
Overview Fish and Fish Habitat Inventory Methodology

Prepared by
BC Ministry of Fisheries
Fisheries Inventory Section

for the
Resources Inventory Committee

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The Resources Inventory Committee consists of representatives from various ministries and agencies of the Canadian and the British Columbia governments as well as from First Nations peoples. RIC objectives are to develop a common set of standards and procedures for the provincial resources inventories, as recommended by the Forest Resources Commission in its report “The Future of our Forests.”

For further information about the Resources Inventory Committee and its various Task Forces, please access the Resources Inventory Committee Website at:
<http://www.for.gov.bc.ca/ric>.

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1. Introduction

1.1 Overview Fish and Fish Habitat Inventory

This manual describes the standards for Overview Fish and Fish Habitat Inventory for British Columbia. The Overview Fish and Fish Habitat Inventory is a low intensity survey covering large watersheds as defined from the *1:50,000 BC Watershed Atlas* (RIC 1997). The overview is ideal for large areas where little fish and fish habitat information is available, and uses the *1:50,000 BC Watershed Atlas* in combination with the 1:50,000 map-based habitat analysis (Coombes et al., in prep.). Guided by an experienced fisheries biologist, this inventory provides information that describes fish species presence, probable distribution within the watershed and broad habitat classification for interpretation of habitat sensitivity and capability for fish production.

The Overview Fish and Fish Habitat Inventory consists of two components:

- *Habitat* inventory: map-derived lake and stream habitat classification for all waterbodies as defined using NTS 1:50,000 mapping. Field data are collected for confirmation of major obstructions to fish migrations, and to document general habitat conditions and significant constraints.
- *Fish* inventory: existing data review and field sampling for fish species presence in representative stream habitat types, including main stems and tributaries and in key lakes. Basic life history characteristics of fish samples are recorded.

The Overview Fish and Fish Habitat Inventory has applications to a variety of resource planning and management initiatives. Some of these include:

- Land and Resource Management Planning (LRMP)
 - in the absence of any information, basic information such as fish species presence and habitat capability can be obtained from an overview inventory. For LRMP this information may be presented at a scale of 1:250,000;
- Forest resource management, including the Forest Practices Code:
 - information collected at the overview level can be applied to operational levels to confirm fish presence;
 - fish species presence may trigger specific management practices within broad areas;
 - information regarding fisheries “values” and sensitivity to assist with the prioritization of the need for more detailed inventory (e.g., *Reconnaissance (1:20,000) Fish and Fish Habitat Inventory*; “species focussed” inventory).
- Fisheries management:
 - information on species and population presence, distribution and individual fish characteristics to apply to stock conservation and to focus further inventory.
- Treaty processes
 - baseline fisheries information and may encompass issues raised above.

Products of the overview inventory include watershed-based 1:50,000 stream reach and lake habitat classification maps, including locations of major barriers and obstructions, locations of fish sampling points and sites of fish species presence, and locations of critical habitat

types. Overview inventory data will provide the basis for future interpreted products such as potential fish distribution, habitat capability and habitat suitability (e.g., Buchan and Korman, 1997; Korman and Buchan, 1997; Porter et al., 1998).

1.2 Overview Inventory Process

The Overview Fish and Fish Habitat Inventory includes pre-field planning, a field program and project reporting. The overview places significant emphasis on using available provincial data sets such as the Fisheries Information Summary System (FISS) and the 1:50,000 map-based habitat analysis (Coombes et al., in prep.). These data sets are obtained and used in the pre-field stages of the inventory to plan the field sampling program. Critical species presence information and habitat observations collected during the field program permit professional interpretation of fish distribution, habitat capability and habitat sensitivity. Most areas requiring overview inventory are remote and access is difficult and costly, therefore, the field program focusses on critical information.

The general contents of an overview inventory includes the following:

Pre-Field Activities

Review and analyze existing data:

- Review FISS and other significant sources of relevant information (e.g., regional fisheries section files)
- Review potential access and other logistical considerations.

Obtain existing FISS and watershed atlas mapped products:

- Obtain watershed atlas base map
- Obtain FISS mapping including existing fish distribution and 1:50,000 map-based habitat analysis maps.

Develop a field project plan:

- Plan overflight and video recording
- Select provisional field sample sites
- Describe sampling and gear type requirements for each site.

Field Program and Reporting

Conduct field program:

- Overflight to confirm major obstructions to fish migrations, and to record general habitat conditions and significant constraints;
- Fish sampling at selected locations in lakes and streams within the watershed;
- Record data on RIC Standard data forms.

Compile data and prepare project reports and maps:

- Edit and provide aerial video record
- Enter field data into the Field Data Information System (FDIS)
- Update FISS records
- Prepare reports and maps presenting the inventory data.

An essential reference for the overview inventory is the RIC standard *Reconnaissance (1:20,000) Fish and Fish Habitat Inventory*. The overview uses many of the same procedures, field data forms and data base management systems for field data as employed in the reconnaissance. Information about the reconnaissance inventory is available on the BC Fisheries web site at: <<http://www.env.gov.bc.ca/fsh/IS>>.

2. Data Review, Map Analysis, and Project Plan

2.1 Introduction

The activities done prior to conducting field work include data review, map analysis and the development of a project plan. The project plan provides a clear description of how the inventory will proceed, including the field activity, data compilation and reporting. The project plan is an important tool to address the balance between adequate watershed coverage and budgetary constraints.

2.2 Project Referencing and FDIS Start-up Files

A project code references all fish and fish habitat inventory projects, including the overview. The project code consists of a ministry-defined code and year, and is used on data forms, databases and reports.

The project code format is: R#-WSGR-NNNNNNNN-YYYY where R# represents the region number (e.g., 01, 04, 7A, etc.); WSGR represents the dominant watershed code (e.g., CHWK); NNNNNNNN represents a computer generated inventory code; and YYYY represents the year of the project. The computer generated portion of the project code is obtained when an FDIS start-up file is requested. The FDIS start-up file is required to set up and allow data entry into FDIS for each new project. The file contains information such as watershed codes and code tables.

The FDIS start-up file can be used to customize FDIS data entry requirements for inventory types. When requesting an FDIS start-up file, make sure it is communicated that the file is to be used for overview inventory. Specific data entry instructions for overview inventory may accompany the start-up file. Contact the BC Ministry of Fisheries Planning and Information Branch, Fisheries Inventory Section, in Victoria to obtain your project code and FDIS start-up file. Consult the BC Fisheries web site <www.env.gov.bc.ca/fsh/IS> for a list of the information required in your submission.

Other project coding (e.g., ministry and Forest Renewal BC project numbers) may be required for reporting purposes. Formats and usage vary regionally. Contact the ministry representative or contract monitor for formats and usage applicable to the project.

2.3 Data Review

Consult FISS and regional files for existing information on the project area. In many cases the overview is conducted where baseline information is lacking. If data review reveals new information, create a bibliography of the new information, and update FISS (maps and forms) for delivery with final project deliverable products. Contact key agencies and individuals (e.g., local guide outfitters) who may have additional information regarding fish and fish habitat of the project area. Anecdotal information often provides useful background information for survey planning. Prepare a list of contacts.

Chapter 2 in, *Reconnaissance (1:20,000) Fish and Fish Habitat Inventory: Standards and Procedures*, Version 1.1, RIC 1998 provides further information on data review, contact lists, bibliography and FISS update procedures.

2.4 Map Analysis

Overview budgets and field work may be limited in comparison with more intensive surveys. In an effort to make best use of limited resources, the use and interpretation of map-based habitat information is an essential component of overview inventory methodology. The FISS 1:50,000 map-based habitat analysis includes information on all waterbodies (lakes and stream reaches) that are present on the NTS 1:50,000 base maps. Individual lake and stream reach data are linked to the watershed atlas. Coombes et al (in prep.) provides a description of the 1:50,000 map-based habitat analysis.

In preparation for planning and conducting the overview, obtain a set of 1:50,000 National Topographic Series maps for the project area, and the following maps and data available from the 1:50,000 watershed atlas and FISS:

1. 1:50,000 watershed atlas base map with watershed codes and 3rd and 4th order watershed polygons.
2. 1:50,000 watershed atlas base map with existing knowledge of fish presence and known or potential obstructions to fish movements.
3. 1:50,000 watershed atlas with lake habitat classification. Lakes can be classified according to elevation and surface area according to appropriate regional criteria.
4. 1:50,000 watershed atlas macroreach map, showing location of macroreach boundaries;
5. 1:50,000 watershed atlas macroreach map as (4) above, classified by stream order.
6. 1:50,000 watershed atlas macroreach map as (4) above, classified by gradient according to appropriate regional criteria. The default gradient classification is 0-1, 1-3, 3-7, 7-12, 12-20, >20.

The above maps can be plotted at any scale appropriate to the project area. In addition to these watershed atlas maps, obtain all FISS data records and the 1:50,000 map-based habitat analysis (lake and stream macroreach) datasets for the project area, if available. Data and maps are available from BC Fisheries Planning and Information Branch, Fisheries Inventory Section, GIS Applications Unit or Regional Inventory Specialist. Information is also available on the BCFisheries Web site at: <<http://www.env.gov.bc.ca/fsh/IS/>>.

Maps and existing data should be reviewed to determine the location of potential obstructions to fish movements, access points and helicopter landing sites. More detailed maps (e.g., TRIM) and air photos may be reviewed if necessary. This information should be noted on the project plan maps.

2.5 Project Plan

The project plan should provide a clear description of how the inventory will proceed, including the field activity, data compilation and reporting. The plan should document proposed scope and timing of field activities including the selection of lakes and streams to sample. Ensure that the proposed project plan, including data capture and reporting, is feasible given the available budget.

2.5.1 Field Sampling Design

The field program provides a maximum amount of information with a minimum of field effort and does not sample stream sites and lakes at random. The field program plan uses an assessment of existing and map-based habitat information to design a survey that generates the most critical and useful information. The design should select fish sampling sites that, all together, are likely to contain the full variety of fish species and fish habitats present in the watershed.

Overflight and Video Record

The objectives of the overflight and aerial video record are to:

- confirm locations of major barriers and obstructions to fish movements;
- record general habitat conditions in the watershed project area.

Video recording is generally restricted to main stem streams and major tributaries (i.e., streams where stream features can easily be observed and captured on video).

The overview should not require a separate flight to collect video data. Instead, field crews collect video during the course of the field program as opportunities exist. The primary reason for this practice is budget constraints and the high cost of accessing these normally remote watersheds. Flights are generally flown in an upstream direction and flight paths are clearly indicated in the project plan. Suitably documented and georeferenced 35mm aerial photography can replace aerial videography in some projects.

Fish Sampling

The objectives of fish sampling in the overview inventory are to:

- describe all fish species and their general occurrence and distribution in the watershed. Sampling should cover all habitats present in the study area, however effort is minimized in habitats where fish presence is unlikely;
- record characteristics of the habitat sampled for fish (including reconnaissance lake survey);
- record basic fish life history characteristics and collect a complete complement of age structures, voucher samples and tissue samples for genetic analysis (or archiving) for each species of concern;
- choose appropriate sampling methods in order to establish a complete species list at the sample location.

Sampling methods for fish are discussed in detail in *Fish Collection Methods and Standard*, Version 4.0, RIC (1997). As these watersheds are often remote and may have had little if any fish sampling conducted in the past, the need for fish voucher specimens should be addressed with MELP regional fisheries staff.

Fish sampling in streams

The fish sampling design for streams should follow these guidelines:

- sample **two** locations in main stems (e.g., 5th order);
- sample **one** location in **each** major tributary (e.g., 4th order or 1 order lower than main stem);
- sample **one** location in **one** 3rd, 2nd and 1st order tributary in each 4th order basin. Sample locations where habitat (e.g., gradient) is suitable to support fish.
- sampling should investigate fish species presence above barriers on major tributary streams or stream sections deemed capable to support resident populations.

Fish sampling in lakes

The selection of individual lakes to include should follow these guidelines:

- sample in major or representative lakes within the study area that will provide the most information about fish species presence and distribution in adjacent lakes. The basis for lake selection is the 1:50,000 map-based habitat classification, the 1:50,000 watershed atlas and an assessment of the lake “network” or connections to adjacent available habitat.
- consider these classification variables: surface area, elevation, basin boundary type, outlet control type and accessibility to colonizing fish.

2.5.2 Project Plan Contents

The project plan should include maps, tables and a brief written description of the following:

- description and flight path of intended video coverage, or 35mm alternative
- location tables of stream sites and lakes proposed for field sampling
- 1:50,000 maps showing proposed sampling sites
- proposed fish sampling methods at each site
- the approximate number and distribution of fish voucher specimens by species per watershed
- type, approximate number and distribution of samples (e.g., fish aging samples, DNA tissue samples) by species per watershed
- additional sampling requirements (e.g., lake bathymetry, water sample analysis)
- detailed budget and logistical planning.

3. Field Data Collection

3.1 Overview Inventory Field Data Collection

Field data collection includes an aerial overflight, fish sampling and associated habitat descriptions at selected sample sites and lakes. Features such as obstructions to fish migration are also recorded.

Prior to initiation of the field program, obtain appropriate permits from applicable resource agencies (e.g., MELP and DFO). Pre-field preparations are described in chapter 2 of the *Reconnaissance (1:20,000) Fish and Fish Habitat Inventory: Standards and Procedures*, Version 1.1, RIC 1998.

Obtain RIC standard field data forms and field guides. Information on how to obtain field forms and fields guides is available on the BC Fisheries web site at:
<<http://www.env.gov.bc.ca/fsh/IS/>>

3.1.1 Data Referencing

The overview inventory requires all data referencing to conform with existing RIC standards.

Waterbody:

Waterbody referencing described in chapter 2 of the *Reconnaissance (1:20,000) Fish and Fish Habitat Inventory: Standards and Procedures*, Version 1.1, RIC 1998 must be followed. Referencing information includes gazetted name, alias and watershed/waterbody identifier or interim locational point (ILP). As watershed codes and waterbody identifiers are available for all waterbodies present on the 1:50,000 watershed atlas, the use of the ILP should be minimal.

Additional information regarding waterbody referencing can be found in *User's Guide to the British Columbia Watershed/waterbody Identifier System*, Revision 2.1. RIC 1997.

Georeferencing sites and features:

Each mapped feature, including those listed in section 3.1.3 *Features*, must be geographically referenced. This is done by recording the universal transverse mercator (UTM) coordinate of the feature or by assigning a unique numeric identifier (NID) to the feature. Locational information for the NID is gathered by digitizing in the GIS process. All features to be represented on final digital mapping require a NID and UTM.

Additional information regarding georeferencing and NIDs can be found in chapter 2 of the *Reconnaissance (1:20,000) Fish and Fish Habitat Inventory: Standards and Procedures*, Version 1.1, RIC 1998.

Reaches

The overview inventory does not include the assignment of reach boundaries either in the office or in the field. Instead, the existing macroreach boundaries and characteristics form the basis for reach habitat classifications and descriptions.

3.1.2 Overflight and Aerial Video

If the project plan requires aerial video data, collect it for 4th order and larger streams to confirm or to determine the location of obstructions to fish movements and to record general habitat conditions. Include upstream valley footage of 3rd order watersheds from stream confluence areas. Georeferenced 35mm photographs can be a substitute for aerial video in some projects.

Significant features to record include:

- potential obstructions to fish migration such as falls, cascades, debris jams, velocity barriers, canyons, beaver dam complexes and others
- streams with significant habitat constraints (these can be natural [e.g., glacial streams, areas of instability] or due to resource extraction activities)
- important cultural features (e.g., access points, camps)
- congregations of fish or redd sites
- significant changes in the stream network that are not identified on the map base
- other features of interest that were identified in the inventory planning process.

Co-ordinate the overflight and aerial photography and videography with fish sampling to minimize access costs.

Adhere to the following specifications for all videography products:

1. Supply original video data as Hi-8™ as well as one VHS copy. Reference the video with a code in the following format:
 - Project code – year – V1, where V1 represents the first video, V2 represents the second, etc. (see section 2.2 of this manual for information regarding the project code).
 - Include a copy of the data log sheet, Figure 7 in *Aerial Photography and Videography Standards: Applications for Stream Inventory and Assessment*, RIC (1997).
2. Mount video equipment externally on the helicopter or hold the camera in such a manner that ensures a clear and stable video image.
3. Video records should be:
 - continuous along the stream network with voice annotation of significant features
 - recorded as discrete portions of the stream network
 - include voice annotations of all significant features.
4. Record voice annotation either through a connection with the helicopter's communication system or through an independently wired audio link.
5. Cross-reference significant features to the map base in a manner that ensures expedient referencing of the video and map base by subsequent users. Use as appropriate:
 - GPS – universal transverse mercator (UTM) coordinates
 - map numeric identifiers (NID)
 - other means if required or approved in advance by the ministry contact.

3.1.3 Features

Features observed during the inventory must be recorded on the features section of the reach table (FDIS) or on the site card. Assign a NID to each feature in both the map and the database. Record only significant features that affect or potentially affect fish or fish habitat. These include:

- falls, cascades and other obstructions (e.g., debris jams, velocity barriers, canyons, beaver dam complexes)
- significant habitat features (e.g., unusual or atypical habitats such as deep pools, areas of extensive braiding)
- point sources of significant habitat constraints, such as major slumps or zones of instability, canyons
- congregations of fish and concentrations of redds
- important cultural features (e.g., access points, camps).

Document the characteristics and significance of obstructions. Obtain photodocumentation of notable features. Take oblique photographs of significant features and of watershed[s] units. These should be planned where appropriate, but will generally result from opportunistic situations encountered while enroute to sampling sites.

3.2 Sampling in Streams

Focus the stream field effort on fish sampling. Conduct sampling at selected sites as identified in the project plan or at equivalent substitute sites when planned sites are inaccessible, too dangerous to access, or when another similar site in the same macroreach is more likely to have a greater variety of fish (in the judgement of the professional fisheries biologist). Fish sampling must cover a broad range of habitats using a variety of sampling techniques as the intent of the inventory is to develop a complete fish species list for both the site and the watershed. Sample site size is variable. In smaller streams (e.g., 3rd order and smaller) the standard “reconnaissance” site length of 10 bankfull channel widths or 100 m, whichever is greater, is suitable. In larger streams, focus sampling on sites with accessible and diverse habitat types.

Record fish collection data on standard fish collection forms (*Reconnaissance (1:20 000) Fish and Fish Habitat Inventory: Data Forms and User Notes*, Version 1.1, RIC 1998). The fish collection forms consists of two sheets: the fish collection form and the individual fish data card. The fish collection form records information on site location and site referencing, sampling methods and a catch summary. The individual fish data card records information, such as length, age, and sex of individual fish captured at the site.

Collect samples from or of fish (for age determination, DNA studies, voucher specimen, etc.) according to the project plan. Representatives of any fish that the crew is unable to identify, or of any diseased or parasitized fish should be preserved. For details of fish sampling and voucher specimen collection, consult *Fish Collection Methods and Standards*, Version 4.0, RIC 1997.

Record sample site data on site cards (*Reconnaissance (1:20 000) Fish and Fish Habitat Inventory: Data Forms and User Notes*, Version 1.1, RIC 1998). In smaller streams (e.g., 3rd order and smaller) where the standard “reconnaissance” site length is sampled, complete the

full site card following standard reconnaissance procedures. In larger streams where specific habitats may be selected for sampling, describe the site by completing a site card for the portion of the stream where fish sampling was conducted and include comments describing what parts of the stream were sampled.

3.3 Sampling in Lakes

Lake sampling closely follows the procedures in *Reconnaissance (1:20,000) Fish and Fish Habitat Inventory: Standards and Procedures*, Version 1.1, RIC 1998). Use the lake survey form to record lake survey data. However, make the following changes from the reconnaissance protocol (unless the ministry contact or project planning indicates otherwise):

1. Exclude full lake bathymetry and substitute an e-line in order to save time in both field and reporting phases.
2. Increase the effort in fish sampling with additional fish sampling techniques. Greater effort to cover the range of habitats using a variety of techniques and to focus efforts on suspected species present is appropriate for overview fish sampling (e.g., small mesh gill net, angling, beach seine).
3. Use field instruments for water sampling unless the project plan has identified the need for more detailed lab analysis.

As for stream sites, record data on fish collection forms (fish collection form and individual fish data cards). Collect samples from or of fish (for age determination, DNA studies, voucher specimen, etc.) according to the project plan.

3.4 Photographic Documentation

Record photographic documentation on the site card, fish collection form, lake survey form and on the features section of the reach form as appropriate (see: *Reconnaissance (1:20 000) Fish and Fish Habitat Inventory: Data Forms and User Notes*, Version 1.1, RIC 1998).

Take colour photographs of one representative fish from each species collected from each lake and major watershed (e.g., 4th order). Photographs including all species captured, with one representative fish per species are acceptable. Representatives of any fish that the crew is unable to identify, or of any diseased or parasitized fish must be photographed as well. The quality of these photographs should enable verification of fish species identifications. Each photograph must include an object of scale, such as a ruler, to indicate the relative size of the fish.

A Guide to Photodocumentation for Aquatic Inventories, RIC (1996) describes photodocumentation standards.

4. Data Compilation and Reporting

4.1 Data Compilation and Reporting

After the field work is complete, analyze samples, complete data entry and prepare final reports and maps. Data entry includes information collected on the field forms as well as the data generated from analysis of samples taken in the field. Reporting includes individual lake survey reports as well as an overview inventory report covering the entire watershed.

4.1.1 Watershed Codes/Waterbody Identifiers

Determine and record the correct watershed code for all lakes and streams, and the correct waterbody identifier for each lake for which data were collected.

Interim locational points (ILPs) are commonly used in the reconnaissance (1:20,000) fish and fish habitat inventory to identify lakes and streams that do not have assigned watershed codes. If ILPs are found necessary for the overview inventory, replace any ILPs numbers used during the project with the appropriate watershed codes. If watershed codes are not available at the end of the project, submit the ILP reference map and ILP tables with the project report.

4.1.2 NIDs and UTMs

Use NIDs consistently and carefully throughout the project to identify where data points occur on the maps. This will allow the GIS and FDIS data sets to link to provide fully functional digital mapping. Replace any field UTM measurements with more map-accurate information from the digital map base (to an accuracy of 1 m) during data compilation and digital data entry, where appropriate.

4.1.3 Post-field Analysis Results

Compile and prepare results from any post-field sample analysis for entry into digital databases. These include:

- **Fish identification** – incorporate verification of fish identification into the fish collection results. Make any changes that result from verified samples on the fish collection forms prior to digital data entry.
- **Fish age analysis** – incorporate results of fish aging into the fish collection forms prior to digital data entry.
- **Water quality results** – the EMS database stores water sample analysis results. For lake inventory projects, compile hard copy results into an appendix to accompany the individual lake survey report. (If the ministry contact provides the digital results, incorporate them into the digital lake report.) Append the stream water sample analysis results to the fish and fish habitat inventory report.
- **Aquatic organism identifications** – incorporate the results of any taxonomic verifications requested into the field forms. This includes aquatic plants and any aquatic wildlife observations. Attach aquatic plant species lists to the individual lake survey reports as an appendix.

- **Lake bathymetric statistics** – if lake bathymetry is part of the lake survey, calculate and record statistics on the bathymetric map. Update bathymetric statistics such as volume and mean depth in the FDIS.

4.1.4 Data Entry into FDIS Database

Enter data from the field surveys into FDIS. Field data includes features, site cards, fish collection forms and individual fish cards and lake survey forms. Use correct watershed codes and waterbody identifiers. Incorporate results of all post field-survey sample analysis. The FDIS includes administrative functions to replace ILPs with watershed codes, cross reference NIDs and UTMs and to update records with sample analysis results.

Provide digital FDIS databases (file required is fdisdat.mdb; consult ministry contact for current specifications) with correct watershed codes, waterbody identifiers, and UTM locations for all data collected during the project. A final quality assurance check using the automated FDIS QA should be run to confirm data quality.

4.1.5 Photographic Documentation

Systematically arrange all slides and/or negatives in a binder and reference using photodocumentation form 1 following standards given in *A Guide to Photodocumentation for Aquatic Inventories*, RIC (1996) and Appendix 6, *Photodocumentation and Scanning in Reconnaissance (1:20,000) Fish and Fish Habitat Inventory: Standards and Procedures*, Version 1.1, RIC (1998).

Provide the following photodocumentation:

- completed photodocumentation form 1
- binder with indexed slides or negatives (with photograph contact sheet)
- indexed photographs in digital photo CD format.

Hardcopy photographs are provided with individual lake and watershed reports.

4.2 Individual Lake Data Compilation and Reporting

A lake report for each lake surveyed in the overview project is required. Reports follow the standard reconnaissance lake report format. Lake outline maps and annotated aerial photographs are required. A bathymetric map is not required unless specifically requested during the project planning phase.

4.2.1 Lake Outline Map

Prepare a final lake outline map for each lake surveyed. The map must show the location of the following:

- benchmark (if applicable)
- E-line, bathymetric transects and/or spot depths
- all inlet and outlet streams including any reaches surveyed
- limnological station

- prominent shoreline features
- fish sampling sites
- dominant aquatic macrophyte beds
- photographic sites and direction of photographs.

4.2.2 Lake Aerial Photograph

One aerial photograph enlargement of each lake surveyed should be appropriately marked to identify the following locations:

- benchmark (if applicable)
- high water mark
- limnological station
- all fish sampling sites
- inlet and outlet streams.

4.2.3 Bathymetric Map

If the lake survey included bathymetric measurements, prepare one hard copy of the lake bathymetric map. The map must follow the standards given in *Bathymetric Standards for Lake Inventories*, Version 2.0, RIC (1999). Calculate and record bathymetric statistics on the map and enter into FDIS using the Update Bathymetry function.

4.2.4 Individual Lake Inventory Reporting

This section describes the layout and format of individual lake inventory reports, as well as hard copy and digital requirements. The full watershed report references all individual lake reports.

4.2.4.1 Report Format

Follow the standard lake report format provided in the *Reconnaissance (1:20,000) Fish and Fish Habitat Inventory: Standards and Procedures*, Version 1.1, RIC 1998 (and errata March 1998). A detailed description of the format, structure and contents of the individual lake report is available on the BC Fisheries web site at: <www.env.gov.bc.ca/fsh/IS/>.

Some inventory projects may require reporting of details or analysis concerning specific aspects of the inventory project. These requirements are project-specific and should be discussed with the contract monitor at the project planning phase. Examples of such requirements are:

- analysis of fish-related information (e.g., length–weight relations)
- non-fish bearing status (streams and lakes) reports.

4.2.4.2 Digital Format

Provide all lake inventory reports in digital format. The project manager should be consulted regarding specific formats. Current specifications are:

- MS Word Version 6
- all maps and photographs linked to the digital version of the report
- bathymetric mapping in compressed G3B format TIFF raster file (see *Bathymetric Standards for Lake Inventories*, Version 2.0, RIC 1999).

4.3 Overview Report and Map Preparation

This section describes the layout and format of the overview fish and fish habitat inventory report, and provides current hard copy and digital requirements. However, consult the ministry representative as these are subject to change.

4.3.1 Report Format

Follow the sample title page and table of contents provided in Appendix 1. This is a modification of the standard reconnaissance (1:20,000) inventory report format. A detailed description of the format, structure and contents of the standard reconnaissance report is available on the BC Fisheries web site at <www.env.gov.bc.ca/fsh/IS/>.

Some inventory projects may require reporting of details or analysis concerning specific aspects of the inventory project. These requirements are project-specific and should be discussed with the contract monitor at the project planning phase. Examples include:

- analysis of fish-related information (e.g., length–weight relations);
- non-fish bearing status (streams and lakes) reports.

4.3.1.1 Digital Format

Provide fish and fish habitat inventory reports in digital format. Consult the contract monitor or your contract terms regarding specific formats as these are subject to change. Current specifications are:

- MS Word Version 6
- all maps and photographs linked to the digital version of the report.

4.4 Maps

4.4.1 Standard Maps

Consult *Standards for Fish and Fish Habitat Maps* RIC 1998 (and Errata April 1999) to confirm mapping content, symbols, labelling, map layout, codes and legends. Note that overview inventory mapping uses the 1:50 000 watershed atlas as the map base.

The overview requires two maps as deliverables. The following are general guidelines for each map; however, consult the regional fisheries inventory specialist for details:

1. **Overview Map** – shows the entire project area (with boundary lines), and includes:
 - 1:50,000 watershed atlas aquatic features and, where legible, annotation as background
 - location of all sample sites
 - 8.5" × 11" size, or 11" × 17" for larger project areas. For very large areas, use larger plots rather than several small maps
 - inset map showing project location in relation to region or province.
2. **Project Map** – summarizes all *new* information the inventory project has collected:
 - use the 1:50,000 watershed atlas aquatic features as the base
 - crop those portions of maps outside the project area
 - present new information such as
 - stream features
 - site and lake data symbols.

Interpretive maps using the existing macro-reach information, historical features information or interpreted products may be requested at the project planning stage. Consult the ministry contact.

4.4.2 Hard Copy Deliverable

Full size maps should be of sufficient scale and size to allow clear interpretation of information, labelling, and other features.

4.4.3 Digital Format Deliverable

Digital deliverables include two tables:

- metadata table
- map features table.

Ensure that the format of the tables and digital maps conforms to the specifications detailed in Appendix 4 of *Standards for Fish and Fish Habitat Maps*, RIC 1998 (and Errata April 1999). Where the standard is ambiguous for overview inventory (its primary focus is reconnaissance inventory projects) consult the ministry contact.

4.5 FISS Updates

Provide updated hard copy FISS data forms. Also include hard copy maps annotated with new FISS data. (*Specifications: Fisheries Information Summary System: Data Compilation and Mapping Procedures*. RIC 1997.). Consult the ministry contact for specific FISS data compilation requirements.

4.6 Summary of Overview Inventory Project Deliverables

Consult the ministry contact for the numbers of copies required of each of the following:

1. Individual lake reports:
 - hard copy of each final individual lake report, including lake outline map, enlarged annotated air photo and bathymetric map (if required)
 - digital final individual lake report in Word 6.0 for each lake surveyed
 - full size hard copy bathymetric map and digital bathymetric map file.
2. Overview fish and fish habitat inventory report deliverables, including:
 - hard copy of the overview fish and fish habitat inventory report
 - digital copy of the overview report in Word 6.0
 - hard copy of each overview and project map
 - digital files for each overview and project map. This includes the metadata table and map features table files.
3. Digital data, including:
 - FDIS database (FDISDAT.mdb).
4. Photodocumentation, including:
 - photodocumentation form 1
 - digital photos on CDs, with index
 - binder with indexed slides and/or negatives.
5. Biological samples as appropriate, including:
 - aging structures organized and labelled
 - voucher samples
 - tissue samples.
6. FISS update, including:
 - hardcopy FISS forms and maps.

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Province of British Columbia. 1999. Bathymetric Standards for Lake Inventories. Version 2.0. Resources Inventory Committee, Victoria, B.C.

Appendix 1. Overview Inventory Report Format

Title Page

Overview Fish and Fish Habitat Inventory
of
Buba Creek Watershed
WSC: 400-033300

Prepared for:

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Arrow Lakes Timber Division
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Anytown, BC
V1L 4K3

Prepared by:

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February 24, 1997

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