

Exhibit A- Scope of Work

(Snohomish County)

The Stillaguamish Flow Assessment Team (SFAT)

The Stillaguamish Flow Assessment Team (SFAT) is composed of Northwest Hydraulic Consultants (NHC), the Stillaguamish Tribe Natural Resources Department, Keta Waters, and Snohomish County Surface Water Management. This scope referred to in item 4 of the attached contract covers work that will be done for this project by SWM as members of the SFAT managed and coordinated by NHC. SWM's services for this project will be provided under this agreement while the other members of the team will provide services under a separate agreement between PSSS and NHC. NHC will act as the coordinator of technical work under both agreements.

Base Agreement Tasks

The tasks under the heading "Base Agreement Tasks" represent the scope of work of to be completed under this agreement between the PSSS and SWM. Additional optional tasks that would require an increase in the NTE amount of this agreement are described under the heading "Optional Tasks"

Task 1: Assess Instream Flow Hydrology and Effects on Salmon Recovery

Task 1 is broken down into a series of sub-tasks. The emphasis of the overall task will be to address the ecological consequences of flow changes which are the result of past and anticipated land use and flow management actions.

Task 1a. Semi-Quantitative Analysis of Flow Management Actions and Hydrologic Effects.

In Task 1a an inventory will be made of the pertinent flow management actions in each pilot basin which have already occurred and those which are anticipated to occur. Flow management actions are considered here to broadly include all anthropogenic actions with direct and indirect effects on streamflows. In this context, flow management actions encompass:

- 1) land management issues and land use change in particular;
- 2) development regulations including forest harvest practices, sensitive areas ordinances, land use zoning, and stormwater management codes;
- 3) water right issues including currently permitted withdrawals, present and future exempt withdrawals, inchoate (permitted but not yet exercised) water rights, and instream flow regulations;

- 4) water management issues including water storage for consumptive supply and/or streamflow augmentation, interbasin transfers of potable water supplies, and interbasin transfers of wastewater discharges and reclaimed water; and
- 5) water conservation and efficient use practices.

Results from Task 1a will provide necessary input to the subsequent characterization of hydrologic conditions as well as a basis for identifying potential future management implications to undo or mitigate past management actions.

Deliverables: SWM staff will support the SFAT with collection, transmission, and interpretation of available data and the drafting and review of a technical memorandum for submission to PSSS.

Task 1b. Review/Prioritize Hypothetical Mechanisms for Salmon-Sensitive Flow Change in the Pilot Basins.

A targeted review of available literature will be conducted of ecological impacts related to shifts in magnitude, timing, duration, and flashiness of flow as well as flow-related effects such as shifts in stream hydraulics, sedimentation, and geomorphic conditions. The review will include but will not necessarily be limited to the latest available literature on Indicators of Hydrologic Alteration (IHA) and Range of Variability Approach (RVA) along with any recent refinements to these methods developed by the King County Normative Flow project. Flow parameters and impact mechanisms identified in this review will be screened and prioritized in light of the flow-affecting management actions identified in Task 1a, and available literature and data on coho and chinook habitat conditions, salmon populations, and life histories in the pilot basins. Based on the flow parameter literature review and knowledge of relevant pilot basin conditions, a set of reach-specific hypotheses will be developed regarding potential, current and future, salmon-relevant, ecological impacts caused by flow changes associated with land use and water withdrawals.

Deliverables: SWM staff will support the SFAT with collection and interpretation of available data and the preparation and review of a referenced literature review and list of hypotheses related to ecological impacts of flow regime-linked basin management actions.

Task 1c. Hydrologic Modeling, Flow Parameter Extraction and Analysis.

HSPF models for the two pilot basins will be used to simulate continuous, long term flow hydrographs from which selected parameters will be extracted for comparison of past, present, and future conditions. Four scenarios will be simulated: pristine (a.k.a. "Template"), current, and at least two future scenarios that reflect reasonable "low" and "high" mitigation measures related to flow regime in the two basins. For each of these scenarios, hydrologic parameters prioritized for "focal" salmon species in the pilot basins will be extracted compared, and analyzed. These parameters will be identified based on a targeted review of available literature conducted in Task 1b.

Deliverables: Provision of all relevant GIS and hydrologic time series data (including but not exclusive to shapefiles of soils, surficial geology, vegetation cover, hydrography, topography, subbasins, sensitive areas, and text-based electronic files of stream flow, and precipitation data) to the SFAT.

Task 1d. Incorporate Hydrologic Modeling Results into Reach Scale Salmon Effects Models

The SFAT will apply two different approaches, Ecosystem Diagnosis and Treatment (EDT) and a simpler, lumped index method. With the EDT approach, we will take up the challenge of deriving, documenting, and applying relationships between the model's inputs (data and parameters) and flow regime information derived in previous tasks. Three tiers of flow-affected EDT inputs that reflect descending levels of precision and confidence with regard to their relationship to flow regime data. Tier-1 will include at least four "Level 2 Environmental Attribute values" in EDT that can be directly identified with relatively high precision and confidence from hydrologic modeling data. Tier-2 and Tier-3 will require supplemental relationships or models and inferences that represent the mechanisms connecting flow regime to EDT parameters for bed scour, embeddedness, fine sediment, temperature, dissolved oxygen, and turbidity, as well as physical habitat structure and size. With regard to some of these parameters, hydraulic modeling or analysis techniques such as HEC-RAS may be employed to assess spatial variation of depth, velocity, wetted area, and perimeter in addition to sediment transport capacity, in order develop a linkage between flow regime and Tier-2 and Tier-3 parameters.

The second approach will modify and apply methods pioneered by Snohomish County of directly evaluating subbasin and habitat characteristics throughout using the Matrix of Pathways and Indicators (NMFS 1996) and/or Quality Indices (May et al. 1997). Modifications will be oriented toward increasing the flow regime sensitivity of these methods. Hydrologic outputs and *a priori* knowledge of current habitat (e.g., Snohomish County SWM 2003) and water quality conditions can be listed as indicators of salmon productivity and compared with Matrix Values. This approach will rely on Snohomish County SWM's databases of water quality and invertebrate data collected Stillaguamish Watershed since 1991 in order to directly tie environmental conditions to fish productivity, assemblage diversity, and relative abundance.

Deliverables: SWM will provide key expertise and support to the SFAT in the interpretation and development of ecological methods and their linkage to flow regime. SWM will contribute to the preparation of a technical memorandum that describes the methods and approaches to be used in Salmon Effects modeling.

Task 1e. Application of Procedures to Estimate Human-Induced Flow Regime Change on Salmon

EDT and the modified index approach described in Task 1d will be applied to the

four scenarios described in Task 1c, pristine, current, and two alternative future flow regimes, in Pilchuck Creek Basin and Church Creek Basin as indicated in the following modeling application table:

	EDT Modeling	Modified Index Approach
Pilchuck Creek/chinook	Yes	Possible
Pilchuck Creek/coho	Yes	Yes
Church Creek/coho	Possible	Yes

EDT modeling for both chinook and coho in Pilchuck Creek will be performed. The EDT results for coho in Pilchuck Creek will provide an opportunity to calibrate the modified index approach for subsequent application to coho populations in Church Creek

Model applications listed as “possible” will be considered for completion by the SFAT subject to two necessary conditions: first, actual costs and progress in completing other work described in this agreement as determined by SWM, and second, the PSSS’s desire to have these modeling applications completed as part of the project.

In applying the existing EDT model, Pilchuck Creek stream reaches will be checked and re- characterized as necessary to show proper sensitivity to the spatial distribution of flow related management practices. Model runs for template, current, and alternative future conditions will be used to derive standard reports. These reports will inform stakeholders about current management actions that are likely to cause unacceptable degradation as measured by life history diversity, productivity, capacity, and equilibrium abundance of the species of concern (i.e., chinook salmon, coho salmon). Similarly, reports will suggest flow-related restoration and protection actions to be considered by stakeholders. It should be noted that iterations or sensitivity runs with the ecosystem model may be necessary to finalize future alternative scenarios represented in the hydrologic modeling described in 1c.

Deliverables: SWM lead the EDT and Index-based modeling applications for this task, contribute to the preparation of the technical memorandum documenting the model applications and results. Further, SWM will assume all costs associated with development, maintenance, and access by the SFAT and PSSS to EDT models employed by the project for its entire duration, but in no case for a period longer than six months.

Task 2 Management Implications of Flow-Related Salmonid Impacts Analysis

Conclusions that can be drawn from Task 1 results will be utilized to formulate pilot basin management options and to describe their likely implications for flow regime-related impacts on salmon. Management options that may be considered include, but are not limited to, enhanced stormwater BMP requirements, impervious area and clearing limit restrictions, instream flow

recommendations, enhanced water conservation, water supply storage, or water source substitution. Descriptions of individual management actions will include an assessment of the strength of the relationship linking them to flow changes and salmon impacts as informed by the results of Task 1 work.

Deliverables: Senior SWM staff will assist with preparation and review of the memorandum detailing the potential management options and implications.

Task 3 Communication of Findings

To enhance transferability of this pilot project, all reviews, applied methods, and assumptions will be documented in a series of sub-task and task-level memoranda. These memoranda will form the basis of a draft and final report documenting the pilot study to facilitate replication of project successes and avoidance of project pitfalls in other stream basins within the Puget Sound Basin. The draft report in the form of an electronic WORD document will be provided to the PSSS for review.

It will be the responsibility of the PSSS to coordinate the review process and provide SWM with a consolidated set of comments from which SWM will prepare and submit final version of the report in both electronic and hard copy form together with all supporting electronic files and data associated with the project.

Additionally, the **SFAT** will document and communicate the preliminary and final results of the study in the form of oral presentations, develop a PowerPoint slide show on the project, submit an abstract for presentation at a suitable regional or national conference, and send a team representative to present the project at the conference contingent on acceptance of the abstract by the conference organizers.

Deliverables: SWM staff will assist in the development of a Powerpoint slide show, project, and making oral presentations of results at two half-day meetings, and in preparing an abstract for presentation of the project at regional or national conference.

Task 4 Project Management and Quality Assurance/Quality Control (QA/QC)

SWM will provide the PSSS with a single point of contact for the technical work of the entire SFAT and will coordinate the work all SFAT members. Dr. David M. Hartley will be the SWM Principal-in-Charge and project manager for this project and will be the designated point of contact for both technical and administrative service to the PSSS under this agreement. Additionally, he will coordinate the technical work of the entire SFAT with regard to development of integrated, quality-assured deliverables. In the event of Dr. Hartley's unforeseen absence or incapacity, Mr. Bill Rozeboom, SWM Senior Engineer, will provide these services to the PSSS.

For its part, the PSSS agrees to assign one or two individuals as coordinators for this project and if two individuals will be assigned, one will be assigned as a technical coordinator and the other as an administrative coordinator.

Deliverables: SWM staff will attend monthly or as-necessary meetings or participate in conference calls with representatives of the PSSS Water Quantity Subcommittee, provide monthly progress reports to the SFAT project coordinator and PSSS describing: completed work items, expected work for the upcoming month, and the status of the project budget and schedule, and coordinate and review all project work with the NHC project manager assure the quality of all products delivered by the SFAT to PSSS.

Optional Tasks

Tasks 5 and Task 6 are described here for the consideration of the PSSS. Performance of task 5 or task 6 in this project would require an increase in the NTE of the attached agreement as well as the contract between NHC and PSSS as noted below.

Task 5 Coordination with NOAA Fisheries to Support SHIRAZZ Modeling

The Shared Strategy Subcommittee on Water Quantity has expressed an interest in having the SFAT coordinate its work with NOAA Fisheries to facilitate SHIRAZZ modeling in the project pilot basins. Two alternative levels of coordination are described below as 5a or 5b:

Alternative 5a, “high” coordination for SHIRAZZ. The SFAT will coordinate with the NOAA-Fisheries scientific team as they identify hydrologic parameters for input into the SHIRAZZ model of the Snohomish Watershed in the first quarter of 2005. Coordination will be accomplished through meetings, conference calls, and e-mail communications. Once these hydrologic inputs (statistics or data) have been identified, the SFAT will perform necessary database programming and calculate these inputs at key locations within the Stillaguamish pilot study basins. The inputs and key locations will be defined and documented in a brief technical memorandum.

Deliverables: None. Note that SWM staff will not have a role or responsibilities under this alternative.

Alternative 5b, “low” coordination for SHIRAZZ. The SFAT will coordinate with the NOAA-Fisheries scientific team as they identify hydrologic parameters for input into the SHIRAZZ model of the Snohomish Watershed in the first quarter of 2005. Coordination through conference calls, and e-mail communications. Once these hydrologic inputs (statistics or data) have been identified, the SFAT will develop a technical memorandum comparing the hydrologic inputs and the relative flow-regime sensitivity of SHIRAZZ (as implemented in the Snohomish Watershed) and EDT (as implemented in the pilot basins of the Stillaguamish Watershed).

Deliverables: Support in preparation and review of a technical memorandum comparing the how each of the two models utilize flow regime parameters.

Task 6 Additional Future Scenario

The Shared Strategy Subcommittee on Water Quantity has expressed in possibly having an additional future scenario modeled in addition to the “high” and “low” future mitigation scenarios described in the base agreement scope. If this task is funded and implemented, the purpose and definition of this 3rd scenario will be determine through dialogue with the Shared Strategy Subcommittee on Water Quantity and/or Shared Strategy’s project technical lead. One possible purpose of this scenario would be locate and demonstrate the “inflection point” in salmon population response as predicted by EDT or index methods associated with future land use or water withdrawal. Another purpose for a third modeling scenario would be to represent a more realistic urbanization “end point” based on methods than in the literature as compared with a more traditional future “build out” scenario adopted in regional basin plans.

Deliverables: All deliverables described in the Base Agreement Scope associated with Tasks 1c, 1d, 1e, 2, 3, and 4 would be augmented appropriately to reflect addition of a 3rd future scenario.

Estimated Project Schedule

The following schedule represents an estimate of project progress based on a project start date of January 10, 2005. Upon execution of this agreement, the lead SWM staff on the SFAT, Mr. Michael Purser will initiate work in coordinated with the NHC project manager, Dr. Hartley.

Task	Description	Interim Deliverable	Due Date-Draft	Due Date-Final
1a	Analysis of pilot basin flow management actions	SWM contribution to SFAT deliverables under NHC-PSSS agreement	2/9/05	2/23/05
1b	Literature review, basin review, and hypotheses	SWM contribution to SFAT deliverables under NHC-PSSS agreement	2/21/05	3/2/05
1c	Hydrologic Modeling and Analysis	SWM contribution to SFAT deliverables under NHC-PSSS agreement	3/9/05	3/23/05
1d	Interpret Model Results at Reach Scale	SWM contribution to SFAT deliverables under NHC-PSSS agreement	3/23/05	4/6/05
1e	Estimation of Human-Induced Flow Regime Change on Salmon	SWM contribution to SFAT deliverables under NHC-PSSS agreement	4/27/05	5/11/05
2	Management Implications	SWM contribution to SFAT deliverables under NHC	5/18/05	6/1/05
3	Communications of Findings	SWM contribution to SFAT deliverables under NHC-PSSS agreement	6/8/05	6/22/05