ANCHOR QEA

720 Olive Way, Suite 1900
Seattle, Washington 98101
Phone 206.287.9130
Fax 206.287.9131
www.anchorqea.com

MEMORANDUM

To:	Dan Haller, P.E., Aspect Consulting, LLC	**Date:**	January 22, 2014
From:	Bob Montgomery, P.E., Anchor QEA, LLC	**Project:**	1302014-02.01
Re:	Methow Valley Irrigation District Flow Benefit Study		

INTRODUCTION

An analysis of flow related benefits of the project was prepared. Two methods were used; Instream Flow Incremental Methodology (IFIM) and a points-based method based upon how flow improvements will affect various salmonid species.

Instream Flow Incremental Methodology

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 Instream Flow Incremental Methodology (IFIM; Ecology, 1992). IFIM study sites were selected by Ecology to represent various reaches in the Methow and Twisp rivers. The Walsh Site on the Methow River (River Mile [RM] 31.5) represents the Methow River from the Town of Twisp to Carlton. The Twisp River Site (RM 1.8) represents the lower Twisp River. These sites were used in this analysis to represent the Twisp and Methow rivers for the reaches affected by the Methow Valley Irrigation District (MVID) improvements. An additional IFIM on the Methow River (KOA Site at RM 49) represents the Methow River from Twisp to Winthrop. That site could have been used to estimate fish habitat benefits from MVID East Canal efficiency improvements; however, as the following analyses will demonstrate, the fish habitat benefits from removing the West Canal diversion on the Twisp River significantly outweigh impacts to fish habitat on the Methow River.

IFIM produces an index of fish habitat called the Weighted Usable Area (WUA). WUA is expressed in terms of square feet per 1,000 feet of river. WUA curves were produced for each IFIM site that relates WUA to flow. For this analysis, the WUA at each flow was obtained and summed for the period analyzed.

The following assumptions were used in the analysis:

- One species was analyzed: spring Chinook. Naturally spawning Upper Columbia River spring-run Chinook are listed as Endangered under the Endangered Species Act (ESA). Both the Twisp and Methow rivers are listed as critical habitat for spring Chinook.
- Changes in fish habitat were analyzed for both spawning and juvenile rearing life stages of Spring Chinook. The months of September and October were analyzed for spawning, and the entire year was analyzed for rearing.
- The allowable diversion for the MVID West Canal (11 cubic feet per second [cfs]) would remain in the Twisp River to its confluence with the Methow River.
- MVID will withdraw from groundwater wells near Twisp. It was assumed that surface water and groundwater are highly connected, so any groundwater withdrawals would result in surface water decreases in the Methow River in the same month.
- A conservative approach to estimating benefits or impacts to the Methow River was performed. It was assumed the replacement of the East Canal would not result in flow improvements from the East Canal intake to Twisp. From Twisp to the existing West Canal end spill, it was assumed 2.4 cfs of the demand for the West Canal service area is supplied from the Twisp area immediately downstream of the Twisp River. The remaining flow benefit of 8.6 cfs would diminish downstream to zero at the West Canal end spill. An average benefit of 4.3 cfs was applied to the 9-mile reach between Twisp and the West Canal end spill.
- The potential exchange between MVID and Twisp would result in both flow improvements (mid-May to mid-August) and flow reductions (mid-August to mid-May), the extent of which is provided in Figure 1 attached.
- MVID diversions occur from May 1 to October 7 on average.
- The IFIM sites described above represent the same reaches of river as described in the Ecology IFIM report.
- The length of the river reaches affected are 4.3 miles for the Twisp River and 9 miles for the Methow River (from Twisp to the West Canal end spill).
- The calculations were performed for normal and dry flow conditions. Normal flow conditions are represented by the 50% exceedance flows and dry flow conditions are represented by the 90% exceedance flows. Daily flows were used in the calculations.

Two flow conditions were analyzed as fish survival is more often a concern during dry conditions.

The results of the IFIM method are presented in Table 1. The results indicate that a substantial increase in fish habitat will result, especially in the critical dry years for fish. The increase in spawning and rearing habitat for Spring Chinook totaled over a year will range from about 47,000 to 109,000 square feet. Table 2 shows the percentage improvement on the Twisp and Methow rivers. On the Twisp River, the improvement in spawning and rearing habitat is predicted to range from 25% in normal years to about 80% in dry years. The improvement on the Methow River is predicted to range from 5% in normal years to about 8% in dry years.

Table 1
Change in Weighted Usable Area in Project Area

Reach From MVID West Canal Intake to Town of Twisp (4.3 miles)	
Total Increase in WUA (Spawning and Rearing) for Median Year	26,951 sq ft
Total Increase in WUA (Spawning and Rearing) for Dry Year	78,232 sq ft
Reach From Town of Twisp to End of East Canal (9 miles)	
Total Increase in WUA (Spawning and Rearing) for Median Year	19,921 sq ft
Total Increase in WUA (Spawning and Rearing) for Dry Year	30,761 sq ft
Overall Change in WUA (Spawning and Rearing)	
Median Year	46,872 sq ft
Dry Year	108,993 sq ft

Notes: sq ft = square feet

Table 2
Percentage Change in Weighted Usable Area in Project Area

Reach From MVID West Canal Intake to Town of Twisp	
Total Increase in WUA (Spawning and Rearing) for Median Year	24.8%
Total Increase in WUA (Spawning and Rearing) for Dry Year	79.6%
Reach From Town of Twisp to End of East Canal	
Total Increase in WUA (Spawning and Rearing) for Median Year	4.9%
Total Increase in WUA (Spawning and Rearing) for Dry Year	7.9%

MULTI SPECIES IMPACTS OF CHANGES TO WITHDRAWAL METHODS

Introduction

This section describes a points-based analysis of potential benefits associated with the MVID Flow Improvement Project. The water resources implementation plan developed for Lewis and Salmon-Washougal watersheds (Ecology 2008) provides a framework for characterizing habitat benefits associated with various restoration actions in order to quantify mitigation credits relative to similarly calculated flow-impact depletion points (HDR and LCFRB 2008). The mitigation credits and depletion points are unitless because they are based on best professional judgment of contributors to the Integrated Strategy for Implementing Water-Right Reservations: Grays-Elochoman and Cowlitz River Basins (WRIAs 25-26) and Salmon-Washougal and Lewis River Basins (WRIAs 27-28) (HDR and LCFRB 2008); the assessment of benefits presented in this section has also been adapted from that document.

In this assessment, Anchor QEA used best professional judgment to apply an adaptation of this methodology to conditions in the Methow basin, including consideration of the habitat limiting factors and the types of potential restoration actions. The scoring system used was developed to characterize the contribution of the restoration actions in providing ecological functions, particularly area for habitat identified as limited in the Methow and Twisp watersheds by Andonaegui (2000). Even though depletions are predicted in all reaches of the river, this evaluation focused on how changes in the methods and locations of the diversions could affect fish species at a variety of life stages.

The project actions analyzed include the following two sub-actions:

1. Discontinuing the diversion of flows from the Twisp River to the MVID West Canal.
2. Pumping of groundwater near Twisp and the effective withdrawal of water from the Methow River.

The points assigned to each restoration action incorporate the action's contribution to usable fish habitat area based on flow. Anchor QEA used a point scoring system that is consistent with the methodology in HDR, Inc., and Lower Columbia River Fish Recovery Board's (LCFRB) report (2008), where higher points are given when there is a direct benefit to fisheries.

To calculate the benefits for these actions, the three following main factors were considered:

1. The change in flows proposed
2. The length of stream affected by the proposed change in flows
3. The number of species at each life stage that could benefit from additional flow

Other actions proposed that will benefit fisheries includes removal of the diversion dam for the MVID West Canal on the Twisp River, cessation of maintenance activities at that dam including excavating the main channel of the river to provide sufficient flow to the canal when river flows are low and removal of a diversion on Alder Creek. Points were not assigned to these restoration actions as the flow restoration action is sufficient by itself to show large benefits.

Study Reaches Considered

The results of an Instream Flow Incremental Methodology Study of the basin (Ecology 1992) were used to determine the specific discharge that provided the maximum habit area for a specific species at a specific life stage. Two different sites were used to represent each of the two distinct sub-actions. These sub-actions are described as follows:

1. Discontinuing the diversion of flows from the Twisp River to the MVID West Canal was characterized by the Twisp Site at RM 1.8 and extrapolated over the 4.3 mile length from the Twisp Diversion to the confluence with the Methow.

2. The impacts of pumping of groundwater near Twisp and up to 9 miles downstream of Twisp was considered as a withdrawal of water from the Methow River (due to the assumed connectivity of groundwater and surface water). These impacts were characterized by the Walsh IFIM site at RM 31.5 per Ecology's IFIM study.

Changes in Flow Considered in the Analysis

The effect of discontinuing withdrawals on the Twisp River was estimated using allowable discharges for the MVID West Canal system and by estimating demand for off-peak months. The flows considered are shown in Table 3:

Table 3
Flow Reduction in Twisp River

	May	Jun	Jul	Aug	Sep	Oct
Peak	11	11	11	11	11	3
Average	6	9	11	11	8	3

Note: All values are in cubic feet per second.

Below Twisp the effect of pumping ground water was considered to have a similar effect on flows as a surface diversion. Flows and their effect on habitat area were the only factors considered, not temperature. It is assumed that any impact of the use of groundwater in place of surface water for irrigation would have a generally beneficial impact on water temperature. The change in flow considered for the nine mile reach downstream of Twisp were calculated based on taking the assumed rates of aquifer withdrawal starting with 2.4 cfs at Twisp and going to a cumulative 11 cfs at the downstream end of the reach. These withdrawals were subtracted from the 11 cfs currently being withdrawn from the Twisp River. The beneficial increase in flows over the 9-mile reach length would therefore be 8.6 cfs at the confluence and decrease to 0 at the downstream end of the project (vicinity of the downstream well). Flows considered by month were taken as an average for the 9 miles at 4.3 cfs. Those flows were pro-rated by the ratio of the average to peak diversion in off-peak months. Additional consumptive withdrawal of water by the City of Twisp was also included in the calculation as shown in Table 4.

Table 4
Change in Discharge of the Methow River Resulting from Using Groundwater in Place of the Existing Twisp River Diversion

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-0.06	-0.06	-0.05	-0.06	4.07	4.02	3.91	3.85	3.97	1.09	-0.04	-0.03

Note: All values are in cubic feet per second.

Benefit to Fish

To determine the benefit of the project to multiple species and life stages of fish consideration was given to several species likely to use the affected reaches. These include spring, summer and fall Chinook, bull trout and summer steelhead. Rearing, holding and spawning were considered as potential habitat needs and one point was assigned per day that additional flow would provide additional habitat area for each potential species – life stage.

The following species' life stages were considered on the Methow River and Twisp River.

Table 5
Species Life Stages Considered

Methow River (Walsh site)	Twisp River (Twisp site)
Summer Steelhead Spawning	Summer Steelhead Spawning
Summer Steelhead Rearing	Summer Steelhead Rearing
Bull Trout Rearing	Bull Trout Rearing
Spring Chinook Spawning	Spring Chinook Spawning
Spring Chinook Rearing	Spring Chinook Rearing
Spring Chinook Holding	--
Summer Chinook Spawning	Summer Chinook Spawning
Summer Chinook Rearing	Summer Chinook Rearing
Summer Chinook Holding	--
Fall Chinook Spawning	--
Fall Chinook Rearing	--
Fall Chinook Holding	--

Benefit Calculation

The impacts on species life stages was calculated by considering the number of days that any additional flow would increase the amount of habitat for a species life stage. If flows were already at or above the level that the IFIM predicted would maximize habitat, no impact of increased flow was assumed. The formula used for the calculation was as follows:

$$\beta^*L^*\Delta Q/100$$

β (Benefit) = the sum of all species life stage benefits per day for each month calculate for each day that additional flow would provide more habitat area meeting requirements of the specific species life stage.

L = the length of the reach affected by the change in discharge in miles.

ΔQ = the average change in discharge along the affected reach in cfs (taken as a monthly average.

Benefits were calculated for average years based on the average daily discharge and for low flow years based on the 90% recurrence flows. For the Walsh site the Methow River at Winthrop (USGS 12448500) gage data was used and on the Twisp River the gage near Twisp (USGS 12448998) was used.

Results

The calculation showed that the overall impact is strongly beneficial. This was most clear in September and early October when flows start to decline, and additional flow is more likely to create additional habitat. In general the benefits of moving diversions downstream also increased the flow available to provide habitat.

Table 6
Restoration Actions Benefits Calculation

	β*L*ΔQ/100												
Site	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Walsh Avg. Flow	-0.80	-0.72	-0.85	-0.19	0.00	0.00	7.39	48.22	85.77	24.42	-0.81	-0.35	**162**
Walsh Low Flow	-0.80	-0.70	-0.88	-0.78	4.03	6.15	34.48	53.77	85.77	24.42	-0.81	-0.35	**204**
Twisp Avg. Flow	0.00	0.00	0.00	0.00	0.00	0.00	7.92	87.12	129.60	11.34	0.00	0.00	**236**
Twisp Low Flow	0.00	0.00	0.00	0.00	41.58	12.87	21.78	87.12	89.28	48.60	0.00	0.00	**280**
												Cumulative Benefit Average Year	**398**
												Cumulative Benefit Low Flow Year	**484**

REFERENCES

Ecology (Washington State Department of Ecology), 1992. *Methow River Basin Fish Habitat Analysis Using the Instream Flow Incremental Methodology*. Prepared by Brad Caldwell and Dave Atterson, Washington State Department of Ecology. Publication Number: 92-82.

Ecology, 2008. *Implementation Plan for the Adoption of Chapters 173-527 and 173-528 WAC Water Management Resources Program for the Lewis Basin, WRIA 27 & Water Management Resources Program for the Salmon-Washougal Basin, WRIA 28*. Prepared by Travis Burns, Washington State Department of Ecology Water Resources Program. Publication Number: 08-11-056.

HDR and LCFRB (HDR, Inc., and Lower Columbia River Fish Recovery Board), 2008. *Integrated Strategy for Implementing Water-Right Reservations – Grays-Elochoman and Cowlitz River Basins (WRIAs 25-26) and Salmon-Washougal and Lewis River Basins (WRIAs 27-28)*. Updated October 2008 – Draft. Prepared for WRIA 25/26 and 27/28 Planning Units. Funded by Washington State Department of Ecology. Appendix I in Ecology (2008).

Andonaegui, Carmen, 2008. *Salmon, Steelhead, and Bull Trout Habitat Limiting Factors – Water Resource Inventory Area 48*. Prepared for the Washington State Conservation Commission. July 18, 2000.

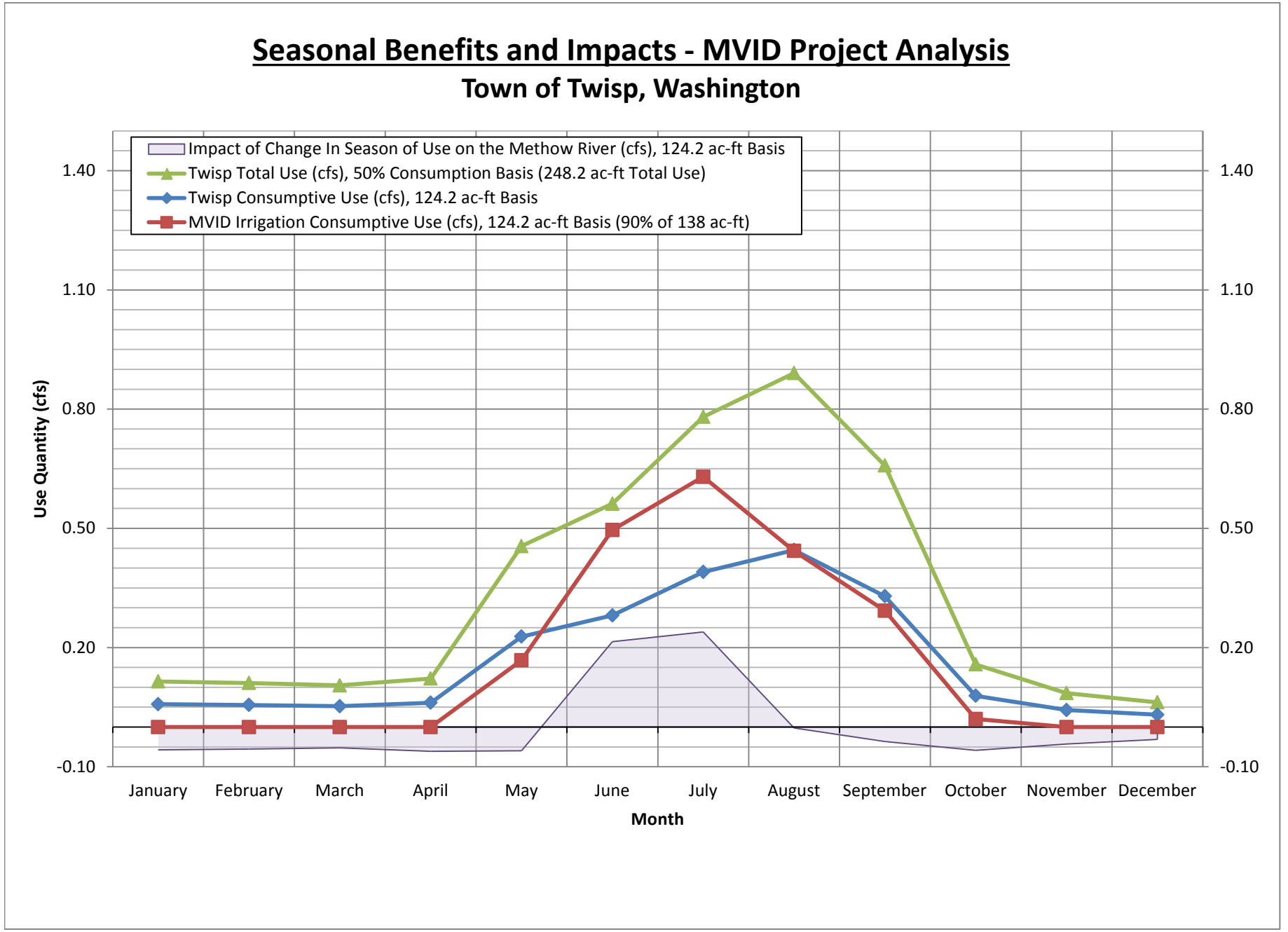

Figure 1. Flow Benefits and Impacts