Evaluating and Designating Fisheries Sensitive Watersheds (FSW)

An Overview of B.C.'s New FSW Procedure

DRAFT

August 2006

BC Ministry of Environment

Abstract

Fisheries sensitive watersheds (FSW) in British Columbia are an important social, economic, and ecological feature of the Province's landscape. To help conserve fisheries values within these watersheds, and consistent with the provisions provided under the *Forest and Range Practices Act* (FRPA) and the Government Actions Regulation (GAR), the Ministry of Environment (MOE) is in the final stage of preparing a procedure to evaluate and designate FSWs. This document is intended to facilitate the sharing of FSW technical and procedural information with affected parties, various levels of government, agencies, and key stakeholders. The document outlines essential areas of the new FSW designation procedure beginning with a description of the context in which the procedure was developed. Second, it provides an overview of the four main procedural steps involved in evaluating FSW candidates to determine their suitability for legal designation under GAR. Third, it explains how evaluation consistency, both provincially and within FSW Evaluation Units, is achieved by using the Watershed Evaluation Tool (WET) and associated data. And finally, the document summarizes the construct and application of the WET prototype, a tool that forms the basis for the new FSW procedure.

Acknowledgements

The authors[1] are grateful to the many individuals who have provided invaluable comment and contribution to both the technical and regulatory aspects of the WET and the new FSW procedure during the course of its development. They specifically wish to acknowledge the following individuals for their significant past or ongoing efforts: Martin Carver, Ted Down, Stewart Guy, Gord Mackinnon, Dave Marmorek, Craig Mount, Mark Nieltz, Marc Porter, and Rodger Stewart.

[1] Lars Reese-Hansen, Ecosystems Biologist, Planning Section, Ministry of Environment, and Eric Parkinson, Senior Research Scientist, Fish Sciences, Ministry of Environment and University of British Columbia.

Contents

List of Tables

List of Figures

List of Appendices

1. Introduction

Distributed across the diverse landscapes characterizing British Columbia are vast networks of rivers and streams hosting world-renowned fisheries values. Over the millennia these values have provided significant social, cultural, ecological, and economic benefits to the province. In some instances, maintaining these values while using forest resources requires modified management strategies to sustain the multitude of benefits provided by these important ecosystems.

Recognizing the value of fish, and fish-producing ecosystems, local, provincial, and federal levels of government have made various attempts over several decades to institute measures intended to conserve fish and their habitat. Typically, these efforts were focused on enhancing specific stocks or habitats, and often were ad hoc in nature, making relative comparisons of their effectiveness impossible or subjective. These measures seldom considered the influence of anthropogenic activities beyond the site-specific stream location of interest. Today, science has shown that there are clear linkages between upland and upstream condition and management practices, and the influence these have on the aquatic habitat characteristics necessary to sustain healthy fish populations in downstream reaches (Hogan and Bird 1998; Reid 1998a; Church and Eaton 2001).

Under the *Forest and Range Practices Act* (FRPA) and the Government Actions Regulation (GAR), the Ministry of Environment (MOE) is developing policy and procedures that will guide a program for evaluating and designating drainages as "fisheries sensitive watersheds" (FSWs). Once a drainage is so designated, forest and range operators will be required to undertake practices that maintain the natural watershed processes that conserve the ecological attributes necessary to protect and sustain fish and their habitat.

This document describes the procedural and technical process the Ministry will use to evaluate watersheds and, where appropriate, designate a candidate as an FSW. The document is divided into four sections:

- Section 1 describes background information fundamental to the development of the FSW program.
- Section 2 details the procedural and technical steps required to evaluate watersheds.
- Section 3 explains the workings of the watershed evaluation tool (WET).
- Section 4 provides an overview of methods applicable to FSW pilot programs that will be conducted this year.

1.1 Program Direction and Goals

Implementation of an effective FSW program is a high priority for the government of British Columbia. This priority is reflected in a number of government pronouncements. For example, in 2005, government recognized the considerable benefits derived from British Columbia's natural resources, including fisheries resources, by establishing as one of its five goals for the next decade (Campagnolo 2005):

"To lead the world in sustainable
environmental management, with the
best air and water quality, and the
best fisheries management, bar none."

Consistent with government's goals, MOE is undertaking its statutory, business, and service planning commitments by demonstrating that implementation of the FSW program is a high Ministry priority. Recognizing the priority of the FSW initiative, several principles have been established to guide the FSW program and its development, thereby assuring its success. These principles are to:

1. Strive for procedural consistency across the province and within each FSW evaluation unit when identifying and establishing an FSW for the purposes of FRPA.
2. Ensure that the process applied to identification of an FSW is technically and procedurally defensible.
3. Consider the best available science/data.
4. Actively apply the principles of continuous improvement and adaptive management, including modifying the procedural tools in light of better science and information.
5. Emphasize operational and procedural efficiency and timeliness.
6. Ensure that procedures to identify and establish an FSW are open and transparent.

1.2 Regulatory Requirements

The authority to establish FSWs is provided by the Government Actions Regulation (GAR). The definition provided in GAR Section 14(1) describes an FSW as a watershed that exhibits two specific characteristics: 1) significant fisheries values, and 2) watershed sensitivity. (Section 14 of the GAR is provided in Appendix 5, together with a Web link to the full text of the regulation.)

For a watershed exhibiting these two characteristics, the Minister of Environment (or delegate) has authority under the provisions of GAR to establish:

- specific objectives describing the desired condition, or conditions, required to conserve fish habitat in the FSW, and
- spatial boundaries delineating the geographic area of the watershed to which the FSW Order applies.

When a watershed is designated as an FSW and provided with an objective, provisions of the *Forest and Range Practices Act* require the content of a *Forest Act* licensee's Forest Stewardship Plan (FSP) to be consistent with objectives for the FSW.

Persons required to prepare operational plans under the *Forest and Range Practices Act* will consider the hazards prevalent in a watershed (e.g., effect of practices on natural watershed

processes), and the risks these hazards pose to fish habitat. Considering this information, FSP content must be prepared consistent with the established objective. After public review, the FSP is submitted to the Minster of Forests and Range delegate, who must approve the plan if it is determined to be, among other matters, consistent with the objective. Once the plan is approved, a licensee must comply with the approved plan. Government will undertake compliance inspections and effectiveness monitoring activities to ensure that applied practices are consistent with plan content.

1.3 Designation Phases

Identification and designation of FSWs will take place in one of three separate phases as described in Appendix 6. Phase I, which addressed the watersheds in Schedule 2 of the Forest Planning and Practices Regulation (FPPR) has been completed. Phase II is under way for the area of the Okanagan-Shuswap Land and Resource Management Plan (LRMP) to implement land use policy pertinent to the management of fisheries sensitive watersheds, and is being considered for the area of the Cariboo Chilcotin Land Use Plan to refine and spatialize watershed-specific land use direction. Phase III will commence with several pilot FSW initiatives to test and fine-tune policy, data availability requirements, and the tools used to evaluate watersheds in the manner set out in this document.

1.4 Information Sharing

To finalize FSW policy and procedure, MOE has laid out a number of tasks and milestones for the program's development and completion (see Figure 1). As one of the initial components of the FSW program development process, distribution of this document signals the beginning of a period of information sharing with stakeholders. Where applicable, this period of information sharing may help inform the final decisions on FSW policy and procedure. Important FSW program tasks and estimated milestones in the completion/initiation periods include the following:

- Development of the Watershed Evaluation Tool (WET) prototype (completed March 2006);
- Completion and distribution of the draft procedures document (September 2006);
- Information sharing with stakeholders on proposed policy and procedures (to be concluded by early Winter of 2006/2007);
- WET sensitivity analysis (Fall/Winter 2006);
- FSW objectives content workshop (Winter 2006);
- Completion of two or three pilot projects situated in key locations in the province (February 2006);
- Publication of the final "procedures for the evaluation and designation of FSWs" document (Spring 2007);
- Launch of the FSW program (early 2007); and
- Development of an FSW monitoring framework (early 2007).

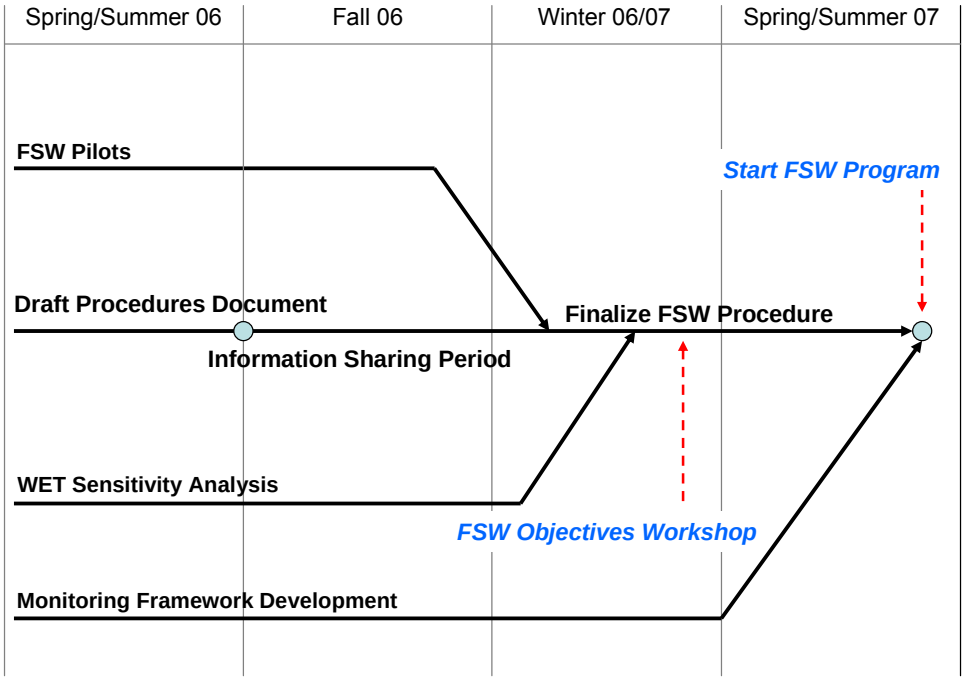


Figure 1. Gantt chart illustrating major tasks and milestones to project completion.

Throughout the information-sharing period, the Ministry anticipates that proposed policy and procedure will be reviewed by stakeholders, academics, forest and range licensee organizations, public agencies, First Nations organizations, and other government agencies. Discussions are expected to inform the technical and procedural nature of the FSW program. The final FSW procedure document will guide provincial government staff, forest and range agreement holders, First Nations, key stakeholders, and interested members of the public through the process of evaluation and designation of fisheries sensitive watersheds once Phase III of the program is implemented in early 2007. The information-sharing period will take place over the next several months and will culminate in a small FSW objectives / practices workshop.

2. FSW Designation Procedure

This section describes the procedural steps required to evaluate and, where appropriate, designate a candidate watershed as an FSW. To achieve two key goals of the FSW program — defensibility and consistency — each candidate FSW will be selected by using a standardized provincial methodology that will consider the best available information in a step-wise evaluation and selection process. One of the strengths of the procedure is its ability to evaluate and apply relative rankings to watersheds both provincially and (with improved precision) regionally.

Although the Watershed Evaluation Tool (WET) uses the best available information and science, it is envisioned that the tool will be modified over time (in a continuous improvement and adaptive management manner) to accommodate improved indicator data and better modelling tools as they become available. Once the FSW program is ready for implementation, it is anticipated that the tool — and responsibility for its operation, maintenance, and periodic upgrading — will reside with the Ministry's Ecosystem Information Section (EIS) in Victoria. The various iterations of the WET ranking lists will then be made publicly available by EIS through the FSW Website.[2] For a detailed description of the WET, including input data and model structure, please see to Section 3 of this document.

Six procedural steps are involved in the designation process, starting with identification of an FSW and ending with monitoring its effectiveness. A flowchart (Figure 2) is provided to help guide MOE Regional operations staff and participants through the procedure. The flowchart, which considers GAR and its consultation requirements, depicts the first four steps of the decision pathway, starting with provincial-level evaluations through to designation or rejection of a specific watershed. The Ministry has statutory responsibility to undertake steps 1 through 4, and the mandate to see implementation of Step 6. The six steps are discussed in this section.

2.1 – Step 1. Provincial WET List (Coarse Filter)

The primary purpose of Step 1 is to produce, and make publicly available, a ranked FSW list of all third-order (or higher) watersheds in the province. This step uses the Watershed Evaluation Tool to produce this list by combining and synthesizing standardized indicator information (available for the entire province and captured from a variety of sources). Where required, the tool, or a portion (i.e., component) of the tool, has a range of other applications. For example, it can be used to spatially stratify watersheds across a defined area or for other resource management initiatives (e.g., prioritizing watershed-level stream-crossing inspection).

By basing Step 1 evaluation on available data that has complete provincial coverage, a province-wide WET list will be generated to discern a shortlist of the top "Provincially Important" fisheries sensitive watersheds (Mackinnon 2004). Provincially important FSWs will be a small selection of those watersheds ranked most highly by the WET and verified by a

[2] MOE FSW website URL: www.env.gov.bc.ca/wld/fsw/

panel of provincial experts, and thus will represent basins with importance at a provincial scale. By using the WET in this way, staff can propose a list of "Provincially Important" candidate watersheds for immediate consultation, eliminating the need for the more detailed regionalized "verification" process required for other watersheds as described in Step 2.

Step 1 will conclude with the preparation of a WET breakout list for each evaluation unit. This list, prepared for regions by headquarters, will include all supporting indicator data along with provincial and regional scores.

2.2 – Step 2. Regional WET List Verification (Fine Filter)

This step has two primary objectives: 1) to improve the distributional accuracy of the WET evaluation listings by using unique regional data; and 2) to prepare a draft candidate FSW package(s) (including legal order and objectives). By its very nature, this step will require the greatest investment by regional MOE staff.

2.2.1 Administrative Regions and FSW Evaluation Units

MOE regional boundaries are characterized in many ways. Although MOE administrative Regions help focus region staff activities and business requirements, these units tend to be drawn by using such anthropocentric parameters as population centres and transportation routes. However, owing to distinct ecological differences between (and within) MOE Regions within the province, areas within the administrative boundaries may not be appropriate geographic units for conducting comparative assessments of natural resource values.

More appropriately, an ecosystem-based approach has been adopted to reflect areas of FSW evaluation called "FSW evaluation units." Areas within the boundaries of FSW evaluation units recognize the importance of distinct and localized ecological interrelationships between such aspects as downstream conditions and management activities; natural watershed processes and their role in maintaining fish habitat; the migratory nature of many fish species within and outside a watershed; and physical downstream connectivity considerations between stream reaches, watersheds, and large basins. The FSW evaluation units were derived by integrating major basins (linkages) with the Nature Conservancy's (Ciruna and Butterfield 2005) Ecological Aquatic Units (EAU). This created a manageable number of FSW evaluation units, each with similar ecological attributes that provides coverage for the entire province. The map in Figure 3 illustrates all FSW evaluation units in the province.

In some cases watersheds, or groups of watersheds of interest, will straddle MOE Regional administrative boundaries. In these cases, regional staff should cooperate to minimize duplication of effort and to clarify which MOE Region will be responsible for evaluating the straddling watersheds and, importantly, the preparation and consultation required to prepare the FSW Order.

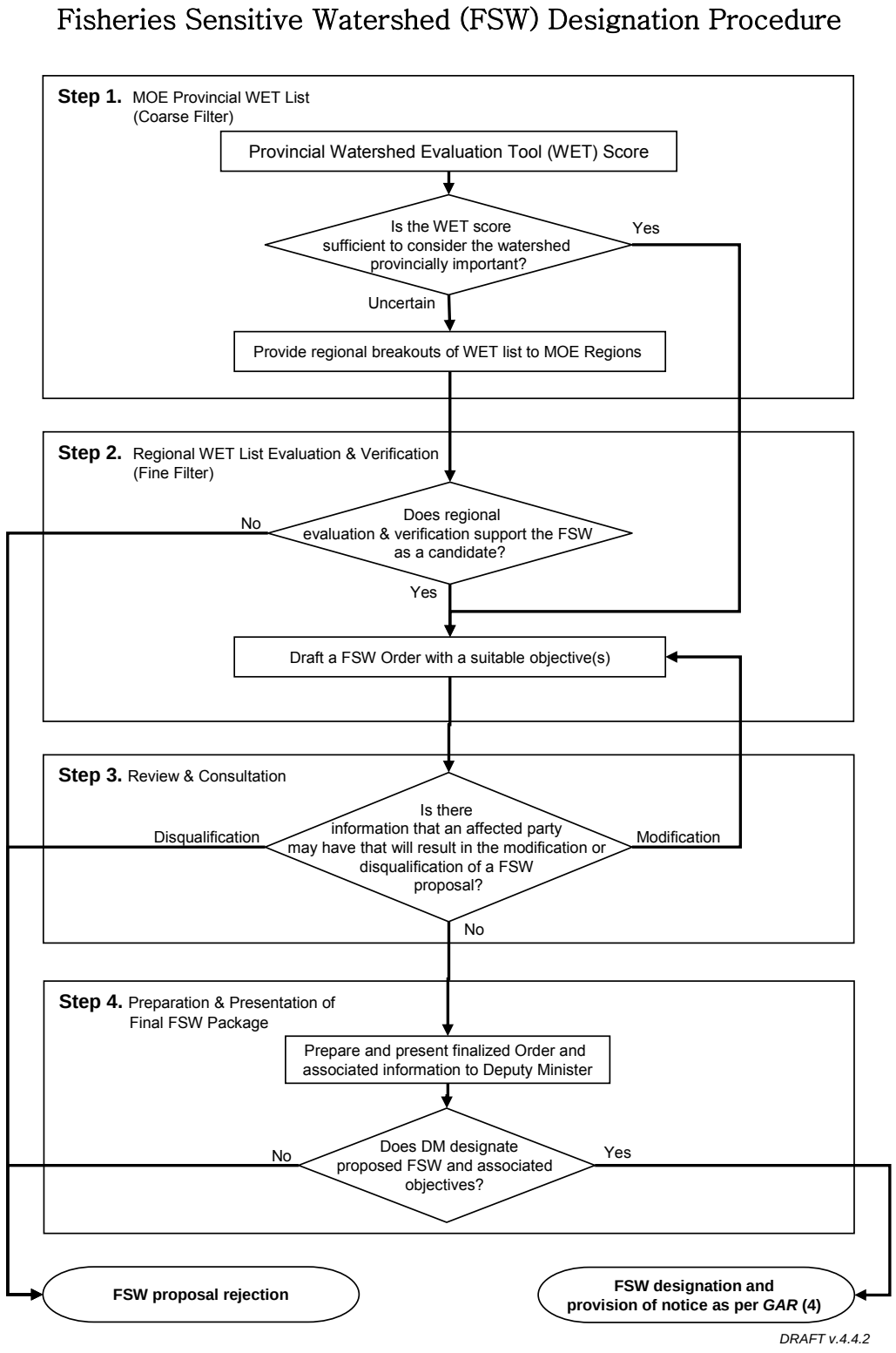


Figure 2. Flowchart depicting the decision pathway for designation of an FSW.

2.2.2 Regional Planning Considerations

This subsection discusses several key considerations that should be incorporated into regional Step 2 implementation planning.

1. Regions should designate an individual either from their Ecosystem Stewardship or from Fish and Wildlife Section as the regional FSW program leader. This individual will be responsible for coordinating, advancing, and completing step 2 and 3 activities. The regional FSW lead will also be required to bring together and/or work closely with the following:
   a. all partners and participants throughout the verification stage of the procedure;
   b. important public agency personnel requiring early inclusion in the planning process, such as Ministry of Forests and Range district staff (e.g., district stewardship foresters), First Nations, DFO, and other key stakeholders;
   c. assigned staff members within each respective Ecosystem Stewardship or Fish and Wildlife Section who have watershed and fisheries expertise; and
   d. the Provincial FSW coordinator.

2. To support the FSW verification process, a communications record should be maintained by the regional FSW program leader. This record should capture the details of communications with all the parties engaged with during the GAR consultation period, and should include the name of individual(s), their organization, date/time of communication, form of communication (e.g., meeting, e-mail, phone call, etc.), nature of communication (e.g., brief description of purpose, content, outcomes, agreements, etc.), and a reference to (file) location of the communication record (e.g., letter, electronically filed e-mail, etc.). This record should be maintained throughout steps 2 and 3 of the procedure and kept on file.

2.2.3 Technical Aspects of the FSW Review

An important goal of the program (item 1 in Section 1.1) is upheld during Step 2 verification by applying methods consistently across an FSW evaluation unit. One of the primary intentions of Step 2 is to consider additional information that is only available for a region and whose use improves upon the results of the provincial Step 1 WET list.

To accomplish this, verification in Step 2 will involve completing two broad tasks:

1. Ensure that all watersheds encompassing a specific FSW evaluation unit are represented in the list of watersheds generated by the WET.

2. By using unique information only available for the FSW evaluation unit, verify that watershed rankings within the WET-generated list are distributed correctly (i.e., are all watersheds listed in an appropriate order of priority or are some too high/low?).

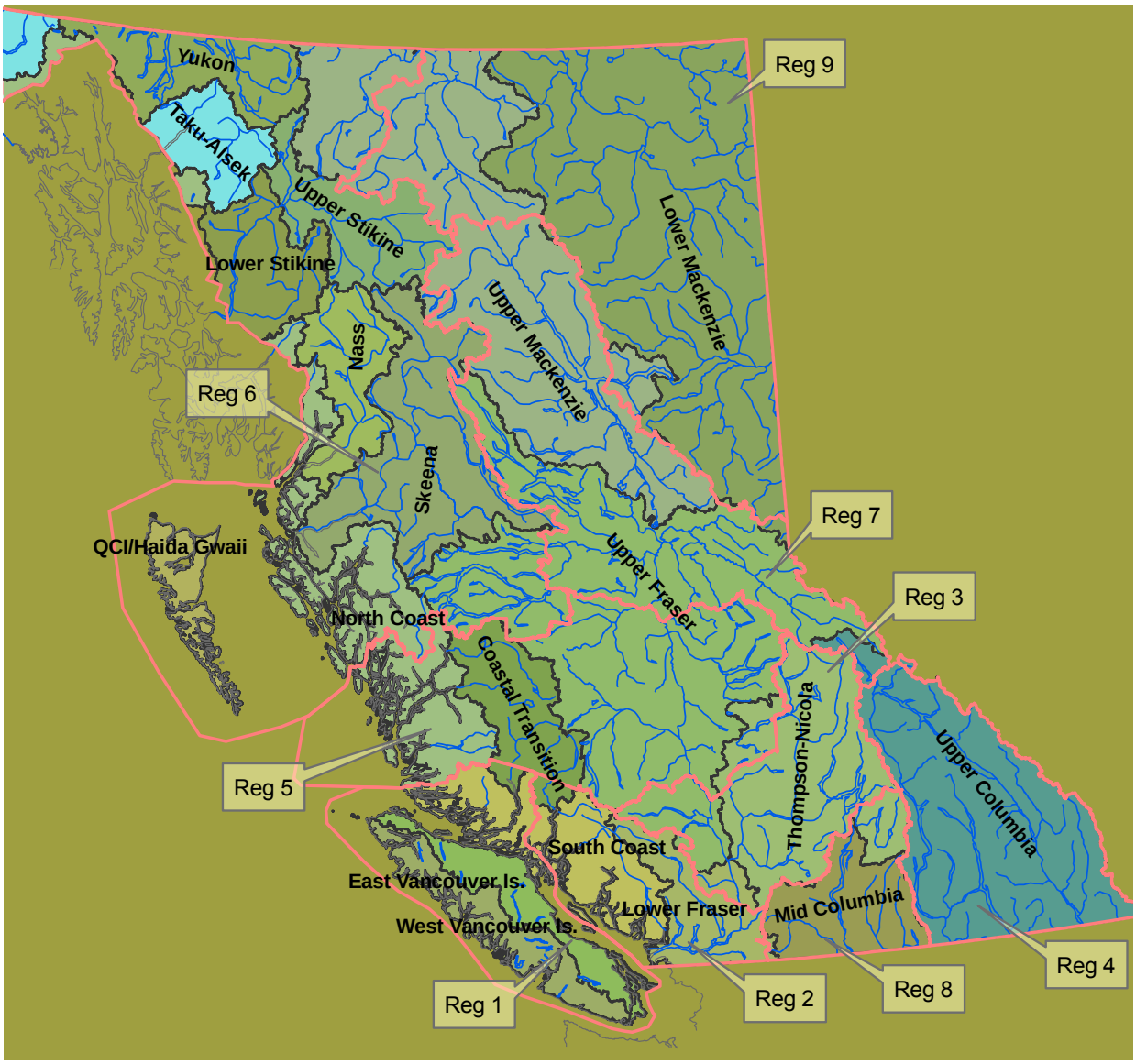


Figure 3. Provincial map with FSW Evaluation Units (named and coloured polygons) and MOE administrative regions (boundaries outlined in red).

Although the first task (1) is important, it is simply a geographic accounting exercise. The second task (2) will involve a higher level of data collection and analysis. The detail required to evaluate and verify watersheds may vary according to where they are positioned on the ranked WET list, where they are located geographically, or other characteristics unique to a specific area. For example, highly ranked watersheds for which extensive regional knowledge is available — or specific watersheds already well known and supported as FSWs — should require less verification to show that these watersheds are FSW candidates. Where there are questions about the suitability of a watershed, more information will be required to evaluate and rank these. In some cases, direction for designation will be supported by a watershed's inclusion in an HLP or LRMP.

When a region begins the Step 2 verification process, staff will receive a copy of the WET list (in an Excel or Access database format). The list will include all input (indicator) values used to derive each watershed's score, including component and subcomponent scores. It will also be possible to generate separate scores where required by using an augmented or modified WET to test for factors such as relative inherent watershed sensitivity vs. sensitivity resulting from anthropogenic disturbance. (See sections 3.1 *WET Structure* and 4.0 *FSW Pilot Projects* for further discussion on this topic.)

Lists will be spatially referenced by using gazetted names and Watershed Atlas watershed codes linked to specified Watershed Atlas boundaries (i.e., GIS watershed polygons). Spatial references will be for the farthest downstream point in a watershed. This will help with task 1, watershed representation (i.e., geographic accounting of watersheds).

In the second part of the Step 2 (task 2) evaluation process, only regionally available/ applicable data should be used. Several data sets are available for the entire province that were considered for use in the design of the WET, but, for various reasons, these were determined to be unsuitable (Marmorek and Alexander 2003). If the use of one or more of these data sets is being considered, regional staff must ensure that its application does not present similar suitability conflicts. Once regions have applied regionally unique data, thereby modifying their regional WET ranking list, ranking comparisons between regions will no longer be valid unless these regions have used identical data inputs acquired by using the same specifications and standards.

Examples of unique and improved regional data types are listed in Figure 4, although this list is not necessarily comprehensive and some regions may have additional examples. The standards used to determine whether a particular data set is suitable for inclusion in the WET are outlined in Figure 5. In some cases, acquisition of new information may be considered to fill regional evaluation data gaps (again, see Figure 5 for data suitability standards). Data gaps may range from a small area(s) where there is no data available despite coverage everywhere else in the FSW evaluation unit, to an entirely new data set that does not currently exist for the unit. Additional criteria for data selection and use are also discussed in Section 4. *FSW Pilot Projects*.

2.2.4 Consultation with Stakeholders and Affected *Forest Act* and *Range Act* Agreement Holders

Although Step 2 is intended to serve as an FSW candidate verification process using a system of corporate information analysis, to some extent it also can form the basis for addressing some aspects of the consultation requirements under GAR s.3. A comprehensive overview of the recommended approach to consultation is set out in the *Government Actions Regulation; Policy and Procedures for Government Staff Assisting Delegated Decision-Makers* (Anon. 2006).[3]

[3] www.for.gov.bc.ca/rco/pfit/

Figure 4. Examples of improved or unique evaluation unit (spatial) data sources

- Up-to-date (forest) roads data from licensees (including active vs. deactivated, non status, etc.).
- Fish species distribution information (licensee, regional, or other sources).
- Land-use/disturbance mapping.
- Detailed soils and landforms mapping.
- Predictive ecosystem mapping (PEM; or another form of ecosystem mapping) as a soils surrogate.
- Rain-on-snow modelling.
- Terrain stability mapping.
- Modelling that reflects unique conditions that exist within the region (e.g., using digital elevation model [DEM] to model mass wasting risk such as gentle-over-steep or road density by terrain/gradient classes).
- Acquisition of new data to fill gaps where a key regional coverage can be completed in a time- and cost-effective manner.
- Where appropriate, consider soliciting information to build on existing knowledge (e.g., newspaper article, or letters to recognized fisheries organizations, requesting verifiable species distribution information).
- Interpretation of remotely sensed data (various approaches).

Figure 5. Evaluation unit data sources standards

- Coverage must encompass all watersheds in the evaluation region (except those that clearly do not influence the outcome of a FSWs evaluation, such as fish distribution in snow field and glacier-covered watersheds).
- Must be spatially referenced to a watershed (i.e., to a specific location and/or Watershed Code).
- Resolution ≈ 1:50,000 or greater.
- Data must be derived using scientifically defensible methodology to ensure accuracy, consistency, and validity.
- Replacement of provincial WET data must improve upon the existing currency or resolution (i.e., use best available information).
- Data must be consistent with the specific requirements defining an FSW (i.e., GAR, s.14) and the provincial FSW evaluation procedure (i.e., component criteria as described by Marmorek and Alexander [2003] or current provincial policy).

For proposed FSW actions, consultation may logically include involvement of stakeholders, and *Forest Act* and *Range Act* agreement holders in Step 2 to ensure the best available information is used during regional verification of candidate FSW lists. Ongoing participation and contribution from multiple stakeholders will help ensure that the process works effectively

and is widely accepted. Furthermore, early participant involvement in Step 2 should minimize the requirement for additional consultation in Step 3, as participants will have firsthand understanding of the procedure and background analysis leading to the selection of candidate watersheds.

2.2.5 First Nations

It is important that First Nations values be captured during the verification procedure in Step 2. Although capturing information pertinent to these values during this step will require collaboration with First Nations experts on watershed values, Ministry staff must also bear in mind the legal responsibility for government to consult with First Nations, which will involve communications with the First Nations communities that have an interest in the candidate watershed. Staff seeking advice on consultation must refer to Ministry policy and procedure.

While the WET has been designed to capture commercial harvest data for both First Nations and non First Nations fisheries, the diverse nature of First Nations throughout the province, together with their distinctive relationship to local fisheries resources, prevents capturing important cultural, ceremonial, and food fishery values adequately. For this reason, effectively integrating First Nation's fisheries values requires direct dialogue with First Nations communities, a task that is best accomplished during the regional portion of the review and evaluation process.

The unique relationship that First Nations have with both government and *Forest Act* and *Range Act* agreement holders operating within traditional territories underlines the importance of early identification and engagement with representatives from recognized First Nations organizations who can provide natural resource information. Ultimately, the approach used to capture First Nations cultural and social fisheries values will be reflected by the diversity of these organizations within the FSW evaluation unit and should be — where there is First Nations interest to do so — endorsed by the First Nations communities that have candidate FSWs within their geographic area of interest.

At a minimum, regional FSW leads should engage First Nations to complete the first item of the two suggested approaches detailed below:

1. Meet with representatives from First Nations to introduce the FSW program; discuss the evaluation and designation procedure; review the WET list, provide updates, and request comments; and where applicable, request written endorsements or concerns regarding particular FSW candidates.

2. Ask all First Nations throughout the FSW evaluation unit to develop their own methodology to rank food fishery and cultural/ceremonial values for each watershed that resides within their territory, and then build the results into the WET regional evaluation procedure.

2.2.6 Preparation of a Suitable Draft FSW Order (Package)

As indicated in the decision flowchart (Figure 2), and before concluding Step 2, a draft copy of the proposed FSW Order must be prepared by MOE regional staff to support the consultation process required under GAR. (See Step 4 below for content details of the final FSW signoff package.) The results of consultation will inform the content of the final FSW package.

When engaging in consultation with *Forest Act* and *Range Act* agreement holders, it is important to demonstrate that the candidate watersheds meet GAR s.14 criteria. A watershed cannot be an FSW candidate unless it meets each one of the following criteria:

1. The watershed must have both significant fish values and watershed sensitivity, as determined by the WET evaluation and FSW procedure.

2. The candidate watershed must require special forest management to protect fish habitat.

3. The special management of the watershed must not already be provided by the *Forest and Range Practices Act* or another enactment (e.g., objectives for a community watershed).

The language used to craft an objective should be consistent with the intent of GAR s.14 and the results-based approach used under the FRPA. Objectives may be modified to suit the specific nature of the watershed's fish habitat protection and special management requirements. Objectives should be concise and worded such that they clearly describe a desired condition, yet do not prescribe a specific practice or strategy to be used to attain the desired condition.

2.3 – Step 3. FSW-GAR Consultation Requirements

MOE must provide *Forest Act* and *Range Act* agreement holders with an adequate opportunity to consider the way that a proposed FSW Order may impact their operations. Consultation in this step is a legal requirement of the Ministry under GAR. Refer to the document, *Government Actions Regulation; Policy and Procedures for Government Staff Assisting Decision-Makers* (Anon. 2006) for detailed information on GAR consultation requirements.

2.4 – Step 4. Preparation and Presentation of FSW Order

The goal of this step is to enact the FSW Order according to the provisions specified in the GAR. In this step a final FSW package is prepared for submission to the Deputy Minister, and where the requirements of the regulation are met to the Deputy Minister's satisfaction, the Order will be approved. Completion of this step, in conjunction with the notification requirements laid out in GAR s.4, legalize the conditions described in the FSW Order. The following are key components of the final package:

1. **Overview document**. The FSW package should begin with a short (1–3 pages maximum), concisely written, overview document describing:
    - The watershed's physical and biological characteristics of interest.

- The methodology and criteria used, including results of the Step 1 and 2 verification procedure, and any other pertinent information used to demonstrate the watershed's eligibility.
- Special management requirements.
- How the above special management directions are not accommodated by FRPA or another enactment.
- Information with respect to the requirements of GAR s.2.

2. **The FSW Order.** The FSW package must contain a copy of the proposed Order and appropriate maps in a format suitable for the Deputy Minister's signature. The Order should include:
    - Management objectives.
    - Spatial information defining the watershed, including:
        - gazetted watershed name(s),
        - BC Watershed Atlas code(s),
        - Forest District(s) in which the watershed resides
        - reference to digital files depicting the area's boundaries and specific polygon attributes (in the format described in Appendix 4).

    and, as required,
    - A non-legal appendix briefly describing any information important to the consideration of the Order.

3. **Supporting Maps.** Printable maps must be submitted to the Deputy Minister for signature. Map files need not be hard copy, but should be forwarded/distributed in an electronic printable format (e.g., .pdf). Each candidate watershed (or groups of proposed watersheds in the same geographic vicinity) should be depicted at a large scale (e.g., ~1:20,000). Where there is more than one proposed watershed, an overview map should be provided showing both: 1) the locations of all watersheds in relation to one another; and 2) the general location of the watersheds throughout the region and their relative location within the province (inset map). See Appendix 4 for a summary of applicable digital mapping specifications.

4. **Communications Record.** The FSW package must contain a summary of communications that outlines MOE's engagement with licensee(s), First Nations, and other key participants during consultation. This summary will be a distillation of the communications record (described in Section 2.2.2, item 2).

5. **Important Correspondence.** Include copies of significant correspondence (e.g., correspondence demonstrating endorsement, or indicating important points of departure, for FSW candidates).

6. **Other Supporting Information.** Include any other important supporting information that may be required for the Deputy Minister's consideration of the package.

Once the FSW Order is signed, it will be posted and made publicly available, along with all relevant background information, on MOE's FSW Website. A notice also will be published in *The British Columbia Gazette*, and Forest Region and Forest District offices will be formally notified. A FSW Order may be, as with all GAR orders enacted by government, amended or rescinded at any time. Rationale for either of these actions will be undertaken by considering new or improved information pertaining to an established FSW.

2.5 – Step 5. Licensee Results / Strategies Preparation, and MOFR Approval

Once an FSW Order and an objective(s) have been established by government, a *Forest Act* agreement holder who is required to prepare a Forest Stewardship Plan (FSP) must develop results / strategies consistent with the objective(s) set out in the FSW Order. FSP content with respect to FSW objectives is subject to the statutory test set out in the *Forest and Range Practices Act*.

2.6 – Step 6. Monitoring and Adaptive Management

Government will develop and implement a monitoring program to evaluate the effectiveness of applied forest and range practices. The effectiveness evaluation will be designed to determine if the desired conditions described in the objectives for the FSW are being achieved. Where problems are identified, an adaptive management process will be triggered, the cause will be determined, and the means to modify forest or range practices determined. In some cases, modifications to the FSW Order will need to be considered and implemented to adjust forest practices.

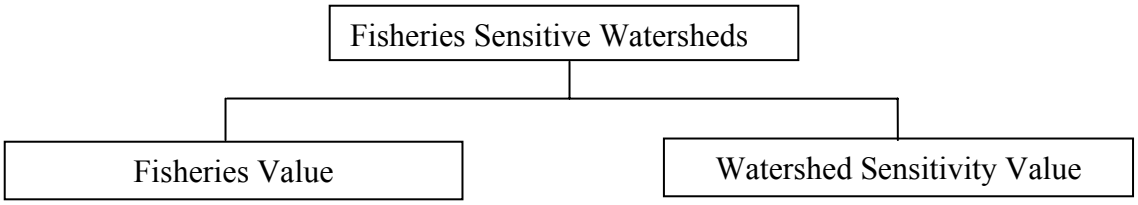
To assist Ministry staff and other interested parties, MOE is preparing a monitoring framework highlighting options that may be used during FSW monitoring activities. It is anticipated that the framework document will serve as a basis for the creation of a more detailed monitoring protocol document intended to serve as a guide to the development of FSW monitoring plans Wherever possible, the Ministry will encourage voluntary monitoring partnerships with forest licensees, First Nations, other agencies (e.g., MOFR and DFO), and interested stakeholders. These partnerships will develop, resource, and implement scientifically defensible monitoring plans.

3. The Watershed Evaluation Tool (WET)

The watershed evaluation tool (WET, or the 'tool') is a product of two workshops and subsequent prototype development that has occurred over the last several years. It was developed to assist in the designation of fisheries sensitive watersheds under the FRPA while providing provincial and regional "consistency" to the evaluation and selection of candidate FSWs.

In early 2003, a workshop, conducted by ESSA Technologies Ltd., was held to define appropriate criteria, to design and test methods for applying these criteria, and to write a work-plan for developing, evaluating, and implementing these methods. A follow-up workshop to further refine the model was held in June 2004 with representatives from both the provincial (Ministry of Water, Land and Air Protection; Ministry of Sustainable Resource Management; and Ministry of Forests) and the federal government (Department of Fisheries and Oceans). Following this, a discussion document outlining an approach to designating fisheries sensitive watersheds was drafted in August 2004 (Mackinnon 2004). This document formed the basis of the current WET prototype. Significant refinements to the WET model have occurred over the last several months, resulting in the prototype described here.

The WET uses a series of indicators to establish a "fisheries value" and a "watershed sensitivity value" for each of the 1:50,000 third-order watersheds found within the coverage of the BC Watershed Atlas. The criteria, indicators, and rationale for the two components of the tool, "fisheries value" and "watershed sensitivity" (Table 1), were established in the two workshops used to explore and critique WET during its early development phase (Mormarek and Alexander 2003; Mackinnon 2004). Consistent with the GAR (s.4), the tool assigns a relative value to the watershed, based on an independent score for these two components.



The WET has been designed to provide a "coarse filter" to the designation of FSWs within the province. To refine these results, application of regional data to the results of this model is expected during Step 2 of the procedure (see Section 2.2 – *Step 2. Regional WET List Verification*). Some further modification to the WET is expected as FSW pilot testing and expert review of the model is undertaken during final FSW program development.

In this section the tool's structure and process steps are described, the rationale for these are provided, and data sources behind the WET are outlined.

3.1 WET Structure

The 1:50,000 BC Watershed Atlas third-order watershed coverage provides the framework for analysis. This coverage has 19,249 polygons associated with the mainstems of streams with an order ≥3 (at the 1:50,000 scale). The shapefiles delineating Watershed Atlas polygons can be found at an MOE ftp site[4] and can be linked to the .dbf file that is the output of this analysis using the WSD_ID identifier.

Each polygon of this coverage is either a watershed, a coastal area with one or more streams with an order ≥3, or an island. Watersheds ≥3 are hierarchically arranged as parent and daughter polygons. The boundaries of smaller polygons within a watershed coincide with changes in stream order and boundaries of watershed groups.

Some of the polygons are without mapped surface water, so these were assumed not to support fish, leaving a total of 17,815 polygons with a total area of 944,000 km^2. These polygons account for greater than 99% of the total area of BC and range up to 190,098 ha in size, although 80% are in the 100–10,000 ha range. Each polygon is associated with a line in a database with fields (columns) that contain either imported or derived data values that are listed in Appendix 1.

Unless otherwise described in this section of the document, input and component values are normalized, summed, and then normalized again to produce a value ranging from 0 to 1 as each process step is executed. As with all components (and subcomponents) of WET, it is recognized that equal weighting and linear scaling is only one of many processing alternatives. To test the influence that one parameter, or a modification to the tool's structure, may have on a final watershed score, MOE has undertaken a preliminary sensitivity analysis of the tool. This analysis indicated that alternative methods of combining score frequently produced similar rankings among watershed (Porter 2006). Pending the results of the pilot evaluations (see Section 4.), a more thorough sensitivity analysis may be considered prior to full implementation of WET prototype.

The tool's design can accommodate new or updated data, and can be restructured for use in alternative or modified applications.[5] Examples of a restructured WET are provided in Section 4 – *FSW Pilot Projects* where modified or augmented WET versions are discussed (see Figures 9 and 10). The ability to easily alter the WET lends itself well to incorporating regional information during Step 2 verification.

[4] ftp://fshftp.env.gov.bc.ca/pub/outgoing/wsLite3.1/_wslite3.1.1/

[5] An alternative application of the WET would include separating subcomponents and their respective scores to help shape watershed management strategies. For example, by using two separate scores generated from the watershed sensitivity component of the WET (i.e. a measure of inherent sensitivity [natural geomorphic and hydrologic sensitivity] and level of human disturbance [development history]), managers can institute development strategies appropriate for the characteristics of the watershed. In this case, a high inherent sensitivity and a low human disturbance score might indicate a preference toward a precautionary approach to development activities within the watershed. Conversely, where inherent sensitivity is ranked as moderate to high, and a high human disturbance score is returned, managers may wish to adopt a mitigative and restorative approach to management activities.

3.2 Fisheries Values

Fisheries values are expressed as the equally weighted sum of two subcomponents, "biodiversity value" and "socio-economic value" (Figure 6).[6] Each of the main subcomponents is the combination of several second-tier subcomponents. In the final step of the analysis, "Fisheries Value" is divided by the square root of the area of the watershed. This point of view assumes that, in ranking watersheds for consideration, the next watershed chosen should have the next highest ratio of benefits (fisheries value) to costs (of implementing management actions), where area is used as a surrogate for implementation costs. Costs might include factors such as smaller allowable annual cuts (AACs), the cost of fisheries or watershed assessment activities, extra costs for implementing specialized harvest or management techniques, and other associated activities required to address the required conditions described in an FSW Order (i.e., objectives). The details of the costs are not important because the implicit assumption is that costs are non-linearly related to watershed area. Use of the square root of area (rather than area) assumes that costs per unit area will be lower for larger watersheds because of economies of scale, as well as the segregation of sensitive areas (hillslopes) from high value fish habitats by intervening landscape features (valley flats, lakes). The assumption of non-linearity is also a compromise between using the absolute value (which chooses larger watersheds because fisheries values are summed over a large area) and the fisheries value per unit area (which chooses small watersheds because fisheries values are patchily distributed).

Consistent with the GAR's focus on special forest management to conserve fish values, an assessment of fisheries values requires an indication of sensitivity of fish species to forest management activities. Therefore, species numbers and presence have been weighted by a relative sensitivity to forest management score according to Porter et al. (2000) (Appendix 2). The sensitivity score for each species is the sum of the scores for 12 traits (Appendix 3). Fish species such as Dolly Varden (*Salvelinus malma*), Bull Trout (*Salvelinus confluentus*), and Coho Salmon (*Oncorhynchus kisutch*) are the most sensitive (scoring 29, 28, and 28, respectively), whereas the least sensitive indigenous species is the Emerald Shiner (*Notropis atherinoides*) (scoring 16). Most invasive species scored lower than 16 (e.g., *Carrassius aurateus* scored 13) for a range of 16 across all species. The relative sensitivity score for each species is expressed as (Score)/16, which results in normalized values that range from 0 to 1 (least to most sensitive, respectively).

[6] First Nations Cultural Score: Although a First Nations Cultural Score has been indicated in the Fisheries Values component diagram (Figure 6), it has not been used as a factor in discriminating between watersheds (i.e., all watersheds are assumed to be of equal value) in this version of the WET. If watersheds are identified regionally by First Nations communities that have lower or higher First Nations cultural values than others, this information will be integrated into the model during the regional verification (Step 2), and weighted accordingly with the other two Fisheries Values components (see Sections 2.2.4 and 2.2.5 of this document for more details on this topic).

3.2.1 Biodiversity Value

The starting point for calculating biodiversity values is the estimation of the Probability of Occurrence (ProbOcc) for each fish species in each polygon. The established range for each species is taken from McPhail and Carveth (1993). Within these ranges, ProbOcc is derived from either a logistic regression model of habitat relationships (wide-ranging, abundant species), a representation of expert opinion (for rare species with limited observation bases), or specific local knowledge of species that are restricted to a few, well-known geographic locations. Exotic species were not included in this analysis.

The species occurrence data set was extracted from the Fisheries Information Summary System (FISS), a database that is maintained jointly by the governments of BC and Canada (www.bcfisheries.gov.bc.ca/fishinv/fiss.html). This database contains more than 160,000 species occurrence records from a variety of data sources. All records have been linked to the watershed polygons by using watershed codes and geographic coordinates. Although the source of each record can be traced, some duplication occurs due to source error. Some duplicated records may still be present, especially for common species. However, much of this duplication was removed by using location and date information, and the error checking process ensured that none of these records were high leverage points.

The data for each species was processed in the same manner:

- Out-of-range records were identified by comparison with published ranges.
  - Each out-of-range record was checked and range revisions made where warranted.
  - Watersheds within the range were characterized along five habitat axes (size, temperature, gradient, lake influence, glacial influence).
  - Logistic regression was used to identify relationships between species presence and watershed characteristics.
  - High leverage points in this analysis were individually checked to ensure that these were valid observations.
  - Regressions were repeated, and questionable observations were removed or corrected.

The Biodiversity component has three second-tier subcomponents. The first subcomponent is "species richness" (SppRichScore), which is the sum of ProbOcc for each species weighted by the relative species sensitivity to forest harvesting. The second subcomponent is "threatened and endangered" (TEScore) and is the product of the sum of ProbOcc for species listed by the Conservation Data Centre (CDC), weighted by the ranking score and the relative species sensitivity to forest harvesting (biological sensitivity). The third subcomponent is "regionally important stocks" (SpecStocks). This score is derived from lists provided by regional MOE fisheries biologists.

"**Regionally important stocks**" are characterized by fish fauna with distinct characteristics, especially if they are at risk (e.g., summer steelhead, Gerrard Rainbow). This should include regionally significant species that are not listed with the CDC or are not known provincially and that represent unique populations, geographic circumstances, or species (e.g., Eulachon, West Slope Cutthroat, Morice Steelhead, river rearing Sockeye, etc). Information on all

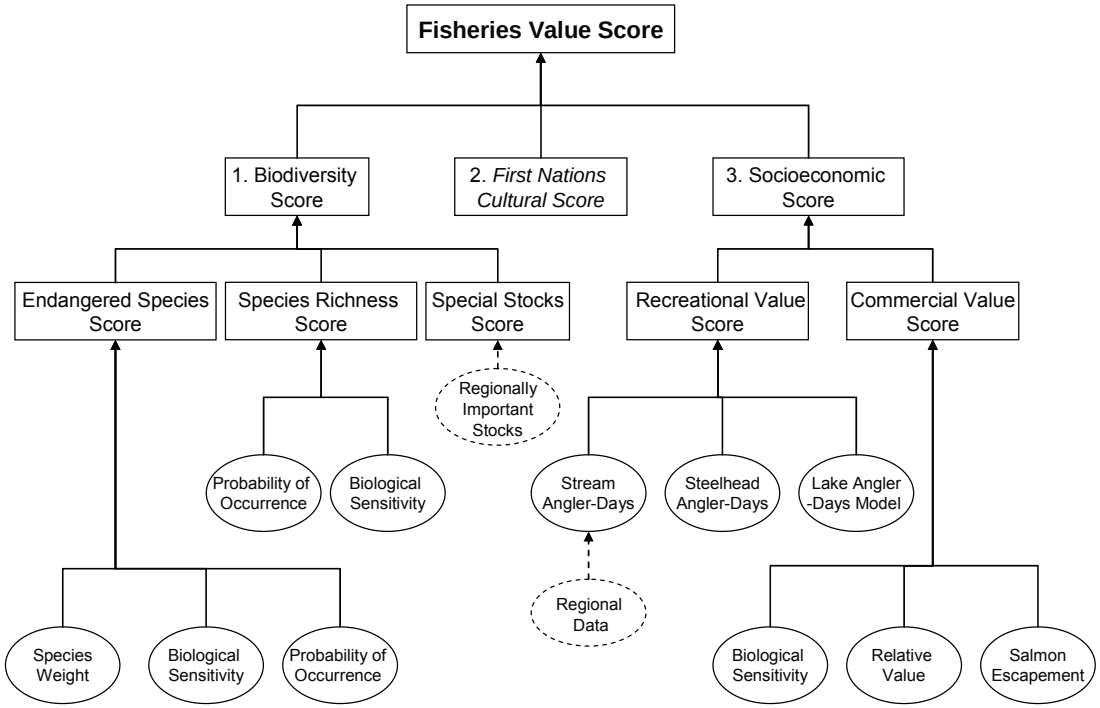
Table 1. Component, subcomponent (criteria), indicators, and rationale for each of the two main Fisheries Sensitive Watershed components. These criteria and indicators are designed to reflect expert opinion captured in a workshop setting (Marmorek and Alexander 2003; Mackinnon 2004).

FSW Component	Subcomponent (Criteria)	Indicators	Rationale
Fisheries Value	Biodiversity Value	Species Richness	Watersheds with more fish species are more likely to support a greater diversity of both fish and other species.
		Threatened and Endangered Species Score	Threatened species require more specific protection than common, wide-ranging species, especially when their habitat requirements make them more sensitive to forest harvesting.
		Special Stocks	Temperate freshwater fish have substantial amounts of intraspecific variation that is difficult to capture in a general sense. This indicator provides input on known representatives of unusual ecotypes.
	First Nations Cultural Values	(TBD)	This factor is meant to capture First Nations values that are above and beyond the commercial value of salmon harvested by First Nations fishers.
	Socio-economic Value	Recreational Value Score	This indicator assumes that all angler days (estimated) at the provincial scale are of equal value.
		Commercial Fisheries Values from Salmon Escapement	Species other than salmon do not support a significant commercial harvest. It is not feasible to directly allocate landed values from DFO marine statistical areas to individual watersheds.
Watershed Sensitivity	Terrain Stability	% watershed with a slope angle greater than 60%	Watersheds (watersheds) with a greater proportion of their total area with slopes in excess of 60% are more sensitive to forestry activity.
	Stream channel stability	Stream channel length on stream channels with < 8% gradient per unit area	Alluvial streams (as represented by streams with a gradient less than 8%) are considered more sensitive to cumulative effects of forest harvesting.
	Level of existing disturbance	% stream bank disturbed (clearcut, selective or fire) along channels < 8% in gradient	Riparian areas adjacent to streams provide fish habitat as well as buffer the impacts of forestry activities. The higher percentage of overall streambank disturbance the more sensitive a watershed is to additional forestry activity.
		Road Density	Roads are the greatest source of sediment to streams. The higher the density of roads in a given watershed, the more sensitive the watershed becomes to a number of forestry-related impacts.
		% of watershed in disturbed state (clearcut, selectively logged, and fire)	The greater the level of disturbance in a watershed, the greater the potential of further impact from forestry-related activity.

species and populations listed by the CDC (e.g., Sturgeon and Stickleback populations) have already been incorporated and should not be duplicated in this list. Lists submitted by regions will be vetted by provincial fisheries experts.

Each of the biodiversity subcomponents is normalized (divided by the maximum value) to produce scores ranging from 0 to 1, before being added together and again normalized to produce an overall Biodiversity Value that ranges from 0 to 1. This process implies that Biodiversity Value is a linear function of three equally weighted subcomponents (see Figure 6).

Figure 6: Components of the Fisheries Value Score. Square boxes contain normalized scores that range from 0 to 1. Ovals contain input data. Dotted ovals contain lists of watersheds to be supplied by the appropriate management representatives.



3.2.2 Socio-economic Value

There are two second-tier subcomponents to "socio-economic value" of a watershed (see Figure 6) — "recreational value" and "commercial value."

Recreational Value Score

This score has three data components, all of which are measured as angler effort (i.e., angler days). Effort on lakes is estimated by using a simple regression model designed for the WET that incorporates:

- lake size,
- proximity to large population centres (Cranbrook and Vancouver)[7],
- distance from roads, and
- lake productivity (total dissolved solids or TDS).

The lake effort model is based on effort estimates derived from aerial boat counts and the National Survey of Sportfishing Activity, which is a mail survey conducted by the Canadian government every 5 years. Currently, stocked lakes are excluded.

This model predicts that lakes that are farther from roads or population centres, are larger, or have very high or low TDS (total dissolved solids), will support lower densities of anglers. Steelhead effort is taken directly from the Steelhead Harvest analysis over the 1980–2000 period (Smith 1999).

"**Stream angler-days**" (angler effort) has not been modelled. Only effort that has been explicitly listed and forwarded to the Provincial FSW coordinator has been included in these calculations (typically <10 per region). Regional fisheries biologists will provide estimates of effort to generate lists of streams (including an indication of their respective FSW evaluation unit) that support significant amounts of angler effort. These lists will be vetted by provincial fisheries experts to ensure consistency and accuracy and then incorporated into the WET. Angler days from the Steelhead Harvest analysis and estimates of effort on all lakes, including large lakes, have already been incorporated into the WET data base and should not be included again on this list.

The Recreational Value Score is the sum of these three angler efforts, normalized by dividing by the maximum value over all watersheds.

Commercial Harvest Score

Salmon escapement data is available for about 1400 watershed polygons in the DFO NUSEDS database. The input data for this analysis was escapement for each species, averaged over 20 years (1985–2005). The average escapement for each species was multiplied by the Biological Sensitivity (Appendix 1) and Species Value (Table 2) and summed over all species for the watershed associated with each polygon. This value was normalized by dividing by the maximum value over all watersheds. Hatchery returns where excluded by using the EscminusHat field in the NUSEDS database. In addition, release records and biostandards

[7] Calculated as $\sqrt{(C^2 + V^2)}$ where C = distance to Cranbrook and V = distance to Vancouver.

were used to estimate projected returns of hatchery fish to each river. These returns were subtracted from the escapement, but if projected hatchery returns were more than 90% of estimated escapement, then wild escapement was assumed to be 10% of estimated escapement.

Table 2: Relative species weight in the commercial harvest score. Average weight is weight at maturity from Groot and Margolis (1991). Wholesale prices are averaged over the 2002–2004 period (Anon. 2005b). Maximum sustainable yield (MSY) harvest rates are derived from maximum recruits/spawner for Coho given by Bradford et al. (2000) and for all other species given by Myers et al. (1999), assuming a Beverton-Holt stock recruitment curve. The Species Value is the product of average weight, wholesale price, and the harvest to escapement ratio at MSY.

Species	Average Weight (kg)	Wholesale Price/kg	MSY Harvest rate	Harvest: Escapement Numbers at MSY	Species Value ($ / escapement)	Species Sensitivity	Relative Weights
Chinook	8.0	$4.32	63%	1.70	58.8	0.82	28.6
Chum	5.2	$1.66	52%	1.10	9.5	0.65	3.6
Pink	1.9	$2.05	47%	0.90	3.6	0.47	1.0
Sockeye	2.7	$7.54	56%	1.28	26.3	0.65	10.1
Coho	3.5	$8.57	59%	1.44	43.2	0.88	22.5

3.3 Watershed Sensitivity

Three criteria were identified that can be used to evaluate watershed sensitivity (see Figure 7). The source of all the data on watershed sensitivity is from either the Provincial Land and Resource Database Warehouse (LRDW) or Integrated Land Management Bureau's (ILMB) Watershed Statistics, which, in turn, is derived from a variety of data sources that are documented in the Watershed Statistics User's Guide and Data Dictionary (Anon. 2002). Watershed sensitivity is the normalized sum of all three subcomponents.

3.3.1 Terrain Stability

Steep terrain and erodable soils increase the susceptibility of watersheds to forestry-induced changes that damage fish habitat. The field, PolyGr61+, is the percentage of mainstem polygon terrain with a slope greater than 60%. The use of a mainstem polygon (rather than a watershed) characteristic reflects the belief that logging on steep terrain that is not directly connected to the mainstem channel (i.e., in tributary watersheds) is less likely to damage mainstem channels. This criterion does not include an indicator linked to soil geology even though, for example, low-gradient marine and lacustrine deposits are known to be highly erodable. Soils maps are available for many parts of the province, but these are not easily accessible in electronic form at a provincial scale. Future versions of the WET will strive to incorporate soil geology information or, alternatively, where available, these data will be entered regionally during the Step 2 regional verification process.

3.3.2 Stream Channel Stability

The density of alluvial stream channels is used as an indicator of watershed sensitivity because fish habitat in alluvial channels is more susceptible to damage from increased bedload and bank destabilization. Channels with gradients greater than 8% are more likely to be bedrock controlled or to be armoured with very large substrate. The workshop also identified certain hydrological characteristics, particularly the susceptibility to "rain on snow" events, as a key indicator of watershed sensitivity (Mormarek and Alexander 2003). As appropriate, this indicator may be incorporated regionally during the Step 2 regional verification process. It is also planned to incorporate this type of information into a future version of the provincial WET.

3.3.3 Existing Disturbance

There is some evidence that damage to fish habitat becomes much more likely when development within a watershed exceeds certain thresholds. The third indicator combines three equally weighted subcomponents: road density, density of alluvial stream bank that has been recently logged, and the proportion of the land area that has been recently logged or burned.

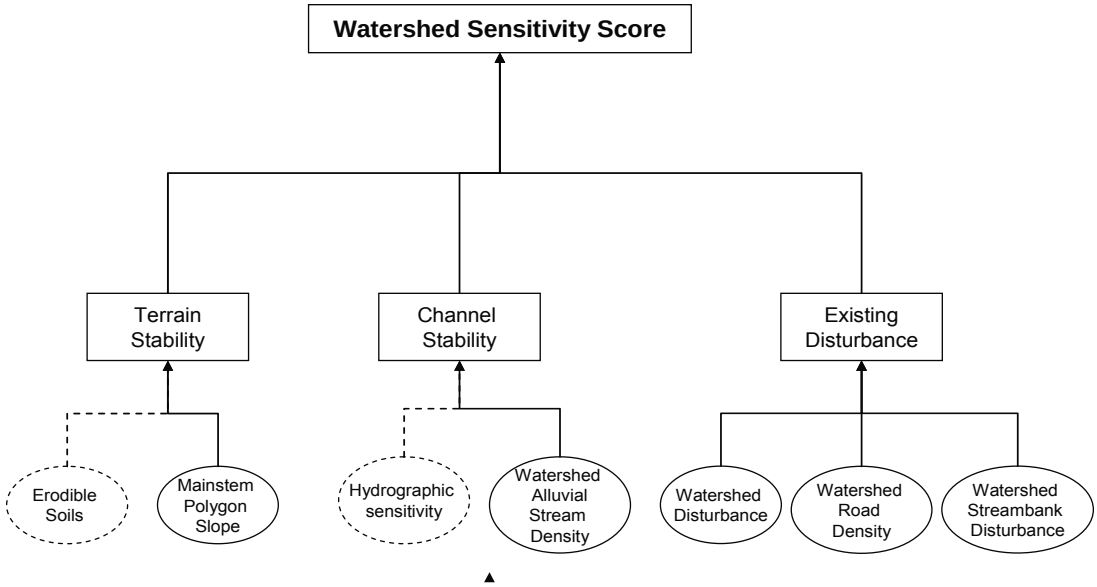


Figure 7: Components of the Watershed Sensitivity Score. Square boxes contain normalized scores that range from 0 to 1. Ovals contain input data. Dotted ovals contain lists of watersheds to be supplied by the appropriate management representatives.

4. FSW Pilot Projects

Two or three regional FSW pilot projects (preferably located in a coastal, northern interior, and southern interior location) are planned before finalizing the FSW procedure. Lessons learned from these pilot projects will be applied to the final procedure.

In addition to areas known for both their high fisheries values and their general watershed sensitivity, selection of the pilot study area should include criteria that would capture a range of values important to evaluating FSWs. Furthermore, sensitive watersheds do not need to be restricted to those with high levels of development history. Instead, pilot locations that contain watersheds with a range of inherent sensitivity and development activity levels would be most useful to test FSW evaluation methods and procedures. Also, areas that meet the above criteria, and that have been assessed by using an alternative ranking-based methodology, would have the added benefit of allowing comparative analysis of the WET approach to another assessment technique.

As a guide to help regions achieve the criteria described above, a three-step pilot watershed selection method is recommended:

1. Spatially identify the desired characteristics required for inclusion in a pilot area (e.g., forest licensee tenure(s), MPB-affected area, areas where alternative [previous] watershed/fish assessments have been completed, and other characteristics as deemed important by a region).
2. By using the scores provided by the Provincial WET, break watersheds occupying the overlap areas containing the desired characteristics into three categories, “high, medium, and low.”
3. From each of the three categories, randomly select an equal number (i.e., ~10) of watersheds for a total of ~30 (number can vary somewhat depending on regional circumstances).

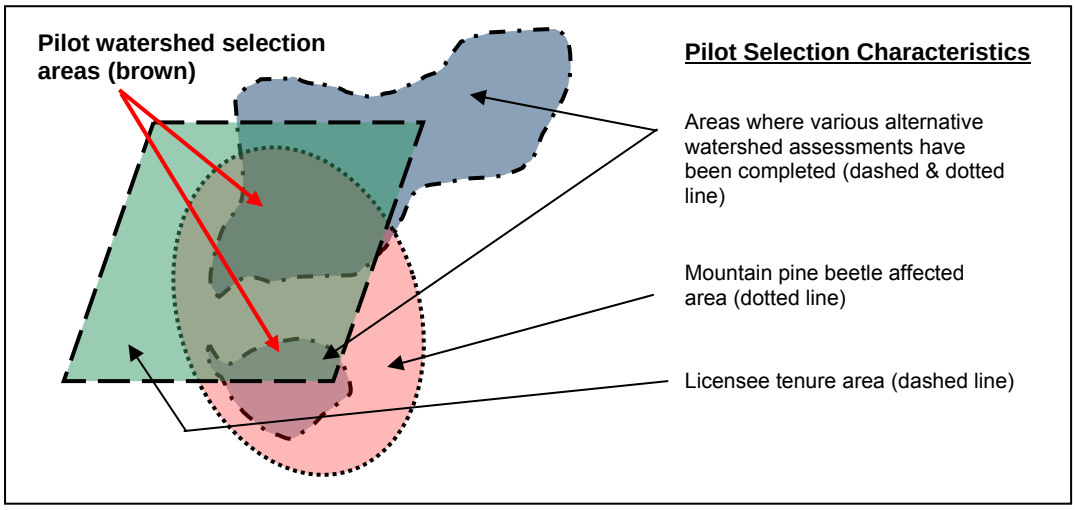


Figure 8. Depiction of a method to select pilot watersheds.

To ensure that a broad range of watersheds with varying sensitivity and fish values has been selected, regions may choose to supplement this list by adding several watersheds that they feel have missing values (e.g., a watershed with known high fish values, high inherent sensitivity, or low development history, etc.) but which were not included in the selection. This approach will help to assess the sensitivity of the tool to different variables (e.g., provincial vs. regional data sources) and variability.

The regional verification methodology used during the pilot projects must build on and complement the WET. FSW pilots should use existing data with complete regional coverage. When considering technical evaluation and verification options, regions must bear in mind that regional capacity is critical; an important feature of Step 2 will be keeping pilot projects simple while maintaining scientific credibility. Examples of regional pilot evaluation and verification methodologies include:

- Using the existing WET structure and process methodology as is, but supplementing it with regional data (e.g., Figure 9),
- Modifying the WET or another existing methodology to build upon the WET (e.g., Figure 10), or
- Generating a new assessment method that complements the WET (Figure 10). [8]

Regions should consider conducting data resolution sensitivity analysis by using (where available) data sets captured at different scales (e.g., 1:20,000 vs. 1:250,000 scale surficial geology mapping). Where a modified WET is being considered, regions must be prepared to also conduct a comparison between the modified results and those of an augmented WET.

[8] Development of a regional methodology must be conducted in conjunction with the provincial FSW coordinator and Ministry personnel charged with operation and maintenance of the tool. This approach will help ensure consistency in the application of the tool, and the integrity of the input data sources and models process structure.

Figure 9. Augmented WET	Figure 10. Modified (adapted) method
An augmented WET tailors the tool to accept improved or unique data inputs. Prior to their use, the user must ensure these inputs/parameters are consistently available across a region of interest. Examples of improved data include up-to-date roads information or field-verified fish distribution information. Examples of unique data include integrating new inputs with the WET such as surficial geology mapping, or PEM features as a sensitive soils surrogate, etc. If deemed a significant factor in a region, another possible input may be use of DEM information to model gentle-over-steep terrain or road-to-stream distance risk metrics. (See Section 2.3.3.of this document for further discussion on this topic.)	A modified watershed evaluation method would be one that differs from the WET approach, but that meets the overriding goals of the program (e.g., principles such as consistency, defensibility, effectiveness; and policy and regulatory requirements). An example of a modified WET might be one where the tool was restructured significantly to accommodate and weight new data. Another example of this approach involves adapting tools such as Wilford and Lalonde's (2004) monitoring framework, or the Vanderhoof watershed sensitivity analysis (WSA) (Anon. 2005a) in a manner that removed redundancies and allowed comparisons among watersheds throughout an entire region. To meet the goals of the program, regions must consider the complexity and cost benefit of engaging in an alternative approach vs. using an augmented WET FSW procedure. Any modified methodology must receive approval from provincial headquarters prior to its used.

4. References

Anon. 2002. Watershed statistics user's guide, v. 1.0. Prep. by Ministry of Sustainable Resource Management and the Decision Support Services Branch for Resources Information Standards Committee.

Anon. 2005. Watershed sensitivity analysis for the Vanderhoof Forest District. Prep. by Triton Environmental Consultants Ltd. for Ministry of Forests and Range and Ministry of Environment.

Anon. 2005b. The 2004 British Columbia seafood industry year in review. Ministry of Environment, and Ministry of Agriculture and Lands. (Available at www.agf.gov.bc.ca/fish_stats/pdf/Seafood_Industry_YIR_2004.pdf)

Anon. 2006. Government Actions Regulation. Policy and procedures for government staff who are involved in assisting delegated decision-makers (draft). Joint Steering Committee Memorandum. (Available at www.for.gov.bc.ca/rco/pfit/)

Beaudry, L.J., J. McConnachie, P.G. Beaudry, and R.G. Pike. 2006. Glossary of hydrologic and geomorphic terms. *In* Compendium of forest hydrology and geomorphology in British Columbia (Appendix 1). Discussion draft, Jan. 2006. FORREX. (Available at www.forrex.org/program/water/PDFs/Compendium/Compendium_Appendix01.pdf)

Bradford, M.J., R.A. Myers, and J.R. Irvine. 2000. Reference points for Coho Salmon (*Oncorhynchus kisutch*) harvest rates and escapement goals based on freshwater production. Can. J. Fish. Aquat. Sci. 57: 677-686.

Church, M. and B. Eaton. 2001. Hydrological effects of forest harvest in the Pacific Northwest (Tech. Rep. 3). Coast Information Team. (Available at www.citbc.org/b-HPG3-ChurchEaton-Jun01.pdf)

Campagnolo, I. 2005. Speech from the throne (6th session and 37th Parliament). Province of BC. (Available at http://www.leg.bc.ca/37th6th/Throne_Speech_2005_6th_37th.pdf)

Curina, K. and B. Butterfield. 2005. EAU BC: Ecological Aquatic Units of BC (review draft). Nature Conservancy of BC.

FPPR (Forest Planning and Practices Regulation). 2005. Forest planning and practices regulation. Government of BC. (Available at www.for.gov.bc.ca/tasb/legsregs/frpa/frparegs/forplanprac/fppr.htm)

FREP (Forest and Range Evaluation Program). 2001. FREP Glossary. BC Ministry of Forests and Range. (Available at www.for.gov.bc.ca/hfp/frep/publications/glossary.htm)

Groot, C. and L. Margolis. 1991. Pacific salmon life histories. UBC Press, Vancouver BC.

Hogan, D. and S. Bird. 1998. Forest management and channel morphology in small coastal watersheds: Results from Carnation Creek and Queen Charlotte Islands. *In* M. Brewin and D. Monita (eds.) Forest-Fish Conference: Land management practices affecting aquatic ecosystems. Northern Forestry Centre, Forestry Canada, Edmonton, AB.

Myers, R.A., K.G. Bowen, and N.J. Barrowman. 1999. Maximum reproductive rate of fish at low population sizes. Can. J. Fish. Aquat. Sci. 56: 2404-2419.

Mackinnon, G. 2004. Designating Fisheries Sensitive Watersheds – An Approach. Draft report by Gordon Mackinnon and Associates Ltd., Nanaimo, BC, for Ministry of Water, Lands and Air Protection, Victoria, BC.

Marmorek, D.R. and C.A.D. Alexander. 2003. Defining "significant fisheries watersheds" and "temperature sensitive streams" for the new results-based forest practices code: results of a workshop held 5–6 Feb. 2003. Draft report by ESSA Technologies Ltd., Vancouver, BC for Ministry of Water, Lands and Air Protection, Victoria, BC. 90 pp.

McPhail, J.D. and R. Carveth. 2003. Field key to the freshwater fishes of British Columbia. BC Resource Inventory Committee. (Available at http://ilmbwww.gov.bc.ca/risc/pubs/aquatic/freshfish/assets/fresh.pdf)

Montgomery, D.R. and J.M. Buffington. 1998. Channel processes, classification, and response. *In* R. Naiman and R. Bilby (eds.). River ecology and management; Lessons from the Pacific Coastal Ecoregion. Springer-Verlag.

Porter, M.J. 2006. Preliminary analyses of the sensitivity of FSW scoring to alternative WET model structure, normalizations and component weightings. Draft report prepared by ESSA Technologies Ltd., Vancouver, B.C. for Ministry of Water, Lands and Air Protection, Victoria, BC.

Porter, M, G. Haas, and E. Parkinson. 2000. Sensitivity of British Columbia's freshwater fish to timber harvest: using species traits as predictors of species risk. B.C. Fisheries Report 114. Ministry of Agriculture, Food, and Fisheries.

Reid, L. 1998a. Cumulative watershed effects and watershed analysis. *In* R. Naiman and R. Bilby (eds.). River ecology and management; Lessons from the Pacific Coastal Ecoregion. Springer-Verlag.

Reid, L. 1998b. Cumulative watershed effects: then and now. *In* R. Ziemer (ed.). Proceedings of the conference on coastal watersheds: the Casper Creek story. Southwest Research Station, US Forest Service.

Smith, B.D. 1999. Assessment of wild steelhead (*Oncorhynchus mykiss*) abundance trends in British Columbia (1967/68–1995/96) using the Steelhead Harvest Questionnaire. BC Fisheries Management Report 110.

Wilford, D. and R. Lalonde. 2004. A framework for effective watershed monitoring. Streamline Watershed Management Bulletin 8(1):5-10.

5.0 Definitions and Abbreviations

Adaptive Management: "…a process for testing hypotheses through management experiments in natural systems, collecting and interpreting new information, and making changes based on monitoring information to improve the management of ecosystems" (FREP 2001).

Adverse Cumulative Effect: The combined effect, resulting from multiple human activities and natural watershed processes, which cause an adverse impact on a stream-channel and fish habitat. Adverse cumulative effects can result from large, or individually minor, but collectively significant impacts taking place in the past, present, or reasonably foreseeable future. (Definition adapted from Reid 1998a, 1998b)

DFO: Federal Department of Fisheries and Oceans.

Fisheries: For the purposes of the Government Actions Regulation and FSW program, fisheries is a generic term used to describe all (or any) fishes relying on an area (i.e., watershed) at some point during their life cycle. The definition includes associated social, economic, and ecological attributes characterized by these species.

Fisheries Sensitive Watershed: An area of land (watershed) identified under the Government Actions Regulation comprising both significant fisheries values and sensitivity to forest or range practices (FPPR 2005).

FRPA: *Forest and Range Practices Act*.

FSP: Forest Stewardship Plan.

FSW: Fisheries sensitive watershed.

GAR: Government Actions Regulation; an enactment under FRPA.

HLP: Higher Level Plan.

LRMP: Land and Resource Management Plan.

MOE: Ministry of Environment or the "Ministry" in this document.

MOFR: Ministry of Forests and Range.

Watershed: "Also referred to as a drainage basin or catchment area, '(w)atersheds are the natural landscape units from which hierarchical drainage networks are formed.' Watershed boundaries typically are the height of 'land dividing two areas that are drained by different river systems' " (Beaudry et al. 2006). For most uses of this term, understanding the definition's purpose and scale of application are important to defining its spatial extent. In BC,

the basic spatial standard is most commonly defined by the 1:50,000 scale Watershed Atlas boundaries (i.e., ≥3rd order) or some aggregation of these.

Watershed processes: Watershed processes are the dominating and naturally occurring physical and biological processes, including interactions between these processes, that shape and maintain the character of a watershed. In the case of an FSW, the typical dominant processes that shape and maintain fish habitat include (but are not limited to) sediment transport, stream hydrology, and riparian function.

WET: Watershed Evaluation Tool.

List of Appendices

Appendix 1. Definitions of variable names used in the Watershed Evaluation Tool

Variable Name	Example of Typical Value	Coverage[9]	Description
MOF_REG	Vancouver	All	
MOF_DIS	Duncan	All	
FWRegion	1	All	
BCWWSD_	19012	All	Identifier from BCWWSD shape file
WS_SHORT	920257701	All	New Watershed Code with -s and trailing 0s stripped out
WSD_ID	COWNWSD000112	All	Identifier from BCWWSD shape file
L_ORDER	5	All	Stream order of mainstem at 1:50,000
WSHDAreaKmd2	1227.0	All	Area of Mainstem Polygon + All tributary Polygons
SqrtWSDArea	35.0	All	Used as a weighting factor in comparing fish values among watersheds
PolyAreaKm2	389.7	All	Area of Mainstem Polygon
TEScore	5.07	All	Sum over Threatened species (Probability of Occurrence x Biological Sensitivity* x Ranking Score**)
SppRichScore	5.89	All	Sum over all species (Probability of Occurrence x Biological Sensitivity*)
SpecStocks	0	List	Presence (1) or Absence (0) of a special Stock***
LakeEffort	17999	All	Lake angler days estimated by the statistical model
StreamEffort		List	Stream angler days as estimated by Regional Biologists
SthdEffort	7516	List	Steelhead Harvest Analysis
SalmonValue	385994	List	Sum over 5 species (Estimated harvest x $value x Biological sensitivity*)
SpecialSelect	-1	All	Used to select a subset of watersheds for regional analysis
PolyGr61+	11.6	All	% of mainstem polygon terrain with a slope >60%
AlluvStrDen	0.468	All	Stream blueline with gradient <8% (km)/Land Area (km^2) for Watershed
RoadDen	2.171	All	Road length (km)/Land Area (km^2) for Watershed
LogAlluvTotDen	0.000283	All	Stream blueline with riparian logging and gradient <8% (km)/Land Area (km^2) for Watershed
TotL_Disturb%	0.117	All	(Logged area + recently burned area)/ Land area for Watershed
Gaze_Name	COWICHAN RIVER	All	Gazetted Name
NSppRich	0.445	All	Normalized Species Richness Score = SppRichScore/ Max(SppRichScore)

[9] "All" represents data from a recognized data source with Provincial coverage. "List" represents data intentionally acquired from (regional) experts representing significant values. Values for watersheds not represented on a list are assumed to be either '0' or missing.

Variable Name	Example of Typical Value	Coverage[9]	Description
NTEScore	0.383	All	Normalized Threatened and Endangered Score = TEScore/Max(TEScore)
BioDScore	0.829	All	Biodiversity Score = NSppRich + NTEScore
NBioDScore	0.446	All	Normalized Biodiversity Score = BioDScore/ Max(BioDScore)
FWEffort	25515	All	Total Angling Effort = LakeEffort (all) + StreamEffort (list) + SthdEffort (list)
NFWEffort	0.562	All	Normalized Salmon Value = SalmonValue / Max(SalmonValue)
NSalmonValue	0.066	All	Normalized Total Angling Effort = FWEffort / Max(FWEffort)
FNCulture		List	Watersheds with low/high First Nations value (Scored 0-1)
SocioEcon	0.628	All	Socio-economic Score = NFWEffort + NSalmonValue + FNCulture
NSocioEcon	0.599	All	Normalized Socio-economic Score = Socio-economic Score / Max(Socio-economic Score)
FishValue	1.046	All	Fisheries Value = NBioDScore + NSocioEcon
NFishValue	0.551	All	Normalized Fisheries Value = FishValue / Max(FishValue)
ValpKm	0.030	All	Fisheries Value per km = Fishvalue/SqrtWSDArea
NValpKm	0.081	All	Normalized Fisheries Value Km = ValpKm / Max(ValpKm)
NPolyGr61+	0.119	All	Normalized % Terrain Slope >60% =PolyGr61+ / Max(PolyGr61+)
NAlluvStrDen	0.103	All	Normalized AlluvStrDen = AlluvStrDen / Max(AlluvStrDen)
NRoadDen	0.166	All	Normalized RoadDen = RoadDen / Max(RoadDen)
NLogAlluvTotDen	0.009	All	Normalized LogAlluvTotDen = LogAlluvTotDen / Max(LogAlluvTotDen)
NTotL_Disturb%	0.117	All	Normalized TotL_Disturb% = TotL_Disturb% / Max(TotL_Disturb%)
CurrDevlop	2.289	All	Current Development Score =NTotL_Disturb% + NLogAlluvTotDen + NroadDen
NCurrDevlop	0.175	All	Normalized CurrDevlop = CurrDevlop / Max(CurrDevlop)
Sensitivity	0.397	All	Watershed Sensitivity to Forest Harvesting = NAlluvStrDen + NCurrDevlop + NPolyGr61+
NSensitivity	0.348	All	Normalized Sensitivity = Sensitivity / Max(Sensitivity)
* (0-1) Derived from a qualitative evaluation by Porter et al. (2000) (Table 1)			
** (0-7) Based on the global and Canadian ranking of threatened species (Table 1)			
*** 0,0.5,1 Watershed is identified by region to contain a stock with high Biodiversity or Socio-economic value that is missed in the formal analysis, e.g., summer run steelhead			

Appendix 2. Relative sensitivities and TEScores for species included in the Watershed Evaluation Tool

TE Scores are assigned to species according to their global (G) and provincial (S) rankings as follows:

	S1	S2	S3
G1	7	–	–
G2	6	5	–
G3	5	4	3
G4	4	3	2
G5	3	2	1

NAME	SCIENTIFIC_NAME	Relative Sensitivity	T&E Score
Dolly Varden	*Salvelinus malma*	1.00	1
Bull Trout	*Salvelinus confluentus*	0.94	3
Coho Salmon	*Oncorhynchus kisutch*	0.94	
Coastal Cutthroat Trout	*Oncorhynchus clarki clarki*	0.88	2
Westslope Cutthroat Trout	*Oncorhynchus clarki lewisi*	0.88	2
Chinook Salmon	*Oncorhynchus tshawytscha*	0.88	
Mountain Whitefish	*Prosopium williamsoni*	0.88	
Cutthroat Trout	*Oncorhynchus clarki*	0.88	
Arctic Grayling	*Thymallus arcticus*	0.81	
Burbot	*Lota lota*	0.81	
Inconnu	*Stenodus leucichthys*	0.75	1
Northern Mountain Sucker	*Catostomus platyhyncus*	0.75	1
Rainbow Trout	*Oncorhynchus mykiss*	0.75	
Broad Whitefish	*Coregonus nasus*	0.69	3
Arctic Cisco	*Coregonus autumnalis*	0.69	3
Shorthead Sculpin	*Cottus confusus*	0.69	2
Coastrange Sculpin	*Cottus aleuticus*	0.69	
Chum Salmon	*Oncorhynchus keta*	0.69	
Lake Trout	*Salvelinus namaycush*	0.69	
Sockeye Salmon	*Oncorhynchus nerka*	0.69	
Least Cisco	*Coregonus sardinella*	0.63	2
Pacific Lamprey	*Lampetra tridentata*	0.63	0
Mottled Sculpin	*Cottus bairdi*	0.63	
Torrent Sculpin	*Cottus rhotheus*	0.63	
Longfin Smelt	*Spirinchus thaleichthys*	0.63	
Longnose Sucker	*Catostomus catostomus*	0.63	
Lake Whitefish	*Coregonus clupeaformis*	0.63	
Round Whitefish	*Prosopium cyclindraceum*	0.63	
Lake Cisco	*Coregonus artedii*	0.56	3
Western Brook Lamprey	*Lampetra richardsoni*	0.56	

NAME	SCIENTIFIC_NAME	Relative Sensitivity	T&E Score
River Lamprey	*Lampetra ayresi*	0.56	
Slimy Sculpin	*Cottus cognatus*	0.56	
Longnose Dace	*Rhynichthys cataractae*	0.56	
Eulachon	*Thaleichthys pacificus*	0.50	2
Chiselmouth	*Acrocheilus alutaceus*	0.50	1
Northern Pearl Dace	*Margariscus margarita*	0.50	1
Prickly Sculpin	*Cottus asper*	0.50	
Spoonhead Sculpin	*Cottus ricei*	0.50	
Lake Chub	*Couesius plumbeus*	0.50	
Pink Salmon	*Oncorhynchus gorbuscha*	0.50	
Pygmy Whitefish	*Prosopium coulteri*	0.50	
White Sucker	*Catostomus commersoni*	0.50	
Speckled Dace	*Rhynichthys osculus*	0.44	3
Umatilla Dace	*Rhynichthys umatilla*	0.44	3
Brassy Minnow	*Hybognathus hankinsoni*	0.44	
Brook Stickleback	*Culaea inconstans*	0.44	
Bridgelip Sucker	*Catastomus columbianus*	0.44	
Largescale Sucker	*Catostomus macrocheilus*	0.44	
Flathead Chub	*Platygobio gracilis*	0.44	
Peamouth Chub	*Mylocheilus caurinus*	0.44	
Redside Shiner	*Richardsonius balteatus*	0.44	
Troutperch	*Percopsis omiscomaycus*	0.44	
Walleye	*Stizostedion vitreum*	0.44	
Ninespine Stickleback	*Pungitius pungitius*	0.38	3
Green Sturgeon	*Acipenser medirostris*	0.38	
Northern Pike-minnow	*Ptychocheilus oregonensis*	0.38	
American Shad	*Alosa sapidissima*	0.38	
White Sturgeon	*Acipenser transmontanus*	0.38	
Spottail Shiner	*Notropis hudsonius*	0.31	3
Goldeye	*Hiodon alosoides*	0.31	1
Leopard Dace	*Rhynichthys falcatus*	0.31	
Finescale Dace	*Phoxinus neogaeus*	0.25	
Northern Pike	*Esox lucius*	0.25	
Northern Redbelly Dace	*Phoxinus eos*	0.25	
Emerald Shiner	*Notropis atherinoides*	0.19	3
Threespine Stickleback	*Gasterosteus aculeatus*	0.19	
Yellow Perch	*Perca flavescens*	0.19	
Subspecies, populations and life history variants			
Williston Lake Artic Grayling*	*Thymallus arcticus*	0.81	3
Lower Kootenay Burbot	*Lota lota*	0.81	3
Steelhead	*Oncorhynchus mykiss*	0.81	
Salish Sucker*	*Catostomus* sp.	0.75	7
Kokanee	*Oncorhynchus nerka*	0.69	
Morrison Creek Lamprey*	*Lampetra richardsoni marifaga*	0.69	3
Nooksack Dace*	*Rhinichthys* sp.	0.63	5
Pygmy Longfin Smelt*	*Spirincus* sp.	0.56	7
Lake Lamprey	*Lampetra macrostoma*	0.44	7

NAME	SCIENTIFIC_NAME	Relative Sensitivity	T&E Score
White Sturgeon populations*	*Acipenser transmontanus* sp.	0.38	4
Cultus Lake Sculpin*	*Cottus* sp.	0.31	7
Threespine Stickleback populations*	*Gasterosteus* sp.	0.19	7
* See BC Conservation Data Centre for details.			

Appendix 3. Functional species traits affecting the sensitivity of fish to the impacts of logging on freshwater habitats (from Porter et al. 2000)

A scoring of '1' indicates the lowest rating of sensitivity for a species, and '2' (and then in some cases '3') indicates higher levels of sensitivity.

Hyperthermia tolerance

1. Tolerant of high water temperatures (temperate eurytherm with upper lethal temp >34ºC) or found predominantly in warm water.
2. Moderate tolerance for high water temperatures (temperature mesotherm with upper lethal temp 28–34ºC) or found predominantly in cool water.
3. Low tolerance for high water temperatures (temperature stenotherm with upper lethal temp <26ºC) or found predominantly in cold water.

Habitat use – Spawning

1. Spawns predominantly in lakes or medium to large sized rivers.
2. Spawns predominantly in small to medium sized rivers.
3. Spawns predominantly in small creeks and headwaters.

Habitat use – Rearing

1. Occurs predominantly in large rivers or lakes.
2. Occurs predominantly in medium to large sized rivers.
3. Occurs predominantly in small creeks and headwaters.

Hypoxia tolerance

1. Tolerant of low DO concentration (lethal limit <1 mg/L) or generally inhabits eutrophic systems.
2. Intermediate sensitivity to low DO concentrations (lethal limit 1–2 mg/L) or generally inhabits mesotrophic systems.
3. High sensitivity to low DO concentrations (lethal limit >2mg/L) or generally inhabits oligotrophic systems.

Siltation tolerance

1. Physiologically tolerant of high levels of suspended sediment or commonly found in silted waters.
2. Physiologically intolerant of high levels of suspended sediment or commonly found only in clear waters.

Reproductive strategy

1. Short life span, early age of sexual maturity (generally in 1st or 2nd year), fast generation times (1–3 years) — rapid return time of populations after disturbance.
2. Moderate life span, intermediate age of sexual maturity (generally in 3rd to 4th year), moderate generation times (3–6 years) - intermediate return time of populations after disturbance.

3. Long life span, delayed age of sexual maturity (generally in 5th year or later), slow generation times (>6 years) — very slow return time of populations after disturbance despite often high individual fecundity.

Feeding mode

1. Nonvisual predator/scavenger/omnivore, eyes adapted for reduced light levels, or else does not feed in freshwater.
2. Visual predator/planktivore reliant on good light for efficient feeding, or else algivore.

Spawning mode

1. Spawns successfully on miscellaneous substrate (sand, silt, vegetation), often with parental care.
2. Spawns on clean gravel/rock substrate (lithophilous) with pre-spawning site preparation or parental care of eggs.
3. Spawns on clean gravel/rock substrate (lithophilous) without site preparation (simple broadcast spawner).

Migration patterns

1. Limited movements through stream or river systems for spawning or overwintering purposes.
2. Moderate movements through stream or river systems.
3. Extensive movements through stream or river systems.

Water column /substrate use

1. Primarily living within the water column or is benthic living on soft substrate.
2. Primarily benthic living amongst rocky substrate.

Spawning season

1. Spring or summer spawner (relatively less exposure to intense flow events).
2. Fall spawner (relatively greater exposure to intense flow events).

Cover use

1. Limited use of large woody debris cover by juveniles and/or adults.
2. Extensive use of large woody debris cover by juveniles and/or adults.

Appendix 4. FSW Mapping Specifications

Spatial Data Standards for Fisheries Sensitive Watersheds

The following information summarizes the basic spatial data requirements for an FSW submission. The final procedures document will describe specific specifications in more detail. The preferred digital format for submission of FSW boundary definitions is an ArcInfo polygon coverage or, at minimum, a shape file with associated FSW attributes as specified below.

Column (Field) Name	Output Width	Type	Number of decimals
AREA	16	Number	0
PERIMETER	12	Number	3
FSW_TAG	14	Character	-
FEAT_NOTES	255	Character	-
FCODE	10	Character	-
WSD_CODE	45	Character	-
GAZ_NAME	30	Character	-

Description of Attributes

AREA (m^2) - Calculated by the GIS software.

PERIMETER (m) - Calculated by the GIS software.

FSW_TAG – Unique alpha-numeric string identifying the FSW polygon. FSW_TAG numbers must be lower case with dashes, e.g., f-6-003, where 'f' is constant, '6' is the MOE region number, and '003' is the 3 digit unique identifier FSW_TAG number in that region.

FEAT_NOTES – An optional description or notation associated with the FSW area.

FCODE – A 10-digit code identifying the polygon as a Fisheries Sensitive Watershed, referenced in the MOE feature code database.

- The FSW code value is FF33515300

WSD_CODE – The Watershed Code at the furthest downstream point in the FSW.

GAZ_NAME – The stream's gazetted (legal) name at the furthest downstream point in the FSW.

Spatial Data Projection
The projection must be in BC Albers.

Sending the Data
ArcInfo coverages must be sent as e00 files, uncompressed (i.e., exported with NONE compression option).

Appendix 5. Government Actions Regulation

GOVERNMENT ACTIONS REGULATION

B.C. Reg. 582/2004

Fisheries sensitive watersheds and objectives

14(1) The minister responsible for the *Wildlife Act* by order may identify as a fisheries sensitive watershed an area of land in a watershed that has significant downstream fisheries values and significant watershed sensitivity if satisfied that the area requires special management to protect fish, that is not otherwise provided for under this regulation or another enactment, by:

(a) conserving:
  (i) the natural hydrological conditions, natural stream bed dynamics and stream channel integrity, and
  (ii) the quality, quantity and timing of water flow, or
(b) preventing cumulative hydrological effects that would have a material adverse effect on fish.

14(2) The minister responsible for the *Wildlife Act* by order may establish a fisheries sensitive watershed objective respecting a matter referred to in subsection (1).

URL: www.for.gov.bc.ca/tasb/legsregs/frpa/frparegs/govact/gar.htm#section14

Appendix 6. FSW Designation Phases

There are three separate phases under which FSW designations will take (or have taken) place. The first phase, completed last year, involved the evaluation and designation of a number of FSWs named in the Forest Planning and Practices Regulation (FPPR). The second phase, currently under way, involves reviewing and, as appropriate, designating qualifying FSWs associated with Higher Level Plans (HLPs) or Land and Resource Management Plans (LRMPs). The last phase is the most encompassing and involves both the development of the Provincial FSW "evaluation and designation" procedure and the launch of the FSW program itself.

Phase I.
The first phase was completed in December of 2005 and involved the review of the 44 watersheds listed in schedule 2 of the FPPR. Of this list 17 were designated as FSWs under GAR. The remaining watersheds did not qualify based on the existing available information, or because they were named in HLP or LRMP documents and thus receive interim FSW status from those cabinet-approved planning documents. In some cases watersheds not receiving designation under Phase I may be subject to re-evaluation during Phase II or III. The legal Orders and related spatial information for Phase I watersheds can be found on the MOE FSW Website.[10]

Phase II.
The second phase is ongoing and involves watersheds named or described in HLPs and LRMPs. Currently, watersheds named or described in the Okanagan-Shuswap LRMP, Cariboo-Chilcotin HLP, and Central and North Coast LRMPs are under review. The procedure for designation will draw on the land use direction provided in the plans, regional rankings provided by a prototype version of the WET, and the local knowledge bases. Not all qualifying watersheds residing within a region of interest (i.e., planning unit) will be designated during this phase; however, these will not be omitted altogether as they can be reconsidered, subject to new or improved information, in the final phase.

Phase III.
The last phase, and the focus of the preceding document, has two distinct components: development and then implementation of the program. Several major tasks and milestones associated with Phase III program development include the following: (see section 1.4 Information Sharing)

The second component involves the implementation of the FSW program in (early) 2007. This component will see the evaluation of the remaining more than 17,000 provincial watersheds and subsequent designation of qualifying FSWs.

[10] MOE FSW website URL: www.env.gov.bc.ca/wld/fsw/