Quality Assurance Project Plan

Spokane River Instream Flow Assessment Project

Submitted to the

Instream Flow Technical Team (IFTT)
WRIA 54 and WRIA 57

C/O Rob Lindsay
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April 2006

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Waterbodies:

Spokane River
River Miles (RM) 64 - 74

Lower Spokane River (WRIA 54) and
Middle Spokane River (WRIA 57) Watersheds

Approvals

Approved by: _____ _____
Rob Lindsay, Spokane County, Lead Agency WRIA 55/57 Date

Approved by: _____ _____
Keith Holliday, Watershed Lead, Department of Ecology Date

Approved by: _____ _____
John Covert, Hydrogeologist, Department of Ecology Date

Approved by: _____ _____
Hal Beecher, Instream Flow Biologist, WDFW Date

Approved by: _____ _____
Pete Rittmueller, Instream Flow Assessment Lead, EESC Date

Table of Contents

Abstract

The Spokane River, located in northeast Washington State, is being studied by planning units organized under the Washington State Watershed Planning Act (Chapter 90.82 Revised Code of Washington, RCW). In response to questions about instream flow and water resource management, EES Consulting, Inc (EESC) under contract to TetraTech/KCM, is undertaking an instream flow assessment. Assessment results will help planning units develop recommendations to protect instream flows in the Spokane River.

This Spokane River Instream Flow Assessment Project is designed to characterize relationships between stream flow and fish habitat on the Lower Spokane River (WRIA 54) and the lowermost portion of the Middle Spokane River (WRIA 57) using analytical tools within the Instream Flow Incremental Methodology (IFIM, Bovee et al. 1998).

Additional instream flow assessments will be completed in selected tributaries to the Lower Spokane River (WRIA 54) using the Toe-Width Method (Swift 1976, 1979).

Background/Problem Statement

Planning units organized under the Washington State Watershed Planning Act (WPA, Chapter 90.82 RCW) are examining instream flow needs and future water supply options in the Spokane River. An assessment of the instream flows in the Spokane River downstream from the falls at Spokane will assist Planning Units with this effort. This QAPP has been developed to assure that results of the instream flow assessment are of the quality necessary for the Planning Units, the Washington Department of Ecology (WDOE) and the Washington Department of Fish & Wildlife (WDFW) to address instream flow issues as part of the Watershed Planning effort.

This QAPP consists of a description of project goals, responsibilities of planning unit representatives and agency reviewers, a schedule, a statement of data quality objectives, field and laboratory methods, study design and methods, quality control procedures, data management procedures, data review and validation, and data quality assessment.

Project Goals and Summary Description

The primary goal of this project is to generate information necessary for planning units to make recommendations to WDOE for protection of instream flows in the Spokane River. The assessment will occur in the Lower Spokane River Water Resource Inventory Area (WRIA 54, Figure 1) and the lowermost portion of the Middle Spokane River Water Resource Inventory Area (WRIA 57, Figure 2).

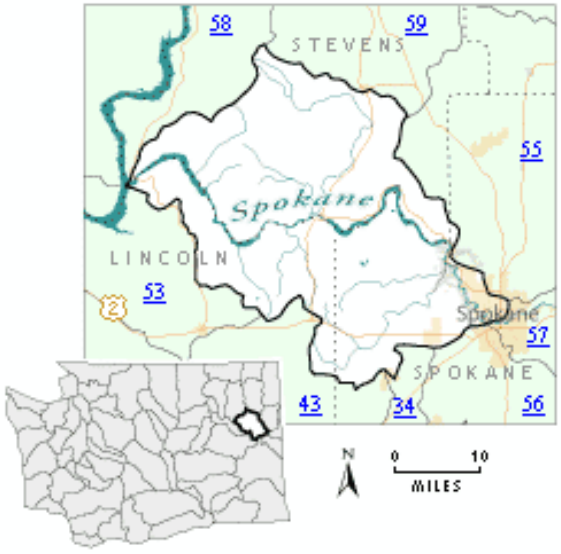

Figure 1. The Lower Spokane River watershed, Water Resource Inventory Area (WRIA) 54.

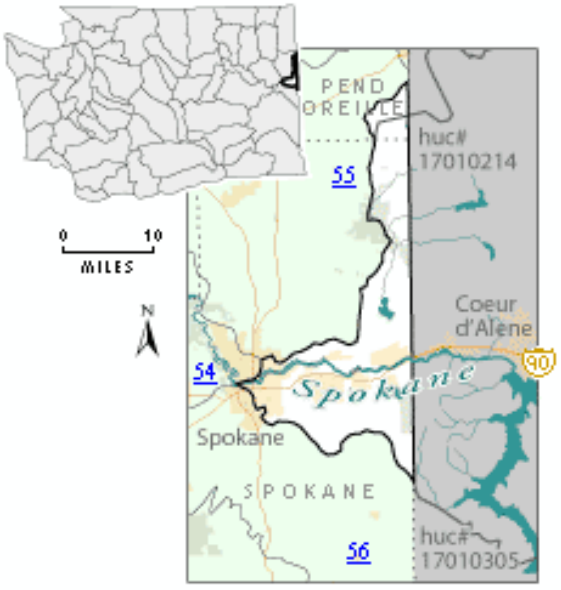

Figure 2. The Middle Spokane River watershed, Water Resource Inventory Area (WRIA) 57.

Responsibilities

Rob Lindsay – Spokane County, Watershed Planning Lead Agency. Rob is responsible for reviewing and approving the QA plan, reviewing and approving the project report, and interacting with the Planning Unit, stakeholders and other interested public (509) 477-6024, rlindsay@spokanecounty.org.

Keith Holliday – Washington Department of Ecology, WRIA 54 and 55/57 Watershed Lead. Keith is responsible for reviewing and approving the QA project plan, reviewing and approving the project report, and interacting with stakeholders and other interested public (509) 329-3431, khol461@ecy.wa.gov.

John Covert – Washington Department of Ecology, Hydrogeologist. John Covert, as technical lead for WDOE, is responsible for reviewing and approving the QA project plan and for reviewing and providing technical comment on the project report (509) 329-3539, jcov461@ecy.wa.gov.

Hal Beecher – WDFW, Instream Flow Biologist. Hal is responsible for reviewing and approving the QA project plan to assure consistency with the instream flow guidelines (WDFW and WDOE 2004); and for providing review and validation of calibration data and other model input data (360) 902-2421, beechhab@dfw.wa.gov.

Jon F. "Pete" Rittmueller – EESC, Instream Flow Assessment Project Lead. Pete is responsible for development of the QA plan, overseeing all elements of the instream flow assessment, and for development of the project report (360) 734-5915, ext. 230; rittmueller@eesconsulting.com.

John Blum – EESC, Senior Fisheries Scientist/Instream Flow Biologist. John is an additional point of contact for field sampling, and is responsible for data management and for review and validation of calibration (360) 734-5915, ext. 231; blum@eesconsulting.com.

Schedule

The Spokane River Instream Flow Assessment Project is scheduled to take place during the 2006 calendar year. In general, scoping and planning would be conducted in the spring, field data collection would be conducted in the summer and early fall (depending on the runoff schedule), and data analysis, model calibration, and reporting would occur in the fall and winter. The anticipated project schedule is presented below in Table 1.

Table 1. Schedule of activites the Spokane River Instream Flow Assessment Project

Task	March	April	May	June	July	August	September	October	November	December
Project Planning and Research										
QAPP Prepraration										
Field Preparation										
High Flow Sampling										
Middle Flow Sampling										
Low Flow Sampling										
Compile/Review Data										
Calibrate Model										
Review and Validate Calibration										
Preprare Draft Report										

Data Quality Objectives

The primary objective of this study is to characterize relationships between stream flow and fish habitat on the Lower Spokane River (WRIA 54) and the lower-most portion of the Middle Spokane River (WRIA 57). In the mainstem Spokane River, these relationships will be developed using a variety of hydraulic models within the Instream Flow Incremental Methodology (IFIM, Bovee et al. 1998). For tributaries to the Lower Spokane River (WRIA 54), relationships will be developed using the Toe-Width Method (Swift 1976, 1979).

The IFIM and the Toe-Width Method do not produce results that can be evaluated for bias or precision. However, analyses performed with IFIM and the Physical Habitat Simulation System (PHABSIM) should be consistent with guidelines developed jointly by WDFW and WDOE (2004) using standardized field techniques.

Bias

There are no specific levels of bias defined for the data to be obtained in this project. Adherence with established protocols will eliminate most sources of bias (Lombard et al, 2001).

Precision

Data quality will be assessed following the model calibration procedure. For "one-flow" hydraulic modeling with PHABSIM, model calibration and data quality are gauged by velocity adjustment factors (VAFs). VAFs represent the relationship between observed and modeled flows, across the range of flows modeled. Ideally VAFs should be 1.0. However, with the one-flow method VAFs between 0.5 and 5 are considered "good" and VAFs between 0.1 and 10 are considered "acceptable" (Payne 2003).

Reporting Limits

PHABSIM results will not exceed reporting limits defined by the instream flow guidelines (WDFW and WDOE 2004). Reporting of model results are not recommended to exceed 2.5 times the highest calibration flow or less that 0.4 times the lowest calibration flow when calibrating velocities from a single set and separating transects.

0.4*Lowest Calibration flow > **PHABSIM REPORTING LIMIT** < 2.5*Highest Calibration flow

Field and Laboratory Methods

A list of the field and laboratory methods that will be used for measurement and analysis of selected study parameters is presented in Table 2. Agency approval of past studies performed by EESC using the methods and equipment identified below demonstrates consistency with agency guidelines (WDFW and WDOE 2004).

Table 2. Parameters measured in the field, method and resolution.

Variable	Method/Reference	Resolution
Discharge	Grover and Harrington 1943	+/- 5%
Velocity	Swoffer or ADCP	+/-0.1 ft./sec.
Depth	Topset wading rod or ADCP	+/-0.05 feet
Substrate and Cover	WDFW and WDOE 2004	n.a.
Water Surface Elevation	Autolevel and Stadia	+/-0.01 feet
Streambed Profile	ADCP and Auto-level/Stadia	+/-0.1 feet
Benchmark and Headpin Elevation	Auto-level and Stadia	+/-0.01 feet
Toe-Width	Swift 1976, 1979	+/-0.1 feet
Fish Habitat Curve Verification	WDFW and WDOE 2004	n.a.
Hydraulic Model Calibration	WDFW and WDOE 2004	n.a.
Habitat Modeling	WDFW and WDOE 2004	n.a.

Study Design and Methods

The primary method used in this study will be the USFWS Instream Flow Incremental Methodology (IFIM) with specific application of PHABSIM (Physical Habitat Simulation). Generally, instream flow study procedures will follow the Instream Flow Study Guidelines (WDFW and WDOE 2004). The PHABSIM method is based on the premise that stream dwelling fish prefer a certain range of depths, velocities, substrates and cover types, depending on the species and life stage, and that the availability of these preferred habitat conditions varies with streamflow. With input from streamflow, substrate, and cover type measurements, PHABSIM will quantify habitat availability over a range of flows. It is important for the water manager to recognize that the result of the study is not a set value but a range of values to be used as a tool for determining relative amounts of habitat available at various stream flows.

A secondary method will be completed in selected tributaries to the Lower Spokane River (WRIA 54) using the Toe-Width Method (Swift 1976, 1979).

Physical Habitat Surveys

A survey of the Spokane River from the Monroe Street Bridge to the backwater from the 9 Mile Reservoir has already been completed. The purpose of the survey was to give an overview of the study area and to determine the types of habitat found within the study area. This information was used to select transects and segment the systems into study reaches. This information, and a habitat frequency analysis, will further be used to finalize transect weighting for the PHABSIM model for each stream.

PHABSIM Approach

The hydraulic analysis for the Spokane River will follow the one-flow method as described in Payne (2003). This method uses one set of velocity measurements and a water surface elevation (WSE), usually at the high flow, and two additional stage discharge points as input to the PHABSIM model to generate hydraulic simulations for the desired range of flows.

Transect Selection

Consolidation of stream segments is necessary to integrate the physical and biological attributes identified in the physical habitat surveys and to define a reasonable number of study sites for instream flow analysis. Transect selection was based primarily upon the results of habitat surveys. Transects are used to model available fish habitat important to a species or life stage of interest. Criteria for transect selection include the following:

a) Habitat types and micro habitat features and/or critical habitat are representative of target species and life stages within the study reach;

b) Physical features such as vertical banks will not hinder measurements;

c) Stream hydraulics are amenable to accepted computer-modeling methods; and

d) Site accessibility.

An agency site visit and consultation meeting was held on March 30, 2006 for all segments and transects. Transects and segments were approved, consistent with agency guidelines (WDFW and WDOE 2004). Table 3 shows final study site segmentation for the Spokane River in WRIAs 54 and 57. A total of 7 transects were approved by planning unit representatives and the agencies. Transect locations and descriptions are shown in Table 3.

Table 3. Spokane River instream flow study segments, transect locations and descriptions.

WRIA #	Transect Number	Stream Channel/Habitat Type	Location
57	Transect A	Run	500 feet to 800 feet downstream from the USGS gage
	Transect B	Smooth glide	300 feet downstream from the USGS cableway
54	Transect A	Medium-width glide	300 feet downstream of riffle, downstream of Rifle Club
	Transect B	Pool-glide complex	200 feet upstream of Transect A
	Transect C	Medium-fast run	Upper half of Rifle Club
	Transect D	Medium run	Upper half of Rifle Club
	Transect E	Glide-run transition	Upper quarter of Rifle Club

PHABSIM Field Measurements

As mentioned in *PHABSIM Approach*, the main methodology to be employed to evaluate habitat on the Spokane River will be the one-flow method (Payne 2003). The one-flow method uses one full set of depth and velocity data across stations for each transect, typically at the high calibration flow. Water surface elevations (WSEs) will be taken at the calibration measurement, as well as at the two other calibration flows (typically medium and low flow). Discharge measurements will be taken at the middle and low flows, as required at study sites and split channels. Substrate and cover are recorded for each station along all transects.

Depth and Velocity Measurements

Depth and velocity measurements in wadeable sections of each transect will be made with a USGS topset wading rod and a Swoffer current meter. In deeper sections, depth and velocity will be measured with an RD Instruments, Acoustic Doppler Current Profiler (ADCP). The ADCP with bottom tracking, accurately measures depth and velocity along a course while simultaneously indexing each measurement relative to the point of origin. The bottom tracking and depth stratification features makes the instrument compatible with the “transect method” of measuring hydraulic variables.

Surveying Methods

Water surface elevations will be surveyed, relative to benchmarks and headpins, at each flow with an auto-level and stadia rod. Where feasible, benchmarks of transects in each study site will be "tied together" by surveying their relative elevation.

Substrate and Cover

Standard substrate and cover codes will be used, as recommended in the Instream Flow Study Guidelines (WDFW and WDOE 2004). These codes will be used unless modified during discussions with the agencies.

Calibration Flows

The EESC Team will attempt to measure WSEs, depths and velocities at the following ranges of flows:

Table 4. Estimated calibration flow range for the Spokane River study.

WRIA	High Calibration	Medium Calibration	Low Calibration
54	3,00 – 5,000	1,300 – 2,500	600 – 1,000
57	2,500 – 4,500	1,250 – 2,200	600 – 1,000

Riffle Photo Points

Photo points will be established and used as a quality assurance tool. Photos will be used to qualitatively evaluate flow over riffles. Results will assure that riffle habitat is not being excessively diminished as flows diminish. Wetted width will be calculated from photos over a range of flows (approximately 600 cfs to 10,000 cfs) using the following approach:

- Two (2) photos will be taken at fixed photo points. Photo 1 will illustrate the entire cross section. Photo 2 will only illustrate the riffle;
- Photo-points will be marked with ground paint or a marker;
- Riffle photo end points will be at a point slightly above the high water mark; and,
- Riffle photos will be vertically centered.

The same camera will be used at all flows for each cross-section. Camera settings will be held constant for each cross-section. Settings will be recorded in a notebook and referenced prior to subsequent pictures taken at each site Magnification will be held constant. A hard copy of previous pictures at each cross-section will be used to verify the photo-point, magnificent, and framing.

Photos will be downloaded, labeled with location, date and time, printed and put in both a hardcopy and electronic file. Electronic record of photos and associated information will be kept by both Spokane County and EESC.

Toe Width Field Methods

Toe-width can only be measured in the field. The toe-of-bank is defined by Swift (1979) as the point where the streambed and one stream bank join (Figure 3).

EESC will collaborate with Washington State agency instream flow experts while selecting toe-width cross-sections. Each cross-section will be established at a pool tailout, perpendicular to the streamflow. A tape, in tenths of foot increments, will be stretched horizontally across the channel. EESC will use a properly maintained and calibrated auto level and stadia rod to measure elevation of the stream bed and banks. EESC will survey significant breaks in slope along the tape. The toe-of-bank on both stream banks, for each transect, will be surveyed and noted. End points of each transect will be established well above bottom of bank, but no higher than the bankfull discharge elevation. Distance between transects may vary depending on the channel morphology of the stream. Therefore multiple transects are necessary per reach evaluate with this method.

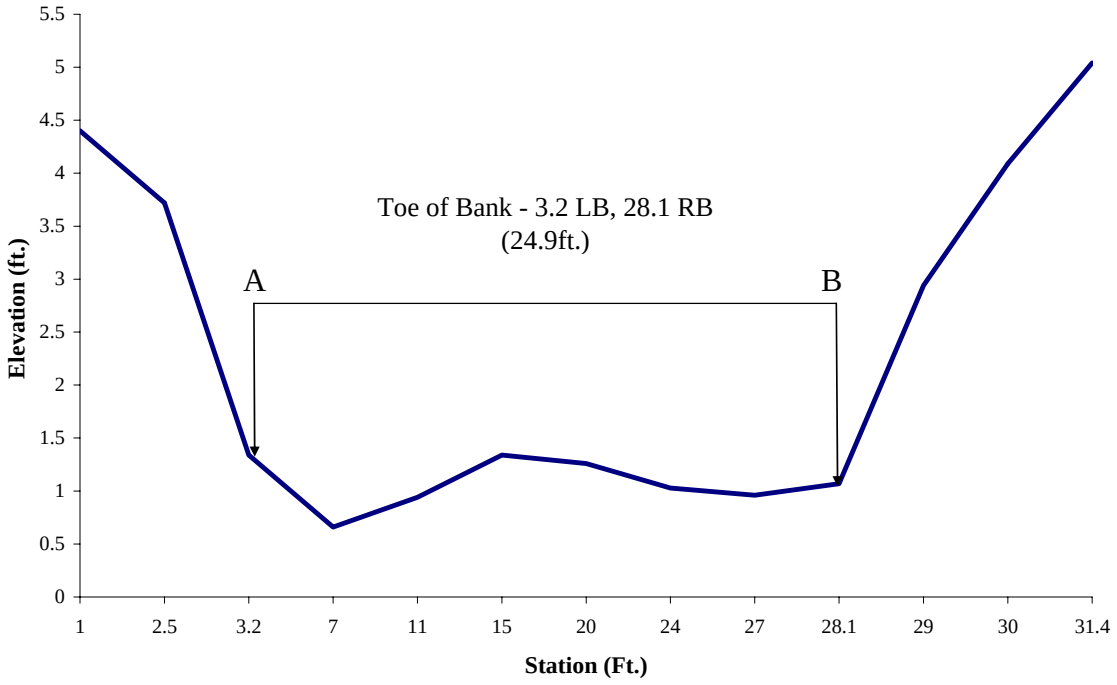

Figure 3. The toe-width of a hypothetical stream cross-section is measured between point A (toe of left-bank, LB) and point B (toe of right-bank, RB)..

Toe Width Analyses

Station and elevation data from field notes will we entered into a spreadsheet. Toe-Width distances will be computed for each transect at each site. An average toe-width (TW) distance will be calculated for each site.

EESC will use the average site toe-width (TW) to calculate the discharge (Q_r) for the steelhead (*Oncorhynchus mykiss*) rearing life history stage according to the following equation (Swift 1976):

$$Q_r = 0.164(TW)^{1.42} \pm 56$$

Quality Control Procedures

Field Quality Control

A number of quality control and quality assurance tests will be conducted during this study including calibration of equipment and quality control for field techniques.

All meters and measuring devices will be calibrated according to manufacturer's guidelines. The auto-level and ADCP will be calibrated at the start of the field season. The ADCP will be field-tested prior to transect measurement. Velocity meters will be calibrated at the start of each sampling day.

PHABSIM field measurements will follow the procedures as described by the USGS Instream Flow Group (Bovee et al. 1998) as further defined by WDFW and WDOE (2004). Toe-Width field measurements will follow the approach described in Swift (1976, 1979). Multiple measurements of toe-width will be made on multiple reaches for each tributary sampled.

Representativeness

Collaboration with Washington State instream flow experts is necessary to assure that this Spokane River Instream Flow Assessment Project produces representative results. EESC will collaborate with experts on both PHABSIM and Toe-Width field techniques.

The Instream Flow Study Guidelines (WDFW and WDOE 2004) were developed to assure PHABSIM model output products are representative. EESC will focus interactions with Washington State instream flow experts on two important field quality control components: transect selection and calibration flow selection. EESC will secure concurrence from Washington State instream flow experts for both components to assure that hydraulic, biologic, and hydrologic model inputs are representative of the Spokane River in the study area.

EESC will also work with Washington State instream flow experts selecting representative reaches and transects necessary to complete toe-width analyses.

Completeness

EESC will collaborate with Washington State instream flow experts and the Instream Flow Technical Team (IFTT) to maximize the amount of useable information to be collected during this study. EESC will follow accepted protocols, procedures, and guidelines. Appropriately calibrated equipment will be used to sample at pre-authorized transects, when pre-approved calibration flow levels are present.

Comparability

PHABSIM and Toe-Width are two of the most commonly applied approaches to instream flow assessment in Washington State (WDOE 2006). Use of these standard approaches will assure comparability of results from this assessment with instream flow assessments made with the same methods elsewhere in Washington State. Additionally, the Toe-Width approach was developed with the intent to have results represent habitat requirements measured using habitat-based approaches (Swift 1976, 1979).

Lab Quality Control

Once field data have been collected, data will be entered into appropriate spreadsheet files, and checked for completeness and against field notes to determine if there were any data entry errors. For PHASBSIM analyses, data will be imported into the PHABSIM model, checked for errors using PHABSIM tools, and saved in original form prior to calibration. Data will be calibrated consistent with agency guidelines (WDFW and WDOE 2004). Calibrated hydraulic data files and habitat preference data will be reviewed and verified with Washington State instream flow experts prior to habitat modeling.

Data Management Procedures

Field data will be recorded at the time of collection. Records will be kept in a field notebook, or directly input and saved in digital files on a computer. Copies will be made of field notes and data files and stored in a separate location from the originals.

Calibration and output data generated during modeling with PHABSIM will be managed by EESC. Draft model calibration results will be reviewed with the agencies consistent with the instream flow guidelines (WDOE 2004). Pre-calibration, post-calibration, and post-modeling files will be saved. Final calibration and output data will be sent to the watershed assessment project manager, watershed lead, and Lead Agency in digital and printed format. The Lead Agency and watershed lead are responsible for further distribution to the Planning Unit, stakeholders and other interested public.

Data Review and Validation

EESC and Washington State instream flow experts will review data generated by EESC prior to distribution to the watershed assessment project manager and Lead Agency, Planning Unit, stakeholders and interested public. Review and approval procedures will be in accordance with the instream flow guidelines (WDOE 2004).

Upon receipt of the verified data from EESC, agency experts will compare the quality assurance and analysis performance information against the data quality objectives. Data will be assessed for completeness and for indications of bias introduced by field

procedures. Agency instream flow experts will share findings with EESC, the watershed lead and Lead Agency. If appropriate, sampling approach, quality control steps, or analytical procedures will be modified for future sampling or modeling rounds to address identified problems.

Bias

There are no specific levels of bias defined for the data to be obtained in this project. Adherence with established protocols will eliminate most sources of bias (Lombard et al, 2001).

Precision

Data quality for "one-flow" hydraulic modeling using PHABSIM is gauged with velocity adjustment factors (VAFs). VAFs represent the relationship between observed and modeled flows, across the range of flows modeled. Ideally VAFs should be 1.0. However, with the one-flow method VAFs between 0.5 and 5 are considered "good" and VAFs between 0.1 and 10 are considered "acceptable" (Payne 2003).

Completeness

The data review and validation process with agency instream flow experts will be used to identify those analytical results that fail to meet the data quality objectives of the project.

Data Quality Assessment

Upon completion of the data review and validation process with agency instream flow experts, the calibration details and output data sets will be sent to the watershed assessment project manager, watershed lead, and lead agency for review and evaluation for representativeness and completeness. Data quality and model performance will be assessed against the project goals. The watershed assessment project manager, watershed lead, and Lead Agency will work with the instream flow assessment project lead and planning unit members to determine the applicability of the data and reports to resolution of instream flow and water resource management issues in the Spokane River.

References

Bovee, K.D., B.L. Lamb, J.M. Bartholow, C.B. Stalnaker, J. Taylor and J. Henrickson. 1998. Stream habitat analysis using the instream flow incremental methodology. U.S. Geological Survey, Biological Resources Division Information and Technology Report USGS/BRD-1998-0004. viii + 131 pp.

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Payne, T.R. 2003. The Influence of Multiple Calibration Velocity Sets on the PHASBSIM Habitat Index. IFIM Users Workshop, Ft. Collins, CO, June 2003.

Swift III, C. H. 1976. Estimation of Stream Discharges Preferred by Steelhead Trout for Spawning and Rearing in Western Washington. USGS Open-File Report 75-155. Tacoma, Washington.

Swift III, C. H. 1979. Preferred Stream Discharges for Salmon Spawning and Rearing in Washington. USGS Open-File Report 77-422. Tacoma, Washington.

Washington Department of Fish and Wildlife (WDFW) and Washington Department of Ecology (WDOE). 2004. Instream Flow Guidelines: Technical and Habitat Suitability Issues. Number 04-11-0007. 64 pp.

Washington Department of Ecology (WDOE). 2006. http://www.ecy.wa.gov/programs/wr/instream-flows/isfsci.html

Appendix A

PROJECT:_____
STREAM:_____

Documentation of consultation with WDFW on instream flow studies - all blanks must be signed by WDFW personnel for completion of consultation.

SCOPING

Study site(s) approved_____date__/__/__
Transects approved_____date__/__/__
Target measurement flows approved_____date__/__/__

HYDRAULIC MODEL

Measured flows approved_____date__/__/__
Hydraulic model approved for the following ranges: date__/__/__

HABITAT PREFERENCE CURVES

Preference curve study design approved (including species, lifestages)
_____date__/__/__
Preference curve study completed _____date__/__/__
Preference curves approved (copy to be attached) _____date__/__/__

INSTREAM FLOWS - LIST BY TIME PERIOD:

MONTH/DATE to MONTH/DATE MINIMUM FLOW (cfs)

_____/____ to _____/____ _____
_____/____ to _____/____ _____
_____/____ to _____/____ _____
_____/____ to _____/____ _____
_____/____ to _____/____ _____
_____/____ to _____/____ _____
_____/____ to _____/____ _____

FLUSHING FLOW REQUIREMENT - >48 HRS/3 YRS _____ cfs

Approved by Department of Fish and Wildlife

_____date__/__/__
Instream Flow Biologist

_____date__/__/__
Regional Habitat Biologist