927.0	0.194	688.4	362.1	179.8		21-30
5817.0	2800.6	1489.2	0.228	1326.3	638.5	339.5	MAY	1-10
7864.0	4257.8	2052.0	0.250	1966.0	1064.5	513.0		11-20
10370.1	6149.4	3116.3	0.212	2198.5	1303.7	660.7		21-31
12258.5	6772.4	3518.8	0.172	2108.5	1164.9	605.2	JUN.	1-10
10609.3	5569.9	2872.2	0.180	1909.7	1002.6	517.0		11-20
8455.8	4022.4	1894.8	0.160	1352.9	643.6	303.2		21-30
5676.2	2756.6	1196.9	0.284	1612.0	782.9	339.9	JUL.	1-10
3792.4	1835.5	810.2	0.298	1130.1	547.0	241.4		11-20
2382.9	1154.6	560.0	0.211	502.8	243.6	118.2		21-31
1559.6	772.8	413.7	0.304	474.1	234.9	125.8	AUG.	1-10
1113.5	568.5	326.0	**NO**	0.0	0.0	0.0		11-20
891.3	483.4	276.0	**DATA**	0.0	0.0	0.0		21-31
740.7	435.7	263.0	**FOR**	0.0	0.0	0.0	SEP.	1-10
707.0	389.8	270.8	**1992**	0.0	0.0	0.0		11-20
675.1	381.2	288.9	**& 1991**	0.0	0.0	0.0		21-30
678.8	428.7	315.6	0.162	110.0	69.4	51.1	OCT.	1-10
687.0	427.8	342.1	0.181	124.3	77.4	61.9		11-20
730.5	435.1	364.2	0.200	146.1	87.0	72.8		21-31
761.6	457.6	343.6	0.209	159.2	95.6	71.8	NOV.	1-10
791.6	462.4	329.7	0.226	178.9	104.5	74.5		11-20
885.2	430.9	310.2	0.208	184.1	89.6	64.5		21-30
797.5	412.4	310.2	0.222	177.0	91.6	68.9	DEC.	1-10
698.6	393.1	290.6	0.175	122.3	68.8	50.9		11-20
708.4	385.5	278.0	0.205	145.2	79.0	57.0		21-31

Appendix K5 Flow Statistics For Exceedence-Frequency Hydrographs.
Methow River at Winthrop statistics are 10-day averages synthesized from
USGS PATERO.gage and 1991 USGS gage data from Winthrop gage.

PATEROS				**WINTHROP**				
1.0%	**50%**	**90%**	**CONVERSION**	**10%**	**50%**	**90%**		
706.4	375.7	248.7	0.600	423.8	225.4	149.2	JAN.	1-10
637.0	404.5	288.4	0.598	380.9	241.9	172.5		11-20
630.3	390.2	285.1	0.604	380.7	235.7	172.2		21-31
622.1	385.9	284.5	0.633	393.8	244.3	180.1	FEB.	1-10
605.6	390.3	285.2	0.707	428.2	275.9	201.6		11-20
633.8	404.4	284.4	0.707	448.1	285.9	201.1		21-29
745.9	412.3	290.9	0.686	511.7	282.8	199.6	MAR.	1-10
918.4	469.4	307.0	0.681	625.4	319.7	209.1		11-20
1266.4	616.4	342.2	0.712	901.7	438.9	243.6		21-31
1810.2	897.8	419.4	0.762	1379.4	684.1	319.6	APR.	1-10
2295.1	1415.8	618.7	0.760	1744.3	1076.0	470.2		11-20
3548.7	1866.5	927.0	0.768	_2725.4	1433.5	711.9		21-30
5817.0	2800.6	1489.2	0.764	4444.2	2139.7	1137.7	MAY	1-10
7864.0	4257.8	2052.0	0.760	5976.6	3235.9	1559.5		11-20
10370.1	6149.4	3116.3	0.743	_7705.0	4569.0	2315.4		21-31
12258.5	6772.4	3518.8	0.776	9512.6	5255.4	2730.6	JUN.	1-10
10609.3	5569.9	2872.2	0.738	7829.7	4110.6	2119.7		11-20
8455.8	4022.4	1894.8	0.762	6_443.3	306_5.1	1443.8		21-30
5676.2	2756.6	1196.9	0.726	4120.9	2001.3	868.9	JUL.	1-10
3792.4	1835.5	810.2	0.671	2544.7	1231.6	543.6		11-20
2382.9	1154.6	560.0	0.671	1598.9	774.7	375.8		21-31
1559.6	772.8	413.7	0.674	1051.2	520.9	278.8	AUG.	1-10
1113.5	568.5	326.0	0.688	766.1	391.1	224.3		11-20
891.3	483.4	276.0	0.694	618.6	335.5	191.5		21-31
740.7	435.7	263.0	0.684	506.6	298.0	179.9	SEP.	1-10
707.0	389.8	270.8	0.662	468.0	258.0	179.3		11-20
675.1	381.2	288.9	0.644	434.8	245.5	186.1		21-30
678.8	428.7	315.6	0.619	420.2	265.4	195.4	OCT.	1-10
687.0	427.8	342.1	0.661	454.1	282.8	226.1		11-20
730.5	435.1	364.2	0.654	477.7	284.6	238.2		21-31
761.6	457.6	343.6	0.654	498.1	299.3	224.7	NOV.	1-10
791.6	462.4	329.7	0.668	528.8	308.9	220.2		11-20
885.2	430.9	310.2	0.647	572.7	278.8	200.7		21-30
797.5	412.4	310.2	0.671	535.1	276.7	208.1	DEC.	1-10
698.6	393.1	290.6	0.599	418.5	235.5	174.1		11-20
708.4	385.5	278.0	0.679	481.0	261.8	188.8		21-31

FLOWS IN CFS ARE FOR 10, 50, 90 t EXCEEDENCE - (Log Pearson)
Statistics for streamflow data METHOW RIVER NR PATEROS, WASH.
Station ID code: 12449950

		10%	**50%**	**90%**
January	1-10	706.4	375.7	248.7
	11-20	637.0	404.5	288.4
	21-31	630.3	390.2	285.1
February	1-10	622.1	385.9	284.5
	11-20	605.6	390.3	285.2
	21-29	633.8	404.4	284.4
March	1-10	745.9	412.3	290.9
	11-20	918.4	469.4	307.0
	21-31	1266.4	616.4	342.2
April	1-10	1810.2	897.8	419.4
	11-20	2295.1	1415.8	618.7
	21-30	3548.7	1866.5	927.0
May	1-10	5817.0	2800.6	1489.2
	11-20	7864.0	4257.8	2052.0
	21-31	10370.1	6149.4	3116.3
June	1-10	12258.5	6772.4	3518.8
	11-20	10609.3	5569.9	2872.2
	21-30	8455.8	4022.4	1894.8
July	1-10	5676.2	2756.6	1196.9
	11-20	3792.4	1835.5	810.2
	21-31	2382.9	1154.6	560.0
August	1-10	1559.6	772.8	413.7
	11-20	1113.5	568.5	326.0
	21-31	891.3	483.4	276.0
September	1-10	740.7	435.7	263.0
	11-20	707.0	389.8	270.8
	21-30	675.1	381.2	288.9
October	1-10	678.8	428.7	315.6
	11-20	687.0	427.8	342.1
	21-31	730.5	435.1	364.2
November	1-10	761.6	457.6	343.6
	11-20	791.6	462.4	329.7
	21-30	885.2	430.9	310.2
December	1-10	797.5	412.4	310.2
	11-20	698.6	393.1	290.6
	21-31	708.4	385.5	278.0

Period of Record = 1959 to 1992

FLOWS IN CFS ARE FOR 10, 50,. 90 % EXCEEDENCE - (Log Pearson)
Statistics for streamflow data METHOW RIVER AT TWISP, WA
Station ID code: 12449500

		10%	**50%**	**90%**
January	1-10	473.9	307.7	213.5
	11-20	447.6	289.4	207.5
	21-31	454.1	278.5	200.4
February	1-10	471.5	279.0	214.1
	11-20	485.1	270.6	209.0
	21-29	457.6	273.1	210.4
March	1-10	456.5	282.6	215.4
	11-20	565.6	300.8	228.4
	21-31	909.0	394.7	247.2
April	1-10	1647.1	647.8	296.5
	11-20	3113.2	1191.8	407.4
	21-30	4369.7	1936.4	625.0
May	1-10	5433.4	2818.7	1217.7
	11-20	9137.0	4727.9	2182.0
	21-31	10709.6	6013.8	2718.9
June	1-10	9313.7	5825.5	2879.0
	11-20	8300.6	4802.2	2221.4
	21-30	6542.9	3457.7	1522.1
July	1-10	4706.4	2226.2	965.3
	11-20	3113.4	1416.8	580.5
	21-31	1721.2	843.8	377.5
August	1-10	1066.2	548.5	274.9
	11-20	769.3	397.0	215.8
	21-31	619.1	314.5	185.7
September	1-10	507.3	280.1	170.1
	11-20	495.6	255.5	167.0
	21-30	490.6	252.3	176.3
October	1-10	622.2	323.8	204.5
	11-20	722.2	351.4	220.8
	21-31	773.3	393.6	250.4
November	1-10	781.3	418.0	265.2
	11-20	713.6	403.7	263.8
	21-30	774.3	379.9	242.2
December	1-10	716.7	363.0	228.9
	11-20	654.0	353.5	223.6
	21-31	554.4	325.3	218.6

Period of Record = 1919 to 1992

FLOWS IN CFS ARE FOR 10, 50, 90 % EXCEEDENCE - (Log Pearson)
Statistics for streamflow data TWISP RIVER NEAR TWISP, WASH.
Station ID code: 12448998

		10%	**50%**	**90%**
January	1-10	156.1	63.0	28.5
	11-20	157.7	69.6	33.5
	21-31	137.7	62.5	32.6
February	1-10	127.8	59.1	32.3
	11-20	133.7	61.3	33.0
	21-29	155.9	63.3	31.5
March	1-10	144.7	63.0	38.1
	11-20	143.1	77.8	43.3
	21-31	291.9	127.4	48.1
April	1-10	483.0	200.9	61.9
	11-20	637.1	260.5	81.3
	21-30	696.5	362.1	172.6
May	1-10	852.2	567.6	313.6
	11-20	1610.6	762.3	240.7
	21-31	1334.3	861.9	311.7
June	1-10	2050.6	939.8	414.2
	11-20	1716.4	875.2	321.9
	21-30	1799.4	801.2	211.2
July	1-10	1826.5	630.6	117.3
	11-20	1064.1	383.0	77.1
	21-31	584.6	206.7	48.1
August	1-10	390.3	116.5	31.2
	11-20	248.7	82.6	24.0
	21-31	181.4	76.6	24.0
September	1-10	116.4	75.3	31.2
	11-20	99.0	49.1	22.0
	21-30	109.4	43.4	21.2
October	1-10	116.2	63.3	24.4
	11-20	100.4	59.4	31.6
	21-31	95.8	66.1	42.9
November	1-10	142.0	78.9	46.3
	11-20	244.9	95.5	40.1
	21-30	305.3	80.4	46.9
December	1-10	302.9	105.7	48.4
	11-20	284.4	108.6	48.5
	21-31	170.4	78.4	43.4

Period of Record = 1975 to 1992

APPENDIX L

INSTREAM FLOWS IN THE METHOW RIVER BASIN, CH. 173-548 WAC

Chapter 173–548 WAC
WATER RESOURCES PROGRAM IN THE METHOW RIVER BASIN, WRIA 48

WAC 173–548–010 General provision. These rules, including any subsequent additions and amendments, apply to waters within and contributing to the Methow River basin, WRIA 48 (see WAC 173–500–040). Chapter 173–500 WAC, the general rules of the department of ecology for the implementation of the comprehensive water resources program, applies to this chapter 173–548 WAC. [Order DE 76–37, § 173–548–010, filed 12/28/76.]

WAC 173–548–020 Establishment of base flows. (1) Base flows are established for stream management units with monitoring to take place at certain control points as follows:

STREAM MANAGEMENT UNIT INFORMATION

Stream Management Unit Name, Control Station Name and Number	Control Station Location by River Mile, Section, Township, Range	Affected Stream Reach (includes tributaries)
Lower Methow Methow R. nr. Pateros (12.4499.50)	6.7 20–30–23E	Methow River confluence with Wells Pool to confluence with Twisp River.
Middle Methow Methow R. nr. Twisp (12.4495.00)	40.0 17–33–22E	Methow River from confluence with Twisp River to confluence with Chewack River.
Upper Methow Methow R. nr. Winthrop (12.4473.89)	50.2 2-34-21E	Methow River from confluence with Chewack River to confluence with Little Boulder Creek and including Little Boulder Creek.
Methow Headwaters Methow R. at Little Boulder Cr. (12.4473.83)	65.3 25–36–19E	Methow River from confluence with Little Boulder Creek to headwaters.
Early Winters Creek Early Winters Cr. near Mazama	27–36–19E	Early Winters Creek from confluence with Methow River to headwaters.
Chewack River Chewack R. nr. Boulder Creek (12.4475.00)	8.7 35–36–21E	Chewack River confluence with Methow River to headwaters.
Twisp River Twisp R. nr. Twisp (12.4489.98)	0.3 7–33–22E	Twisp River from confluence with Methow River to headwaters.

(2) Base flows established for the stream management units in WAC 173–548–020(1) are as follows:

Base Flows in the Methow River
(All Figures in Cubic Feet Per Second)

[CODIFICATION NOTE: The graphic presentation of this table has been varied slightly in order that it would fall within the printing specification for the Washington Administrative Code. The following table was too wide to be accommodated in the width of the WAC column. The table as codified has been divided into two tables with Part 1 covering the Lower Methow, Middle Methow and Upper Methow and with Part 2 covering the Methow Headwaters, Early Winters Creek, Chewack River and Twisp River.]

PART 1

Month	Day	Lower Methow (12.4499.50)	Middle Methow (12.4495.00)	Upper Methow (12.4473.89)
Jan.	1	350	260	120
	15	350	260	120
Feb.	1	350	260	120
	15	350	260	120
Mar.	1	350	260	120
	15	350	260	120
Apr.	1	590	430	199
	15	860	650	300
May	1	1,300	1,000	480
	15	1,940	1,500	690

PART 1

Month	Day	Lower Methow (12.4499.50)	Middle Methow (12.4495.00)	Upper Methow (12.4473.89)
Jun.	1	2,220	1,500	790
	15	2,220	1,500	790
Jul.	1	2,150	1,500	694
	15	800	500	240
Aug.	1	480	325	153
	15	300	220	100
Sep.	1	300	220	100
	15	300	220	100
Oct.	1	360	260	122
	15	425	320	150
Nov.	1	425	320	150
	15	425	320	150
Dec.	1	390	290	135
	15	350	260	120

PART 2

Month	Day	Methow Headwaters (12.4473.83)	Early Winters Creek	Chewack River (12.4475.00)	Twisp River (12.4489.98)
Jan.	1	42	10	56	34
	15	42	10	56	34
Feb.	1	42	10	56	34
	15	42	10	56	34
Mar.	1	42	10	56	34
	15	42	10	56	34
Apr.	1	64	14	90	60
	15	90	23	140	100
May	1	130	32	215	170
	15	430	108	290	300
Jun.	1	1,160	290	320	440
	15	1,160	290	320	440
Jul.	1	500	125	292	390
	15	180	45	110	130
Aug.	1	75	20	70	58
	15	32	8	47	27
Sep.	1	32	8	47	27
	15	32	8	47	27
Oct.	1	45	11	56	35
	15	60	15	68	45
Nov.	1	60	15	68	45
	15	60	15	68	45
Dec.	1	51	12	62	39
	15	42	10	56	34

(3) Base flow hydrographs, as represented in Figure 1 in the document entitled "water resources management program, Methow River basin" dated 1976, shall be used for definition of base flows on those days not specifically identified in WAC 173-548-020(2) and 173-548-030.

(4) All rights hereafter established shall be subject to the base flows established in WAC 173-548-020(1) through (3), except as provided under WAC 173-548-030 herein.

(5) Future appropriations of water which would conflict with base flows shall be authorized, by the director, only in those situations when it is clear that overriding considerations of the public interest will be served. [Order DE 76-37, § 173-548-020, filed 12/28/76.]

WAC 173-548-030 Future allocations—Reservation of surface water for beneficial uses. (1) The department determines that there are surface waters available for appropriation from the stream management units specified in the amount specified in cubic feet per second (cfs) during the time specified as follows:

(a) Maximum surface water available for future allocation from the indicated reach is as follows:

Month	Lower Methow	Middle Methow	Upper Methow	Methow Head-waters	Early Winters Creek	Chewack River	Twisp River
Oct.	95	30	44	15	29	09	14
Nov.	116	101	46	06	21	10	15
Dec.	112	99	44	17	26	10	15
Jan.	50	36	26	08	19	03	09
Feb.	51	37	29	09	19	04	10
Mar.	147	139	80	38	19	24	18
Apr.	565	590	273	336	35	118	148
May	2,922	2,927	784	412	403	809	703
Jun.	3,116	2,833	1,017	1,249	294	1,292	890
Jul.	965	877	583	608	189	308	298
Aug.	214	192	203	109	94	70	70
Sep.	62	55	76	33	47	23	26

All figures in cubic feet per second.

(b) The control station for each reach is defined in WAC 173-548-020.

(c) The appropriation limit is set forth to be an amount equal to the one in two year natural reach discharge on a monthly basis for all management reaches except Early Winters Creek. The appropriation limit for Early Winters Creek is set forth to be an amount equal to the estimated natural mean monthly streamflow for that stream.

(2) The amounts of water referred to in WAC 173-548-030(1) above are allocated for beneficial uses in the future as follows:

(a) Allocation of surface waters by use category (April through September):

Use Description	Apr.	May	Jun.	Jul.	Aug.	Sep.
Lower Methow						
Single Domestic and Stock Use	2.0	2.0	2.0	2.0	2.0	2.0
Base Flow	860	1,940	2,220	800	300	300
Public Water Supply, Irrigation, and Other Uses	Remaining waters up to the appropriation limit set forth in WAC 173-548-030 (1)(c)					
Middle Methow						
Single Domestic and Stock Use	2.0	2.0	2.0	2.0	2.0	2.0
Base Flow	650	1,500	1,500	500	220	220
Public Water Supply, Irrigation, and Other Uses	Remaining waters up to the appropriation limit set forth in WAC 173-548-030 (1)(c)					
Upper Methow						
Single Domestic and Stock Use	2.0	2.0	2.0	2.0	2.0	2.0
Base Flow	300	690	790	240	100	100
Public Water Supply, Irrigation, and Other Uses	Remaining waters up to the appropriation limit set forth in WAC 173-548-030 (1)(c)					

Use Description	Apr.	May	Jun.	Jul.	Aug.	Sep.
Methow Headwaters						
Single Domestic and Stock Use	2.0	2.0	2.0	2.0	2.0	2.0
Base Flow	90	430	1,160	180	32	32
Public Water Supply, Irrigation, and Other Uses	Remaining waters up to the appropriation limit set forth in WAC 173-548-030 (1)(c)					
Early Winters Creek						
Single Domestic and Stock Use	2.0	2.0	2.0	2.0	2.0	2.0
Base Flow	23	108	290	45	8.0	11.0
Public Water Supply, Irrigation, and Other Uses	Remaining waters up to the appropriation limit set forth in WAC 173-548-030 (1)(c)					
Chewack River						
Single Domestic and Stock Use	2.0	2.0	2.0	2.0	2.0	2.0
Base Flow	140	290	320	110	47	47
Public Water Supply, Irrigation, and Other Uses	Remaining waters up to the appropriation limit set forth in WAC 173-548-030 (1)(c)					
Twisp River						
Single Domestic and and Stock Use	2.0	2.0	2.0	2.0	2.0	2.0
Base Flow	100	300	440	130	27	27
Public Water Supply, Irrigation, and Other Uses	Remaining waters up to the appropriation limit set forth in WAC 173-548-030 (1)(c)					

All figures in cubic feet per second

(b) Allocation of surface waters by use category (October through March):

Use Description	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Lower Methow						
Single Domestic and Stock Use	2.0	2.0	2.0	2.0	2.0	2.0
Base Flow	425	425	350	350	350	350
Public Water Supply, Irrigation, and Other Uses	Remaining waters up to the appropriation limit set forth in WAC 173-548-030 (1)(c)					
Middle Methow						
Single Domestic and Stock Use	2.0	2.0	2.0	2.0	2.0	2.0
Base Flow	320	320	260	260	260	260
Public Water Supply, Irrigation, and Other Uses	Remaining waters up to the appropriation limit set forth in WAC 173-548-030 (1)(c)					
Upper Methow						
Single Domestic and Stock Use	2.0	2.0	2.0	2.0	2.0	2.0
Base Flow	150	150	120	120	120	120
Public Water Supply, Irrigation, and Other Uses	Remaining waters up to the appropriation limit set forth in WAC 173-548-030 (1)(c)					

Use Description	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Methow Headwaters						
Single Domestic and Stock Use	2.0	2.0	2.0	2.0	2.0	2.0
Base Flow	60	60	42	42	42	42
Public Water Supply, Irrigation, and Other Uses	Remaining waters up to the appropriation limit set forth in WAC 173-548-030 (1)(c)					
Early Winters Creek						
Single Domestic and Stock Use	2.0	2.0	2.0	2.0	2.0	2.0
Base Flow	15	15	10	10	10	10
Public Water Supply, Irrigation, and Other Uses	Remaining waters up to the appropriation limit set forth in WAC 173-548-030 (1)(c)					
Chewack River						
Single Domestic and Stock Use	2.0	2.0	2.0	2.0	2.0	2.0
Base Flow	68	68	56	56	56	56
Public Water Supply, Irrigation, and Other Uses	Remaining waters up to the appropriation limit set forth in WAC 173-548-030 (1)(c)					
Twisp River						
Single Domestic and Stock Use	2.0	2.0	2.0	2.0	2.0	2.0
Base Flow	45	45	34	34	34	34
Public Water Supply, Irrigation, and Other Uses	Remaining waters up to the appropriation limit set forth in WAC 173-548-030 (1)(c)					

All figures in cubic feet per second.

(c) Allocations presented in this section do not limit the utilization of waters stored for later release, provided such storage does not infringe upon existing rights or base flow and is duly permitted under RCW 90.03.290 and 90.03.350.

(d) As the amount of water allocated for each category of use approaches the amount available for future allocation set forth in WAC 173-548-030(1), the department shall review the program to determine whether there is a need for program revision. [Order DE 76-37, § 173-548-030, filed 12/28/76.]

WAC 173-548-040 Priority of future water rights during times of water shortage. (1) As between rights established in the future pertaining to waters allocated in WAC 173-548-030 (2)(a) and (b), all rights subject to this program shall be regulated in descending order of use category priority regardless of the date of the priority of right.

(2) As between rights established in the future within a single use category allocation of WAC 173-548-030, the date of priority shall control with an earlier dated right being superior to those rights with later dates. [Order DE 76-37, § 173-548-040, filed 12/28/76.]

WAC 173-548-050 Streams and lakes closed to further consumptive appropriations. The department, having determined based on existing information that there are no waters available for further appropriation through the establishment of rights to use water consumptively, closes the streams and lakes listed in (a) and (b), and ground water hydraulically connected with these surface waters to further consumptive appropriation[.] This includes rights to use water consumptively established through permit procedures and ground water withdrawals otherwise exempted from permit under RCW 90.44.050. Specific situations in which well construction may be approved are identified.

No wells shall be constructed for any purposes, including those exempt from permitting under RCW 90-.44.050, unless one or more of the following conditions have been met and construction of the well has been approved in writing by the department prior to the beginning of well construction:

(1) The proponent has a valid water right permit recognized by the department. For an existing community domestic use, a water right permit must be held by a purveyor of an approved system. (For the purposes of this chapter, an approved water system is one in compliance with the state drinking water regulations, chapter 246-290 WAC and the state surface and ground water codes, chapters 90.03 and 90.44 RCW); or

(2) The proponent has obtained a valid state surface or ground water right through a transfer approved by the department under the statutory authority of chapter 90.03 or 90.44 RCW; or

(3) The proponent is replacing or modifying an existing well developed under the exemption from permit clause of RCW 90.44.050 and this has been approved in writing by the department; or,

(4) If the ground water being sought for withdrawal has been determined by the department not to be hydraulically connected with surface waters listed as closed, the department may approve a withdrawal. When insufficient evidence is available to the department to make a determination that ground and surface waters are not hydraulically connected, the department shall not approve the withdrawal of ground water unless the person proposing to withdraw the ground water provides additional information sufficient for the department to determine that hydraulic continuity does not exist and that water is available.

(a) STREAM CLOSURES

The following streams are closed all year, including all ground waters hydraulically connected to these streams.

Stream Name (Includes Tributaries)
Wolf Creek
Bear Creek (Davis Lake)
Thompson Creek
Beaver Creek
Alder Creek
Benson Creek
Texas Creek
Libby Creek
Cow Creek
Gold Creek
McFarland Creek
Squaw Creek
Black Canyon Creek
French Creek

(b) LAKE CLOSURES

The following lakes are closed all year, including all ground waters hydraulically connected to these lakes:

Name	Location
Alta Lake	3 mi. SW of Pateros
Black Lake	25 mi. N of Winthrop
Black Pine Lake	9 mi. SW of Twisp
Crater Lake	10 mi. W of Carlton
Davis Lake	Bear Creek Drainage
Eagle Lake	11 mi. SW of Carlton
French Creek	Sec.28, T.31N., R.23E.
Libby Lake	10 mi. W of Carlton
Louis Lake	20 mi. W of Winthrop
Middle Oval Lake	16 mi. W of Carlton
North Lake	20 mi. W of Winthrop
Patterson Lake	Sec.8, T.34N., R.21E.
Pearrygin Lake	Sec.36, T.35N., R.21E.
Slate Lake	14 mi. W of Winthrop
Sunrise Lake	16 mi. W of Methow
Upper Eagle Lake	12 mi. W of Carlton
West Oval Lake	16 mi. W of Carlton

[Statutory Authority: Chapters 34.05, 90.54, 18.104, 90.03 and 90.44 RCW. 91-23-093 (Order 91-27), § 173-548-050, filed 11/19/91, effective 12/20/91; Order DE 76-37, § 173-548-050, filed 12/28/76.]

WAC 173-548-060 Ground water. If it is determined that a future development of ground water measurably affects surface waters subject to the provisions of chapter 173-548 WAC, then rights to said ground water shall be subject to the same conditions as affected surface waters. [Order DE 76-37, § 173-548-060, filed 12/28/76.]

WAC 173-548-070 Effect on prior rights. Nothing in this chapter shall be construed to lessen, enlarge, or modify existing rights acquired by appropriation or otherwise, and legally vested prior to the effective date of this chapter. [Order DE 76-37, § 173-548-070, filed 12/28/76.]

WAC 173-548-080 Enforcement. In enforcement of this chapter, the department of ecology may impose such sanctions as are appropriate under authorities vested in it, including but not limited to the issuance of regulatory orders under RCW 43.27A.190 and civil penalties under RCW 90.03.600. [Statutory Authority: Chapters 43-.27A, 90.22 and 90.54 RCW. 88-13-037 (Order 88-11), § 173-548-080, filed 6/9/88.]

WAC 173-548-090 Appeals. All final written decisions of the department of ecology pertaining to permits, regulatory orders, and related decisions made pursuant to this chapter shall be subject to review by the pollution control hearings board in accordance with chapter 43-.21B RCW. [Statutory Authority: Chapters 43.27A, 90-.22 and 90.54 RCW. 88-13-037 (Order 88-11), § 173-548-090, filed 6/9/88.]

WAC 173-548-100 Regulation review. The department of ecology shall initiate a review of the rules established in this chapter whenever new information, changing conditions, or statutory modifications make it necessary to consider revisions. [Statutory Authority: Chapters 43.27A, 90.22 and 90.54 RCW. 88-13-037 (Order 88-11), § 173-548-100, filed 6/9/88.]

APPENDIX M

SNORKELLING OBSERVATIONS OF FISH IN THE METHOW BASIN

Appendix M Snorkelling Observations of Fish in the Methow Basin

The IFIM sites and other selected sites were surveyed by Brad Caldwell and Dave Catterson snorkelling on August 18, 1991, and by Caldwell and Catterson with Hal Beecher on September 16 and 17, 1991. The purpose was to gather some general observations on the existing fish distribution and abundance at the IFIM sites.

Snorkelling Observations on August 18. 1991

Methow River - Walsh Site - RM 31.5 - We surveyed from transect 6 to 1 (858 feet) and saw 30 suckers (6-8 lbs.), 1 juvenile rainbow trout (3 in.), 8 rainbow trout (8-17 in.), and many whitefish (10-15 in.). No salmon seen.

Methow River.- Deep hole where side road meets Methow River about 1 mile downstream of the town of Twisp - about RM 39 - We surveyed the deep pool and found 12 suckers (6-8 lbs.), 1 juvenile chinook (4in.), 2 bright adult chinook (20-25 lbs.), 4 rainbow trout (8-12 in.), and 20 whitefish (10-17 in.).

Methow River - KOA Site - RM 49 - We surveyed 1122 feet (transect 3 to 200 feet downstream of corner logjam) and found 7 chinook juveniles (3.5 in.), 4 rainbow trout (12 in.), 2 cutthroat trout (12-13.in.), and 64 whitefish (7 to 24 in.). No suckers, adult salmon or steelhead, nor bull trout were seen. The water temperature was 57 degrees F at 1:30 PM.

Methow River - Weeman Site - RM 59 - From Weeman bridge down to transect 8 (3696 feet) we saw 12 chinook juveniles, 4 rainbow trout (6-8 in.), and 3 whitefish. The water temperature was 58 degrees F at 4 PM in the mainstem Methow River.

In the spring-fed side channel along transects 3-7 (787 feet long) on the Weeman site we found 69 brook trout (6-13 in.) and 132 chinook juveniles (3.5 in.). The water temperature was 51 degrees F at 4 PM in the side channel.

In the mainstem Methow River at the Weeman site from transect 7 down to transect 1 (1354 feet) we found 4 brook trout (10-11 in.), 82 chinook juveniles (3.5 in.), 1 adult chinook (20 lbs.), 5 rainbow trout (6-7 in.), and 2 whitefish.

Methow River - Chokecherry Site - RM 66.5 - We surveyed from transect 7 to 2 (870 feet) and found 32 chinook juveniles (3.5 in.) and 1 whitefish (10 in.). No adult chinook, steelhead, bull trout, brook trout, or cutthroat trout were seen. Water temperature was 57 degrees F at 6 PM.

Twisp River - RM 1.8 - We surveyed from transect 7 to 1 (784 feet) and found 36 chinook juveniles (3.5-4 in.), 40 rainbow trout (6-12 in.), and 3 whitefish (6-7 in.). Water temperature was 58 degrees F at 12 PM.

Chewuch River - RM 1.3 - We surveyed from transect 7 to 1 (697 feet) and found 40 chinook juveniles, 8 rainbow trout (6-11 in.), and 1 whitefish (6 in.). Water temperature was 65 degrees F at 2:30 PM.

Early Winters Creek - RM 1.0 - We surveyed from transect 8 to 3 (269 feet) and found 33 chinook juveniles (3.5-5 in.) and 12 rainbows (4-15 in.). The water temperature was 54 degrees F at 6:30 PM.

Snorkelling Observations on September 16 and 17, 1991

Methow River - Walsh Site - RM 31.5 - We surveyed from transect 8 to 1 (1340 feet) and found 30 suckers (8-10 lbs.), 1 juvenile chinook (4 in.), 5 bright and 1 dark adult chinook (7-30 lbs.), 2 rainbow trout (15-17 in.), and 75 whitefish (5-24 in.). Water temperature was 55 degrees F at RM 49 at 2 PM.

Methow River - Deep hole where side road meets Methow River about 1 mile downstream of the town of Twisp - about RM 39 - We surveyed the deep pool and found 2 adult sockeye, 30 bright adult chinook (15-35 lbs.), 5 rainbow trout (6-12 in.), 2 adult steelhead (12 lbs), 1 bull trout (10 in.), 1 cutthroat trout (10 in.), and 40 adult whitefish. Water temperature was 55 degrees F at RM 49 at 2 PM.

Methow River - KOA Site - RM 49 - We surveyed from transect 8 down to corner logjam (2837 feet) and found 1 chinook juvenile (5 in.), 18 bright adult chinook (15-30 lbs.), 2 rainbow trout (8-17 in.), 1 steelhead (12 lbs.), 2

bull trout (16-17 in.), 3 cutthroat trout (10-16 in.), and 100 whitefish (6-20 in.). The water temperature was 55 degres F at 2 PM.

Methow River - Weeman Site - RM 59 - We surveyed from the spring-fed side channel along transects 3-7 (787 feet long) and found 60 brook trout (3-13

in.) and 150 chinook juveniles (3-5 in.). Water temperature was 48 degrees F.

In the maninstem Methow River at the Weeman site we surveyed from transect 7 down to transect 1 (1354 feet) we found 2 brook trout (6-8 in.), 44 chinook juveniles (3-5 in.), 1 adult chinook (20 lbs.), 3 rainbow trout (8-15 in.), and 36 adult whitefish. Just 100 feet downstream of transect 1 were 14 spawning chinook. While at the same spawning area one week later (September 26) we videotaped 6 sockeye spawning in the same area. No other spawning surveys have ever recorded sockeye spawning this far upstream in the Methow River and tribal spawning surveys in 1991 did not find any sockeye in the Methow basin.

The water temperature on September 26 was 58 degrees F at 1 PM at the Chokecherry Site but was 52 degrees F at the same time 7.5 miles downstream. This was due to large inflow of 48 degrees F ground water mixing with the 58 degrees F surface water by the time the surface water reached the Weeman Site.

Methow River - Chokecherry Site - RM 66.5 - We surveyed from transect 8 to 1 (1353 feet) and found no fish. Water temperature was 54 degrees F at 2 PM. In an isolated side channel just upstream of transect 8 we saw 15 chinook juveniles and 3 rainbow trout.
Methow River - Gate Creek Campground - RM 69.8 - We surveyed 300 feet and found 75 chinook juveniles (3-5 in.), 1 dead adult chinook (8 lbs.), and 2 rainbow trout (9-10 in.). On a spot survey a month later Art Larson found that the 8-foot deep pools had dried up completely.

Twisp River - RM 1.8 - We surveyed from transect 8 to 1 (1163 feet) and found no chinook juveniles, 3 rainbow trout (3-10 in.), and 2 whitefish (14 in.). Water temperature was 55 degrees F at 11:30 AM.

Chewuch River - RM 1.3 - We surveyed from transect 7 to 1 (697 feet) and found 3 chinook juveniles (3-5 in.), 4 rainbow trout (3-8 in.), and 2 whitefish (3-9 in.). Water temperature was 56 degrees F at 1 PM.

Early Winters Creek - RM 1.0 - We surveyed from transect 8 to 3 (269 feet) and found 30 chinook juveniles (3-5 in.) and 20 rainbow trout (2-8 in.), and 2 bull trout juveniles (2.5-6).

APPENDIX N

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LITERATURE CITED

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APPENDIX O

ECOLOGY'S MISSION STATEMENT

OUR MISSION

WASHINGTON STATE DEPARTMENT OF ECOLOGY

The mission of the Department of Ecology is to protect, preserve and enhance Washington's environment and promote the wise management of our air, land and water for the benefit of current and future generations.

To accomplish this mission, Ecology will:

- Recognize its most valuable asset is its dedicated and committed employees and it will provide necessary support, training and professional development.
- Promote prevention and conservation as the most effective ways to preserve our natural resources and protect the environment.
- Enforce environmental laws and regulations in a fair and firm manner.
- Provide public education programs to promote wise use of our natural resources and encourage environmental protection.
- Offer information, technical and financial assistance to help the public, governments, businesses and industries comply with environmental laws and regulations.
- Promote the recognition that compliance with environmental laws and regulations is compatible with a sound economy.
- Promote meaningful public involvement in the development of rules, regulations and new initiatives.
- Provide leadership in addressing emerging problems and strive to bring public agencies and diverse interest groups together to address environmental issues.
- Use an integrated approach to resolve environmental issues.
- Place special emphasis on educating and working with youth to create a strong environmental ethic.
- Help state agencies set an example in environmental protection.
- Work with the executive and legislative branches to promote sound environmental policy.

WASHINGTON STATE DEPARTMENT OF ECOLOGY