# *Technical Memorandum*

**To:** **Rob Lindsay, WRIA 54 & 57 ISF Work group members**
**From:** **Stan Miller**
**Date:** **June 24, 2007**
**Subject:** **Analysis of Instream Flow Results For WRIA 54 and 57 Studies**

The following discussion provides some background information on Spokane River flow and how existing and future needs fit with the amount of water likely to be available.

The crux of establishing an instream flow recommendation for the Spokane River will be to reconcile the flow needs for fish established by two different studies on different portions of the River with the desires for aesthetic flows and for power generation. This memo provides a summary of the results instream flow studies conducted to determine the needs to support fisheries in the Spokane River. These studies have been conducted over the last four years and carry significant implications for establishing a minimum flow for the Spokane River at the Spokane gage.

Tim Hardin of the firm Hardin-Davis of Albany, Oregon directed the first of these studies during the summer of 2003. Avista as part of their relicensing effort and Spokane County using part of the Watershed Planning ISF supplemental grant for WRIA 57 funded this work. The Hardin – Davis work examined flow needs for spawning in the River between the State Line and Sullivan Road in the Spokane Valley and in the reach below Monroe Street. Rearing needs were studied only in the state line to Sullivan area. Rainbow trout was the target species in this work.

Pete Riettemier directed the second portion of the work as the lead of the EES team, a subcontractor for Tetra Tech. Tetra Tech conducted the second study for Spokane County using the ISF supplemental grant for WRIA 54. The EES work examined flow needs for rearing both Mountain Whitefish and Rainbow trout in the River in the reach below Monroe Street and at a site adjacent to the Spokane Rifle Club. Because spawning for Rainbow trout below Monroe Street was studied by Hardin – Davis, EES evaluated spawning needs only in the Rifle Club reach.

The availability of water to meet fisheries needs at various locations in the Spokane River can be estimated using USGS stream gaging data from a number of stations. USGS stream gaging data from stations at Barker Road (Spokane River near Greenacres 12420500) and Monroe Street (Spokane River at Spokane 12422500) are important for the areas in which recent fisheries studies have been conducted. There are two data sets available for the Barker Road site based on time of operation; the gage at Barker was operational from March 1, 1948 through June 30, 1952. It was placed back in service as part of Spokane County's Watershed Planning effort in August of 1999 and has seen continuous operation since. In service since 1891,the Spokane River at Spokane gage is the oldest continuously operating gage in Washington. Given this continuous data both the Barker data sets can be compared to the flow at Spokane.

Table 1 provides a summary of the relationships between the flows at Barker and Monroe Street for both of the individual data collection periods and for all of the data viewed collectively. In order to provide an evaluation of the relationships during the critical summer and fall flow periods, the flow regressions performed on flows ranging from 500

to 2500 cubic feet per second at the Spokane River near Greenacres (Barker Road bridge) gage are shown. The relationships using the entire data set tend to show a larger increase between the two measuring points but are not significantly different. The use of 500 cfs as the minimum at the Barker gage is appropriate for future flow estimates at downstream gages as that is the target flow established for this gage in Avista's license application for the Post Falls and Spokane River Hydroelectric Projects. Typical high flows in the fall after the beginning of "release" from Coeur d'Alene Lake after Labor Day are in the 1500 to 2500 cfs range. This validates the use of 2500 cfs as the upper limit for regressed data used in this evaluation.

Interestingly, the data in Table 1 shows a significant change in Aquifer recharge between the late 1940's and early 1950's and the last seven years. Based on the regression equations the groundwater flow added between Barker and Monroe is nearly 400 cfs less now than in the past. This is consistent with the decrease in seven – day average low flow observed in the data for the flows at the Spokane Gage. The high regression coefficient (> 0.99) for the two data sets suggests that these are from statistically different data universes. The fact that the regression coefficient for the combined data is a significantly poorer correlation than either of the individual data sets supports the conclusion that the data sets are different. For that reason it is recommended that the 1999 to present data be used for estimates of future flows.

| Table 1. Barker vs. Spokane Gage; Flow at Barker > 500 cfs and < 2500 cfs | | | |
|---|---|---|---|
| Data Set | Regression Eqn. | $r^2$ | Flow at Spokane (500 cfs @ Barker) |
| 1948 – 1952 | y = 0.94x + 1000 | 0.993 | 1470 |
| 1999 – 2007 | y = 0.93x + 620 | 0.996 | 1120 |
| All data | y = 0.91x + 764 | 0.782 | 1220 |

Both the 2003 study by Hardin – Davis and the 2006 work by EES used habitat simulation for rainbow trout as the key indicator for establishing flow needs for the various segments of the river. Due to recommendations from the WDFW, EES also evaluated the needs for mountain whitefish in the lower Spokane. Both efforts used habitat simulation modeling to evaluate flow needs. In this approach an estimate of the amount of riverbed, expressed in square feet, of the study segment that has the desired water depth and flow velocity for the target species and life stage is determined for a range of flows. The optimum flow is determined from the curve of flow plotted against useable area.

The critical period for evaluating rearing habitat occurs during the low flow months from July through October. The following discussion is based on needs identified for this time period.

The Hardin – Davis work showed that the maximum weighted usable area (WUA the measure of habitat used in this study) for rearing juvenile rainbow trout occurred at 300 cfs at a study cross section just upstream from Barker Road. For adult life stages of rainbow trout the greatest amount of rearing habitat occurred at about 600 cfs at the same cross section. Coincidentally, the maximum WUA when both juvenile and adult fish

needs are considered occurs at about 500 cfs. In order to account for the rapid loss in habitat that occurs when flow at the Barker Road site drops below 600 cfs, the initial recommendation for flow at Barker was 600 cfs. Further discussion of this topic in the Avista Water Resources Work Group, it was decided to keep the flow recommendation for Barker at 500 cfs. The reasons for this were two: 500 cfs provided near maximum habitat and a continuous flow of 500 cfs at Barker could be achieved with at flow of near 600 cfs at Post Falls Dam. In addition to the maximizing effect on WUA instream temperature studies revealed that with flows at Barker at 500 cfs or lower, the Aquifer recharge below Barker could maintain an instream temperature below 20 degrees C. Also, based on historic runoff statistics, a flow of 600 cfs at Post Falls could be maintained over 80% of the time without lowering the level of Lake Coeur d'Alene

Using a much less intensive data collection effort Hardin – Davis found that downstream at Sullivan Road between 200 and 450 cfs provided the optimum habitat for adult rainbow. The Sullivan "reach" includes a "boulder" segment (250 cfs) and a "cascade" segment (450 cfs). The lower flow need for the boulder segment stems from the effect of protruding boulders on the overall availability of habitat by confining flow to a fraction of the channel cross section. The flow needs for juvenile rainbow was found to be proportionally lower than those for adults.

The difference in flow needs between Barker Road (500 cfs) and Sullivan (200 – 450 cfs) can be explained by the difference in stream profile. At the Barker site the section is wide and shallow while at Sullivan the channel is confined to a relatively narrow channel at normal flows. At any given flow the water is deeper at Sullivan than at Barker.

During the summer of 2006 an EES team directed by Pete Rittmueller evaluate two reaches of the Spokane River below the Monroe Street Bridge. The upstream segment lay between Monroe Street and the confluence with Latah Creek. (This reach was evaluated for spawning habit by Hardin – Davis but based on the opinion of Chris Donnelly of WDFW if flows were adequate for rearing in the middle Spokane they would be OK at the downstream sites so rearing habitat was not evaluated.) A down stream segment adjacent to the Spokane Gun Club was also evaluated. Based on the EES work 850 – 1100 cfs at Monroe Street will provide 80% to 90% of the maximum habitat for both rainbow trout and mountain whitefish. Only 650 - 850 cfs is needed to provide the same benefits at the Rifle Club site.

The EES study also noted an accretion of flow between the Monroe Street and Rifle Club sites. This study and a USGS seepage run conducted during the summer of 2005 indicate flow increases in the 250 – 300 cfs range.

The EES work found basically the same conditions for the lower Spokane as occurred in the Hardin – Davis work on the middle Spokane, Higher flows are needed for rearing at the study site between Monroe Street and Latah Creek than downstream near the Rifle Club. This is again a broad shallow channel vs. narrower deeper channel situation.

Considering the data in Table 1 if there is a flow of 500 cfs at Barker with Aquifer recharge flow at Monroe Street should be in the 1100 to 1200 cfs range. As this is at the top end of the identified flow for fish in the Monroe – Latah reach; meeting the 500 cfs target at Barker will put us in good shape at Monroe as well. However, with an additional 250 cfs added between Monroe Street and the Rifle Club a flow of at least 1350 cfs can be expected. This is nearly double the flow needed for rearing at the Rifle Club.

The high correlation between flow needs in the middle Spokane and the lower Spokane somewhat simplifies the work needed to put forth a flow recommendation for protecting fish. The disconnect between the flow needs in the two lower Spokane study sites is the primary complication.

Two things need to be examined before recommending which of the lower Spokane flows should determine the final recommendation. First, how significant is the habitat contribution at the Rifle Club reach. Second, how "steep" is the curve on either side of the recommended flow for the Monroe and Rifle Club sites. If the Rifle Club provides a large amount of habitat, it may be desirable to "sacrifice" some upstream habitat to preserve this reach. If the reaches have similar habitat value, that is they contain approximately the same WUA, the flow that protects the reach in which the amount of habitat changes most rapidly with change in flow should be given preference.