Technical Memorandum No. 2a
Minimum Instream Flow Framework
Draft

WRIA 35 – Middle Snake River Basin

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1.0 Introduction

This is Technical Memorandum No. 2a under the Level 2 Instream Flow Assessment for WRIA 35. Tech Memo No.1 describes the overall stream flow management framework and the management points developed for the basin. The framework identified setting minimum instream flows (MIF) for two of the management points in the Middle Snake watershed. The framework also includes a review of administrative closures. This Tech Memo 2a presents the approach used to develop the preliminary MIF recommendations to be considered by the Planning Unit. Tech Memo 2b will document the review of administrative closures.

As presented in Tech Memo No. 1, MIF are proposed for Management Point 1 – Tucannon River at Starbuck (MP-1) and Management Point 3 – Tucannon River at Marengo (MP-3). Pending completion of instream flow studies in the Asotin subbasin, MIFs may be developed for one or more additional management points. Refer to Exhibit 1 for the locations of these management points. MIF were developed through an analysis of both hydrologic data and fish habitat and presence information, as described below.

2.0 Hydrologic Data

The hydrologic data consisted of monthly flow exceedance curves for each management point. Exceedance curves describe the frequency of flows of a given magnitude during the period of record. Typically, exceedance values are described as percentages, e.g., "the 50% exceedance flow for November is 108 cfs". This is synonymous with the term "median monthly flow for November". This means that - in the case of a hypothetical 20-year gage record - the monthly flow in November (computed as the mean of daily flows for each year) exceeded 108 cfs in 10 of those years. Similarly, the 10% exceedance flow level was met in only 2-out-of-20 years. Keep in mind that these are average monthly flow values; in other words, daily or instantaneous discharges in November may exceed the 10% exceedance flow more than 10% of the time, but the average daily flow for the month is not expected to exceed that level more than once every ten years. Consider the following example from a neighboring watershed:

> *The Touchet River has a flow record extending from 1924 to 1989 (no data between October 1929 and April 1951). To compute the 10% exceedance flow for July, the average daily flow was first computed for each calendar year for the month of July. The monthly averages (a total of 45 values) were then placed in rank order from lowest to highest. The resulting 10% exceedance value is 73.8 cfs.*
>
> *Alternatively, if all of the daily records across all years are placed in rank order and the 10% exceedance level is identified in a similar fashion, the resulting discharge is 80 cfs. As it turns out in this example, daily flows exceed the 73.8 cfs monthly 10% exceedance level 14.5% of the time across all years.*

It is also worth recognizing that exceedance flows are a statistical description of the flow regime, based on past experience. Future flow conditions will not be identical to those in the past. Where gage records are relatively short or outdated, flow statistics will not be as reliable, particularly for "extreme" conditions, such as the 10% exceedance level. This is the case for MP-3 at Marengo. The flow record is very short and outdated. While the median flow estimate may be relatively accurate, the 10% exceedance flow may change substantially with only a few more years of additional data.

3.0 Fish Habitat Information

Fish habitat information comprises the PHABSIM model output from studies performed by Dr. Mike Barber (Washington State University) and the Department of Ecology, coupled with the expertise of local fish biologists. PHABSIM is a set of linked models that couples hydraulic and physical characteristics of a stream reach (i.e., depth, velocity, substrate, instream cover) with the habitat preferences of specific fish species and life stages. PHABSIM develops a quantitative relationship between discharge and the amount of fish habitat for several species and lifestages. It is frequently also referred to as IFIM (Instream Flow Incremental Methodology). IFIM is an analytical technique for recommending flows for a stream that begins with problem identification and typically ends with flow recommendations. PHABSIM is the central modeling component of IFIM, but a larger suite of considerations is included in the overall IFIM approach.

The purpose of the hydraulic component of the model is to simulate depth and velocity for a range of discharges at a number of transects along a study reach, based on input data provided by the modeler. Input data typically consist of three sets of field measurements of depth and velocity at each transect, taken during three distinct flow conditions (e.g., high, medium and low flow). Once the hydraulic models have been calibrated, depth and velocity is simulated for a range of discharges in user-defined flow increments (e.g., 10 to 1000 cfs in increments of 10 cfs).

The habitat portion of PHABSIM utilizes Habitat Suitability Curves (HSC) for a number of species and lifestages of interest. For the Barber study at Marengo (MP-3), the model applied HSC's for three lifestages of steelhead (spawning, fry and juvenile), two lifestages of Chinook salmon (spawning and juvenile rearing), and two lifestages of bull trout (spawning and general adult). The Ecology study at Starbuck did not include a fry stage for steelhead, and bull trout lifestages included spawning and juvenile, but not the general adult category.

Typically, for each species/lifestage (e.g., steelhead spawning), three HSC's are used to describe the suitability or preference of the fish for depth, velocity and substrate, respectively. For juvenile lifestages, an HSC for instream cover (e.g., log jams, overhanging vegetation, undercut banks) is frequently substituted for the substrate curve in the analysis. HSC's are developed using field observations of fish occurrence. In some studies, site-specific HSC's are developed to more accurately reflect conditions and fish preferences in the local area, while other studies apply regionally developed 'default' suitability curves. The Barber study applied default preference curves supplied by WDFW. The Ecology study applied modified, site-specific curves for the depth and velocity preferences of Chinook and steelhead juveniles, while applying default agency curves for juvenile substrate and cover preferences as well as all bull trout preference curves.

After simulating the hydraulics at each transect for the discharges of interest, PHABSIM computes the combined suitability (i.e., considering depth, velocity and substrate/cover) for each species/lifestage for a large number of computational 'cells' across all transects[1]. By combining results for all of the transects at a site, the model produces an estimate of Weighted Usable Area (WUA) for each species/lifestage at every simulated discharge level. WUA represents the amount of suitable habitat available in a reach at a particular discharge, as weighted by the combined suitability for each species/lifestage.

An example of a WUA output table for Tucannon at Starbuck (MP-1) is provided below (Table 1). The WUA values are provided as "square feet per 1000 linear feet of stream". This convention makes it straightforward to adjust the estimate of total WUA to a longer (or shorter) study reach. In each WUA column, the value in bold type represents the maximum value in that column. For example, the highest amount of steelhead spawning habitat occurs at a discharge of 105 cfs.

Table 1
Weighted Usable Area for the Tucannon River at Starbuck (MP-1). Units in square feet per 1000 linear feet.

Flow (cfs)	**Steelhead**		**Chinook**		**Bull Trout**	
Discharge (cfs)	Spawn	Juvenile	Spawn	Juvenile	Spawn	Juvenile
25.0	971	641	3064	1125	5165	982
30.0	1908	820	4260	1198	5386	1323
35.0	3005	988	5352	1255	5494	1639
40.0	4216	1139	6353	**1284**	5572	2057
45.0	5573	1274	7303	1269	5628	2574
50.0	6977	1398	8162	1258	5640	3384
55.0	8229	1502	8895	1256	**5663**	4041
60.0	9338	1577	9516	1263	5621	4714
65.0	10272	1626	10021	1253	5552	5255
70.0	11068	1676	10452	1246	5470	5791
75.0	11665	1726	10772	1233	5382	5257
80.0	12073	1767	10983	1214	5310	6636
85.0	12333	1793	**11092**	1188	5221	6969
90.0	12432	**1803**	11087	1153	5119	7250
100.0	12607	1787	10812	1063	4862	7801
105.0	**12629**	1772	10561	1005	4737	8055
110.0	12621	1750	10264	936	4607	8275
120.0	12588	1733	9552	840	4305	8693
130.0	12491	1732	8711	782	4016	9166
140.0	12281	1727	7884	750	3751	9532
150.0	12044	1702	7091	705	3529	9767
160.0	11832	1678	6349	656	3339	**9837**
170.0	11626	1666	5736	617	3145	9810
180.0	11333	1626	5238	599	2954	9717
190.0	11008	1577	4875	587	2794	9543
200.0	10677	1520	4620	572	2637	9321
300.0	7359	1084	3254	649	1715	6883
400.0	4909	1016	2885	777	1461	4645
500.0	3526	1096	2422	912	1266	3747

[1] There are several different methods for combining the three individual suitability values into a single combined suitability value. A discussion of these techniques and their implications is beyond the scope of this report.

The PHABSIM model provides a convenient and recognized way of relating changes in discharge to available fish habitat. However, it should be recognized that the model (like all models) is an extreme simplification of the natural system that it attempts to describe, and that the model has had its detractors since it was first developed in the 1980s. From the Planning Unit's perspective, it is important to keep in mind what the model is and what it is not. No single tool can adequately prescribe the best solution for an instream flow regime. For example, PHABSIM assumes that depth, velocity, substrate and cover are the most important habitat (and only) variables affecting the distribution and abundance of fish. Moreover, the model assumes that these factors influence habitat selection by fish independently of each other. Other factors - such as food availability, temperature, and water quality – are not considered at all within the model. The model also assumes that WUA bears a 1:1 correlation to fish biomass. This assumption reflects the premise that fish are always habitat-limited, whereas other factors may well be equally important. In interpreting model results, the limitations of the approach should be kept in mind, and other factors may require careful consideration in the development of final flow recommendations.

More details about the PHABSIM modeling studies prepared for the Tucannon basin can be found in Barber (2004) and Ecology (1995).

4.0 Method for Developing MIF Recommendations

The Planning Unit developed a two-tiered approach to making MIF recommendations for each management point. First, WUA data from each study were combined with the local fisheries knowledge of agency and tribal biologists to develop a set of "ideal" fish-based flows.[2] Secondly, these first-tier recommendations were compared to the hydrologic data to ensure consistency between recommended flows and the hydrograph. This approach is described in more detail below.

WUA results were first converted to a "percentage-of-maximum" format to facilitate comparison across species/lifestages, as well as to better convey the incremental changes in WUA with corresponding changes in discharge. Table 1 (above) is repeated below as Table 2 in the percentage-of-maximum format. In other words, for each column of WUA values, the maximum value is set to 100% while others are scaled accordingly as a percentage of that maximum value.

[2] This draft of the memo has not yet been reviewed by agency and tribal biologists. Their input will be included in subsequent drafts.

Table 2 Percentage-of-Maximum WUA Values for Tucannon at Starbuck (MP-1).						
Flow (cfs)	**Steelhead**		**Chinook**		**Bull Trout**	
Discharge (cfs)	Spawn	Juvenile	Spawn	Juvenile	Spawn	Juvenile
25.0	8%	36%	28%	88%	91%	10%
30.0	15%	45%	38%	93%	95%	13%
35.0	24%	55%	48%	98%	97%	17%
40.0	33%	63%	57%	**100%**	98%	21%
45.0	44%	71%	66%	99%	99%	26%
50.0	55%	78%	74%	98%	100%	34%
55.0	65%	83%	80%	98%	**100%**	41%
60.0	74%	87%	86%	98%	99%	48%
65.0	81%	90%	90%	98%	98%	53%
70.0	88%	93%	94%	97%	97%	59%
75.0	92%	96%	97%	96%	95%	53%
80.0	96%	98%	99%	95%	94%	67%
85.0	98%	99%	**100%**	93%	92%	71%
90.0	98%	**100%**	100%	90%	90%	74%
100.0	100%	99%	97%	83%	86%	79%
105.0	**100%**	98%	95%	78%	84%	82%
110.0	100%	97%	93%	73%	81%	84%
120.0	100%	96%	86%	65%	76%	88%
130.0	99%	96%	79%	61%	71%	93%
140.0	97%	96%	71%	58%	66%	97%
150.0	95%	94%	64%	55%	62%	99%
160.0	94%	93%	57%	51%	59%	**100%**
170.0	92%	92%	52%	48%	56%	100%
180.0	90%	90%	47%	47%	52%	99%
190.0	87%	87%	44%	46%	49%	97%
200.0	85%	84%	42%	45%	47%	95%
300.0	58%	60%	29%	51%	30%	70%
400.0	39%	56%	26%	61%	26%	47%
500.0	28%	61%	22%	71%	22%	38%

The interpretation of WUA results for purposes of setting fish-based flow recommendations requires two additional steps. At this time, MIF recommendations will be set on a monthly basis. Smaller intervals (e.g. half-month intervals) may be appropriate when there is a significant change in the flow hydrograph within a given month. Since the MIF will be on a monthly basis, a "species periodicity table" (i.e., a calendar of fish presence) is also established for each site on a monthly basis. As part of the planning process, project biologists provided their best estimates of species/lifestage presence for each of the management points[3]. A species periodicity table for the Tucannon at Starbuck (MP-1) is provided in Table 3.

[3] The fish presence information has been reviewed by Glen Mendel from WDFW.

Table 3 Species Periodicity Table for the Tucannon at Starbuck (MP-1).						
	Steelhead		**Chinook (Spr. and Fall)**		**Bull Trout**	
	Spawn	Juvenile	Spawn	Juvenile	Spawn	Adult
October						
November						
December						
January						
February						
March						
April						
May						
June			**			
July			**			
August						
September						

** - Spring Chinook spawning migration.

Note: In both of the spawning columns, black shading indicates the peak spawning period, while gray shading indicates potential spawning and/or post-spawning egg incubation. For all other lifestages, gray shading indicates likely presence.

As multiple species are present during any particular month and as different flow levels favor different species and lifestages, the second step involves the monthly prioritization of species/lifestages for purposes of flow recommendations. By combining information on species periodicity with other aspects of life history and biology, project biologists identified 1st, 2nd and 3rd tier priorities for each month.[4] Table 4 shows the species/lifestage priorities for the Tucannon at Starbuck (MP-1).

Table 4 Species Priority for the Tucannon at Starbuck (MP-1).						
	Steelhead		**Chinook (SP and Fall)**		**Bull Trout**	
	Spawn	Juvenile	Spawn	Juvenile	Spawn	Juv
October		**2**	**1**	**2**		**2**
November		**2**	**1**	**2**		**2**
December	3	**2**	**1**	**2**		**2**
January	**2**	**2**	**2**	**2**		**2**
February	**1**	**2**	**2**	**2**		**2**
March	**1**	**2**	**2**	**2**		**2**
April	**1**	**2**		**2**		**2**
May	**1**	**2**		**2**		**2**
June	**2**	**1**	**1**	**2**		**2**
July	**2**	3	**1**	**2**		
August		3				
September		3				

[4] The priorities have been reviewed by Glen Mendel, WDFW staff. Changes to the priorities may be made after review by other members of the Planning Unit.

A value of one (1) for a species during a particular month indicates that it should receive the highest priority for flow setting consideration. If two species/lifestages are identified as top priorities, then the needs of both should be considered equally.

To develop initial fish-based flow recommendations, Tables 2 and 4 were analyzed in tandem on a month-by-month basis. For each month, the approach is to identify the discharge that provides maximum benefits to the highest priority species/lifestage(s). At the same time, the approach identifies opportunities where a slight increase or decrease in the selected discharge would continue to capture a very high percentage of WUA for the 1st tier priority while providing an increase in the WUA for 2nd and/or 3rd tier priorities. The result of the month-by-month analysis is a preliminary set of MIFs.

Finally, the fish-based flow recommendations were compared to the hydrologic statistics for the site in question. Consistent with the approach used to recommend MIFs in the Walla Walla basin, the preliminary recommendations for MIF not allowed to exceed the 10% exceedance flow for any particular month. In other words, if the recommended flow from the fish-based analysis is higher than the 10% exceedance flow, then the recommended flow is reduced to match the 10% level. The intent of this provision is to maintain coherence between ‘ideal’ fish flows and observed instream flow conditions. For Tucannon at Starbuck (MP-1) example, the 10% exceedance flow was identified as the recommended MIF only in August, whereas for the Tucannon at Marengo (MP-3) the 10% flow was applied during the entire June-October period. Changes in species priorities will naturally have an impact on the need to apply the 10% “rule” since certain lifestages have much higher “optimal” flows than do others.

Throughout Washington State, extensive discussions have revolved around the practicality and biological value of setting MIFs for certain months as high as the 10% exceedance level (or even higher). During the discussions in the Walla Walla Basin, both Ecology and WDFW have expressed the perspective that setting MIFs relatively “high” achieves an important biological objective by protecting instream flows during ‘good years’. During the late summer months in particular (when the 10% provision is most likely to be invoked), fish survival, growth and productivity are generally higher as stream discharges increase, i.e., “the more water the better”. By setting the threshold for MIFs during the late summer at a level that prohibits further out-of-stream use except in the wettest 10% of years, the planning unit succeeds in protecting the occasional “bumper crop” of fish that often contributes disproportionately to the abundance of subsequent generations.

Tables 5 and 6 below show the results of the preliminary MIF process for MP-1 and MP-3. Exceedance statistics are also provided as a reference. An asterisk (*) indicates that the recommended MIF level is set to equal the 10% exceedance flow. Note that the WUA results, percentage, periodicity, and species priority tables for MP-3 used to define the preliminary MIFs are included in Appendix A.

Table 5 Recommended MIF for the Tucannon at Starbuck (MP-1). Exceedance flow statistics provided for reference.				
	MIF	**10%**	**50%**	**90%**
October	85	102	83	65
November	85	134	108	87
December	85	281	135	88
January	100	383	162	96
February	105	455	217	129
March	105	335	226	142
April	105	426	255	159
May	105	433	265	165
June	90	330	178	88
July	85	126	77	51
August	79*	79	61	43
September	85	89	72	52

Table 6 Recommended MIF for the Tucannon at Marengo (MP-3). Exceedance flow statistics provided for reference.				
	MIF	**10%**	**50%**	**90%**
October	88*	88	70	59
November	150	160	83	68
December	150	175	83	70
January	150	228	83	68
February	120	234	142	93
March	120	219	159	125
April	120	276	188	164
May	120	335	219	130
June	175	179	108	76
July	84*	84	65	49
August	61*	61	53	45
September	74*	74	59	53

References

Barber, M. 2004. “Minimum Instream Flow Study of Tucannon River at Marengo.” State of Washington Water Research Center. Washington State University.

Caldwell, B. 1995. “Tucannon River Fish Habitat Analysis Using the Instream Flow Incremental Methodology.” Open File Technical Report No. 95-167. Washington State Department of Ecology.

APPENDIX A – TUCANNON RIVER AT MARENGO TABLES

Table A-1
WUA results for the Tucannon River at Marengo (MP-3). Units in square feet per 1000 linear feet.

	Steelhead		Chinook			Bull Trout	
Discharge	Spawn	Fry	Juvenile	Spawn	Juvenile	Spawn	Adult
20	1,503	5,759	831	3,754	2,239	10,016	1,972
25	2,482	6,054	1,044	5,146	2,546	10,825	2,785
30	3,492	**6,064**	1,248	6,389	2,794	11,454	3,425
35	4,470	5,851	1,427	7,518	2,980	12,139	3,916
40	5,411	5,637	1,588	8,526	3,089	12,733	4,379
45	6,255	5,210	1,720	9,384	3,141	13,194	4,912
50	6,985	4,823	1,847	10,163	3,201	13,670	5,458
55	7,613	4,533	1,971	10,859	3,247	14,096	5,912
59.2	8,027	4,365	2,064	11,410	3,305	14,432	6,156
65	8,468	4,166	2,173	12,129	3,383	14,793	6,430
70	8,872	4,078	2,268	12,661	3,444	15,036	6,784
75	9,333	3,999	2,360	13,170	3,504	15,223	7,097
80	10,533	4,715	2,392	14,299	3,236	15,207	7,503
90	11,251	4,553	2,473	15,010	3,231	15,402	7,749
100	11,859	4,248	2,539	**15,339**	3,232	**15,487**	7,907
111.1	12,305	3,773	2,633	15,328	3,267	15,435	8,172
120	**12,362**	3,472	2,700	15,226	3,285	15,368	8,525
135	12,175	3,152	2,819	14,805	3,330	15,115	**8,816**
150	12,254	3,963	3,009	14,271	3,439	14,896	8,669
175	11,613	3,463	3,191	13,307	3,533	14,160	8,528
181.6	11,313	3,381	3,241	13,032	3,573	13,976	8,448
200	10,591	3,178	3,381	12,227	3,689	13,454	8,338
225	9,636	3,216	3,564	11,332	3,846	12,712	8,182
250	9,109	3,384	**3,722**	10,591	**3,946**	11,980	8,080

Table A-2
Percent-of-Maximum WUA Values for the Tucannon at Marengo (MP-3).

	Steelhead		Chinook			Bull Trout	
Discharge	Spawn	Fry	Juvenile	Spawn	Juvenile	Spawn	Adult
20	12%	95%	22%	24%	57%	65%	22%
25	20%	100%	28%	34%	65%	70%	32%
30	28%	**100%**	34%	42%	71%	74%	39%
35	36%	96%	38%	49%	76%	78%	44%
40	44%	93%	43%	56%	78%	82%	50%
45	51%	86%	46%	61%	80%	85%	56%
50	57%	80%	50%	66%	81%	88%	62%
55	62%	75%	53%	71%	82%	91%	67%
59.2	65%	72%	55%	74%	84%	93%	70%
65	69%	69%	58%	79%	86%	96%	73%
70	72%	67%	61%	83%	87%	97%	77%
75	75%	66%	63%	86%	89%	98%	81%
80	85%	78%	64%	93%	82%	98%	85%
90	91%	75%	66%	98%	82%	99%	88%
100	96%	70%	68%	**100%**	82%	**100%**	90%
111.1	100%	62%	71%	100%	83%	100%	93%
120	**100%**	57%	73%	99%	83%	99%	97%
135	98%	52%	76%	97%	84%	98%	**100%**
150	99%	65%	81%	93%	87%	96%	98%

Table A-2
Percent-of-Maximum WUA Values for the Tucannon at Marengo (MP-3).

	Steelhead		Chinook			Bull Trout	
Discharge	Spawn	Fry	Juvenile	Spawn	Juvenile	Spawn	Adult
175	94%	57%	86%	87%	90%	91%	97%
181.6	92%	56%	87%	85%	91%	90%	96%
200	86%	52%	91%	80%	93%	87%	95%
225	78%	53%	96%	74%	97%	82%	93%
250	74%	56%	**100%**	69%	**100%**	77%	92%

Table A-3
Species Periodicity Table for Tucannon at Marengo (MP-3)

	Steelhead			Chinook (Spring)		Bull Trout	
	Spawn	Fry	Juvenile	Spawn	Juvenile	Spawn	Adult
October							
November							
December							
January							
February							
March							
April							
May							
June				**			
July				**			
August							
September							

** Spring Chinook spawning migration.

Table A-4
Species Priorities for the Tucannon at Marengo (MP-3)

	Steelhead			Chinook (Spring)		Bull Trout	
	Spawn	Fry	Juvenile	Spawn	Juvenile	Spawn	Adult
October		3	**2**	**2**	**2**		**2**
November			**2**	**2**	**2**		**2**
December	3		**2**	**2**	**2**		**2**
January	**2**		**2**	**2**	**2**		**2**
February	**1**		**2**	**2**	**2**		**2**
March	**1**		**2**		**2**		**2**
April	**1**		**2**		**2**		**2**
May	**1**	3	**2**		**2**		**2**
June	**2**	3	**1**	**1**	**2**		**2**
July	**2**	3	**2**	**1**	**2**		3
August		3	**2**	**1**	**2**		
September		3	**2**	**1**	**2**		

APPENDIX B – SPECIES PRIORITIZATION NARRATIVE

Species Prioritization Narrative for IFIM Study Sites

A brief discussion of species presence and priorities for flow setting purposes for management points on the Tucannon River as reflected in the Tables 3 and 4 and A-3 and A-4. The tables are duplicated here for convenience.

Whenever peak spawning is likely to occur for any species, it will receive a priority value of '1'. In cases where two or more species/lifestage categories have equivalent priority, recommended flows attempt to attain a high percentage (>90%) of maximum weighted-usable-area (WUA) for all categories.

1.1 Tucannon at Starbuck – MP#1

Table B-1. Species priorities for the Tucannon at Starbuck.

	Steelhead		Chinook (SP and Fall)		Bull Trout	
	Spawn	Juvenile	Spawn	Juvenile	Spawn	Juv
October		**2**	**1**	**2**		**2**
November		**2**	**1**	**2**		**2**
December	3	**2**	**1**	**2**		**2**
January	**2**	**2**	**2**	**2**		**2**
February	**1**	**2**	**2**	**2**		**2**
March	**1**	**2**	**2**	**2**		**2**
April	**1**	**2**		**2**		**2**
May	**1**	**2**		**2**		**2**
June	**2**	**1**	**1**	**2**		**2**
July	**2**	3	**1**	**2**		
August		3				
September		3				

The priorities in Table B-1 reflect a combination of species presence and sensitivity to flow in the lower Tucannon River. A numerical value in a cell indicates that the species/lifestage is likely or potentially present during that month. A ranking of '1' reflects the highest priority for purposes of flow setting.

1.1.1 Steelhead

Steelhead spawning occurs in the mainstem Tucannon beginning at approximately Kellogg Creek and continuing to the upper basin. Spawning typically occurs during the February to May period, though occasional spawning has been recorded as early as late December. The '2' ranking in June and July reflects the importance of adequate incubation flows following spawning.

Steelhead rearing occurs primarily upstream of Kellogg Creek, but may occur further downstream as well. Steelhead rearing takes place year-round. The ranking of '1' for June reflects the fact that peak spawning is over, but rearing steelhead are still present in this portion of the river and rearing habitat is very important to steelhead production. During the July-September period (priority '3'), the river is typically too warm and juveniles move further upstream into cooler tributaries or mainstem areas.

1.1.2 Chinook (fall and spring)

The lower section of the Tucannon is used for spawning primarily by fall Chinook, with a peak spawning time from October to December, with incubation to follow through March. Spring Chinook, which have an earlier spawning period, migrate through the area during the June-July period, thereby justifying the '1' ranking for those months. Actual spawning takes place primarily upstream. See MP#3. Note that the habitat suitability curves for migration likely look different than for spawning, but in the absence of such curves in the IFIM analysis, we are using the spawning flows as a surrogate.

Chinook juveniles may be present in the lower Tucannon year-round, with the likely exception of August-September when temperatures are too high.

1.1.3 Bull trout

No bull trout spawning occurs in the lower Tucannon. Juveniles, sub-adults and migrating adults may pass through the area during all but the warmest months, from July-September. However, desirable bull trout habitat is located in the upper basin upstream of Panjab Creek.

1.2 Tucannon at Marengo – MP#3

Table B-2. Species priorities for the Tucannon at Marengo (MP#3)

	Steelhead			Chinook (Spring)		Bull Trout	
	Spawn	Fry	Juvenile	Spawn	Juvenile	Spawn	Adult
October		3	**2**	**2**	**2**		**2**
November			**2**	**2**	**2**		**2**
December	3		**2**	**2**	**2**		**2**
January	**2**		**2**	**2**	**2**		**2**
February	**1**		**2**	**2**	**2**		**2**
March	**1**		**2**		**2**		**2**
April	**1**		**2**		**2**		**2**
May	**1**	3	**2**		**2**		**2**
June	**2**	3	**1**	**1**	**2**		**2**
July	**2**	3	**2**	**1**	**2**		3
August		3	**2**	**1**	**2**		
September		3	**2**	**1**	**2**		

Unlike the study for MP#1, the IFIM study at Marengo included analyses for steelhead fry and for non-spawning bull trout adults. Bull trout juveniles were not included.

1.2.1 Steelhead

Steelhead are known to spawn in the mainstem and several tributaries throughout the upper basin. Same timing as described above.

Steelhead fry consist of young-of-the-year juveniles that emerge from the gravel in late spring or early summer. Consistent with discussions with WDFW biologists (Glen Mendel for Tucannon, Hal Beecher for Walla Walla in 2004), based on typical growth trajectories, the fry stage is considered to last only until October of the first year.

Steelhead juveniles are present year-round. In some years, temperature is likely limiting in late summer, but not to the extent seen in the lower river. Thus, steelhead juveniles have a rating of '2' rather than '3' at this location during the summer months.

1.2.2 Chinook (spring only)

Only spring Chinook spawn in the vicinity of this management point and in areas upstream. The high priorities for June and July are mainly associated with migration, with peak spawning in August-September. As in the case for MP#1, migration habitat suitability curves were not applied in the IFIM study, so the spawning flow values are used here as a surrogate.

Spring Chinook juveniles are likely to be present year-round. In some years, high temperatures may be limiting, but not nearly to the extent seen at Starbuck.

1.2.3 Bull trout

Spawning and rearing for bull trout occurs well upstream, above Panjab Creek. Thus, spawning flows were not considered here. Note, however, that the optimum spawning flow is the same in this case for Chinook and bull trout and the timing is similar, so including bull trout would not change the recommendations. This is only true at this Management Point. Bull trout adults may be found migrating through the area throughout the year, with the likely exception of the warmest months in August and September.