manager's copy

Stream Inventory Handbook

Region 6

1992 ~ Version 6.0

Table of Contents

CHAPTER 1

Stream Inventory Handbook

100.0 Introduction

BACKGROUND: Periodic, recurring inventories are an integral part of the fish habitat and watershed management programs and form the foundation for effective program management. They should produce comparable information, both between administrative units, as well as across time. They will generate the baseline information that will be used to support a variety of management activities, including, but not limited to; timber sales, range allotments, special use development and fish habitat and watershed restoration programs. They will also serve as the basis for stream monitoring and evaluation programs. Specifically, inventories will identify existing aquatic and riparian conditions, identify factors limiting the productive capabilities of habitats, measure attainment of meeting stream habitat objectives, be used to help assess cumulative watershed effects, and can be used to refine Land Management Plan Standards and Guidelines.

The purpose of the inventory is to identify existing riparian and aquatic ecosystem conditions on a basin-wide scale. As inventories are completed and repeated over a number of years, the information generated by them will be particularly useful in measuring attainment of the habitat objectives defined for the stream system. In this context, the inventory will be applied as a basic "monitoring" tool.

INVENTORY ATTRIBUTES: Key attributes of the Region 6 Level 1 and 2 stream inventory include:

Driven by questions that are to be addressed. Identification of management questions formed the basis for the content of the inventory. The ability to address questions consistently and comparably across units has been demanded of the USFS by both users and managers of the resources. Inventory and analysis procedures were developed to provide the information necessary to answer those questions..

Contains a consistently applied set of core attributes. The Level 1 and 2 inventory contains data attributes that were identified by USFS interdisciplinary team as being the most critical in defining aquatic resource condition. The survey is attribute driven, rather that driven by classification systems. It was acknowledged that classification systems can change over time, while attribute data remains constant. However, information collected can be related to a number of classification systems, if the user determine that the classification system plays and important role in analyzing and interpreting the data. (For example, the Rosgen Stream Classification System is a component of the survey, however, the attributes that define Channel type are collected. Hence, a Rosgen Stream Class can be derived from the data.)

Quantification in nature. Where practicable, the inventory generates quantitative estimates of habitat attributes. There are some attributes such as cover that are difficult to describe in quantitative terms. Where this has occurred, categories or classes that attempt to qualify the amount of these attributes have been used (e.g., range of quantities: canopy cover, class 1 = 0-25 percent, 2 = 25-50, etc.).

Statistically valid approach. The inventory meets assumptions for standard statistical analysis and results in estimates with known bounds of error.

Repeatable. Documentation of a standardized protocol and ability to segregate and evaluate surveyor bias support consistency in the replication of survey efforts, both across time and administrative boundary.

Coordinated with other resource areas and management entities. This survey represents an integrated approach between USFS watershed and fisheries disciplines in defining aquatic resource conditions. It has been reviewed and is compatible with similar stream inventories developed by state agencies, specifically the Oregon Department of Fish and Wildlife and Timber, Fish and Wildlife in Washington State. This survey, as with these others, does not include information at a high enough resolution to address all management information needs for a number of other resource areas, such as range, wildlife, or soils.

Integration of the stream inventory with the USFS Integrated Resource Inventory (IRI) is underway. The IRI currently does not address the aquatic components of a basin. It has been recognized that this stream survey protocol, with minor modification will provide the information needs currently lacking in the IRI. Full integration should occur by 1994.

Cost efficient. Following 2 years of operational testing, the average cost to complete this survey is $500 dollars per mile. Local conditions such as stream size, channel complexity, location etc contribute to a range of costs from less than $350 dollars to more than $700 dollars per mile. These estimates include data collection, data entry, analysis and report writing.

ESTABLISHING FOREST PRIORITIES

The stream inventory program should become an institutionalized component of the fisheries and watershed programs. As such, a realistic rate of inventory should be identified in these program areas. The "Rise to the Future" Action Plan recommends a survey rate of 10 percent of fish bearing streams per year. This infers a 10 year recurrence interval for all fish bearing streams.

Forests should consider the following factors in setting priorities for stream inventory:

* Sensitivity of stocks present.
* Habitat/watershed vulnerability or sensitivity; watersheds that are particularly vulnerable or sensitive to management activities should be a high priority. Likewise, it is important some watersheds that can serve as controls be assigned a high priority.
* Level of planned activity in the watershed.
* Management plan development (Wild and Scenic Rivers) or agency coordination/cooperation.
* Relative importance of watershed in terms of fish production to use.
* "Representativeness" of watershed to others for stratification and extrapolation of information to those systems that are lower priority.
* Size/feasibility of of detecting change and managing that change (it is more difficult to detect change in larger systems and frequently more difficult to mitigate those effects).

STREAM INVENTORY PROGRAM MANAGEMENT

Data Management

This will facilitate the sharing of information between units, and support Regional efforts to integrate level 2 survey information into a GIS environment. The ORACLE application has the capability to run on either the DG, or on local pc hardware. Forests wishing to manage data on the PC will be required to purchase pc ORACLE. Regardless, all data will ultimately require storage within the corporate data environment.

PRESENTATION OF INFORMATION

Beginning in 1991, a suggested report writing format for summarizing and presenting stream inventory data is presented in the manual. This format was developed following a review of numerous samples of reports generated over the past 2 years. It contains 2 basic components which provides information in a legible, understandable format to 2 distinct audiences: Line and Staff, and the Technical Specialist.

Because the information requirements of the 2 groups are so different, an executive summary serves to capture the primary condition and identify the issues, concerns and opportunities of the system for line and staff. The executive summary is generated from the main body of the report, which contains all information generated by data interpretation and the summarization of any field observations. The report essentially aggregates information from the reach level, into a basin summary.

The foundation for every report should reside in sound interpretation of the information presented in the 6 basic summary tables. Rather than merely a regurgitation of numbers and figures, interpretation should begin investigating the inter-relationships that exist between the data attributes. For example, width:depth ratios relative to residual pool volumes, and bank substrate. Correlations of pools per mile to riparian vegetation composition and amount of large woody debris can aid in identifying potential habitat deficiencies in systems as well as give an indication of potential rehabilitation potential.

Although basic data interpretation can be completed by the individuals conducting the stream survey, all reports should have journey level fish biologist or hydrologist review and concurrence. The management applications section of the report should be written by the journey level professionals. A full understanding of the inter-relationships of the fisheries and hydrology programs will result in the development of sound, realistic management recommendations.

110.0 Survey Manual Overview

CONTENT

The 1992 Stream Inventory Handbook provides instruction for conducting the Level 1 and Level 2 stream survey. It contains five primary sections: Procedures manual, Appendices, forms, report format and miscellaneous notes. A software Users Guide is available as part of the computer. The Handbook remains relatively unchanged except for a few minor revisions. Those are be itemized in the section labelled "Items of Special Interest" below.

Procedures Manual: This contains the specific instructions for conducting both the office and field surveys. Information collected from the office phase is placed on the A and B1 forms. The B1 form serves as a preliminary guide for initial reach delineation. It will be discarded following ground verification of reach stratification. The field phase utilizes forms B2, C, C1, C2, and C3 which contain information on the physical attributes of the stream, and form D which documents fisheries information.

Appendices: The appendices contain specific information that support a number of the data attributes collected in both the office and field phases.

Forms: There are a total of 8 forms that are completed as part of the survey. These clean copies are provided as masters from which to make your working copies. **Please note:** Waterproof, smudge-proof forms can be developed by using opaque transparencies as the base medium. These are relatively inexpensive, and can be mass produced on any Xerox machine.

Report Format: This section contains a suggested report writing format to follow in developing the final stream survey reports. Instructions for each subject area are provided.

Miscellaneous Notes: Included are specific information items that require forest level decisions or interpretations, examples of completed data tables and a diagram of a stream system stratified into individual habitat units to demonstrate habitat unit identification protocols.

Software Users Guide: This is provided as a supplement.

ITEMS OF SPECIAL INTEREST

The following changes have been made in version 5.0. They address technical limitations in computer software as well as reflect mutual decisions between Forests and the Region following 3 years of operational testing of the methodology.

General:

1. Measurements: In order to comply with current GIS Standards, all measurements must be taken in English Standard. This will ensure compatibility of databases across the Region.

2. Side Channels: Based on forest consensus, side channel habitats will no longer be stratified. Treat each side channel as a single habitat unit, and collect *only* the following information: wetted length, width and depth.

3. Reach Delineation: Where private land is encountered and *access allowed*, *do not* separate the private land as a separate reach; include it as part of the reach defined by the geomorphic criteria. Where *access is denied*, artificially separate the private land and label it a separate reach. *DO NOT* identify or assign any habitat units to the reach. If access is

acquired at a later date, the Oracle program will update the database and assign new NSO's to all habitat units.

4. Watershed Codes: The GIS standard for labeling streams is employed in the manual. See Appendix K for stream delineation procedures.

5. Fish Species Identification: The GIS Standard for identifying fish species is used: Use the first 2 alpha characters of the genus and species to generate a 4 digit alpha code. Follow AFS standard as identified in "A list of Common and Scientific Names of Fishes from the United States and Canada", 4th edition, 1990, Special Publication No. 12. Each Forest shall develop a species list with common names for cross reference.

6. Calibration Ratios are developed for each observer by watershed. It is important for observers and recorders to maintain their respective roles through an entire reach. Change roles only at the beginning of a new reach.

7. NSO's and Habitat Unit Numbers: Each habitat type has a unique NSO and Habitat Unit Number. If a long habitat unit is stratified, each subsection of that habitat unit shall follow this rule.

Forms:

1. Header Information: All forms have been revised to facilitate data entry in the Oracle Software. Note on Form B2, the observer and recorder information is required for each reach. This will ensure that appropriate correction factors are generated for each reach.

2. Form D: Enter actual number of fish observed in one of 2 categories: adults and juveniles. The software program will automatically assign the number to a size category.

CHAPTER 2

Stream Inventory Handbook

APPENDICES

210 LEVEL I - IDENTIFICATION LEVEL - OFFICE PHASE

210.1 - *Requirement/Objectives.* The objective of the office phase is to provide the field crews with a general introduction to the stream system targeted for survey. This is accomplished through assembly and summarization of any data that has been previously collected for the basin. This information will be used to tentatively stratify the stream system into stream order and stream reach. A reach is a relatively homogeneous section of stream that contains attributes of common character. Review of the information compiled by the office phase will be extremely valuable in selecting sampling intervals using Hankin/Reeves methods, planning stream access logistics, summarizing initial hydrologic information, and initially identifying perennial and fish-bearing streams.

Photo analysis and use of maps of suitable scale e.g. 4 inches = 1 mile/ 1:15,840, will enable the survey team to identify with some accuracy such attributes as: sinuosity, vegetative types in riparian and upslope areas, watershed acres, valley bottom widths, tributary confluences, and watershed characteristics. The maps created during this process will be of great value to the field crews who survey the watershed more intensively at a later date. An effective field map(s) will show tributary streams, road crossings, access points, and general location of notable geologic features, and unique characteristics. These parameters will be used by the field crew to accurately locate reach breaks and features in the basin.

210.2 - *Standards.* The office phase survey will provide information only as accurate as the scale and accuracy of the maps, photos and previously collected data. Accuracy will also be affected by the human error introduced when measuring the attributes required. At a minimum, use 1:15,840 scale USGS topographic maps. Any measurements should be confirmed with a map wheel, dot grid, or other standard method of measurement.

210.3 - *Equipment Needed.*

- Topographic Maps/Aerial Photos--Scale of 4 inch to the mile preferred.
- Planimeter/Map Wheel
- Calculator
- Watershed Codes from FSH 2509.24
- Hydrological Data--flow, temperature, turbidity, stream class, macroinvertebrate, etc.
- Geological Information--Geological province, landform type, etc.
- Past Stream Surveys--Measured length of reaches, pool/riffle/glide ratios, etc.
- Level I - Office Phase Form
    - Form A - Stream Identification Form
    - Form B1 - Preliminary Reach Identification Form
- Canopy cover template

210.4 - *Procedure.* The office phase requires the completion of Forms A and B1. Much of information for Form B1 can be collected from the aerial photos and topographic maps. Each set of form instructions have an "Attribute" and "Measurement/Recording" section. The "Attribute" describes the parameter evaluated, while the "Measurement/Recording" section provides instruction on how to collect the attribute information. At the end of each discussion, a character or numeric field length is given. **PLEASE NOTE THAT THE INSTRUCTIONS FOR COMPLETING THE HEADER FOR EACH FORM ARE LISTED IN FORM "A1" INSTRUCTIONS. ATTRIBUTES A THROUGH H ARE THE SAME FOR EACH FORM.** Where additional header information is required, specific instructions are given for that form.

OFFICE DATA ENTRY INSTRUCTIONS:
STREAM IDENTIFICATION - FORM A, R6-2500/2600-10.

Fill out a Form A for *each* stream:

ATTRIBUTE	MEASUREMENTS/RECORDING
A. State	Enter the appropriate 2 letter code: Oregon OR Washington WA California CA (FL:2 (e.g., ZZ))
B. County	Uses FS-ATLAS national standard (FL:3 (e.g., 999))
C. Forest	Enter appropriate two digit code for the Forest. (FL:2 (e.g., 99))
D. District	Enter appropriate two digit code for District. (FL:2 (e.g., 99))
E. Stream Name	Enter name of stream as shown on USGS quad limiting the length of the name to 40 characters. (FL:40)
F. Watershed Code	Refer to FSH 2509.24 for 6-field code which codes stream to specific NFS watershed. Enter only the first four 2-paired numbers of the code. The fifth field pair and sixth field alpha code will be entered as shown for NFS Code below. (FL:8 (e.g., 99,99,99,99))
NFS Code	Enter the fifth field pair and sixth field alpha character of the NFS watershed code found in FSH 2509.24. Include sixth field alphabet code for subdrainage if identified on your Forest. There are 4, four digit blocks that are used to identify streams beyond the current 6th field alpha code. See appendix K for the paper describing the process. (FL:3 (e.g., 99,A))
G. USGS Quad	Enter the name of the registered USGS 1/2 Quad containing the stream mouth or point where it leaves the Forest. This is the 1:15,840 or 4 inch to the mile map base used in TRI. (FL:60)
H. Survey Date	Enter the date the field survey began using the following format: DD-MMM-YY (ie., 01-Jun-91).
I. Name	Person filling out Form A; follow DG format (J.Smith). *NOTE*: This parameter *will not* be entered into the computer Form A.

1. Watershed Area	Calculate the area of the basin above the mouth or above the point where the stream leaves the Forest to the nearest 250 acres. This measurement may be easier to attain using a map scale of 1" = 1 mile. (FL:6 (e.g., 999,999))
2. Stream Order	Utilizing the Strahler method (Appendix A), identify stream order. A 1st order stream is the smallest fingertip intermittent tributary. (FL:1 (e.g., 9))
3. Stream Class	Designate the stream class of the stream(s) to be surveyed (e.g. Class 1, 2, 3, 4. See FSM 2526 or TRI Aquatic subsystem. Note: The SMART program will not accept Roman numberals for stream class designations at this time. Numeric codes must be used.) If not available, leave blank. (FL:1)
4. Fish Species and Data Source	Starting from the left, record dominant or management emphasis fish species known to be in the basin. See Appendix B for species abbreviations. If no data exist, write "Nothing on record." *NOTE*: This field is 240 characters long (Memo FL = 240).
5. Flow Data	Enter in narrative form, the availability of flow data. List all sources, such as USGS gauging stations, Forest monitoring sites, IFIM studies, etc., and dates data were collected. If no data exist, write "Nothing on record." *NOTE*: This field is 240 characters long (Memo FL = 240).
6. Water Quality Data	Review files for any quantitative physical or chemical data. Reference the type and source of information, and year data were collected. If no data exist, write "Nothing on record." *NOTE*: This field is 240 characters long (Memo FL = 240).
7. Macroinvertebrate Data	Enter, in narrative form, the type and source of information. Examples include analysis conducted by the Aquatic Ecosystem Analysis Lab, local forest studies, etc. If no data exist, write "Nothing on record." *NOTE*: This field is 240 characters long (Memo FL = 240).
8. Previous Surveys	Reference the source of the information, level of survey and year accomplished. If no data exist, write "Nothing on record." *NOTE*: This field is 240 characters long (Memo FL = 240).

9. Historical Land Use Data	Record here any useful historical information you may have regarding the stream (e.g. old photos, interviews on file, splash dams, mining, literature, etc.). Also review the Forest's Historical Land Use Atlas -- see an Archeologist for this document. If no data exist, write "Nothing on record." *NOTE*: This field is 240 characters long (Memo FL = 240).
10. Coordination	Verify participation or coordination with other agencies or interest groups. Explain group and their work to be accomplished (Memo FL = 240).
11. Comments	Use this space to elaborate on the above attributes. Note apparent watershed problems, special features or habitats, fish stocking information, management problems, studies, critical habitats, special land allocations, etc. (Memo FL = 240).

OFFICE DATA ENTRY INSTRUCTIONS:
PRELIMINARY REACH IDENTIFICATION - FORM B1, R6-2500/2600-20

This form will incorporate much of the data completed in Form A, but will break the stream system into *preliminary* homogeneous stream reaches necessary for selecting sampling intervals and summarizing, interpreting, and reporting information. NOTE: In establishing sampling intrvals, 10% of mandatory measured units are required for the entire stream, by observer, rather than by reach. Reach characteristics which should be used to initially select stream reach breaks are: valley form and valley width (Appendix C), relative gradient changes, channel form changes, stream order (tributary confluences), sinuosity, and flow changes.

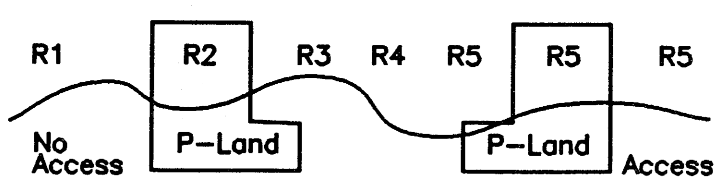
The field crew will verify the initial reach breaks and locate them accurately on a field map/photo. This form serves as a "tickler list" in identifying potential reach breaks; actual delineation will occur on the ground. At times, not all of the parameters listed on this form will be used to identify reach breaks.

Fill out a Form B1 for each stream reach:

(NOTE INSTRUCTIONS FOR ATTRIBUTES A - H ARE LISTED ON THE FORM A INSTRUCTIONS):

Form B1 Instructions

1. Reach Number and River Mile — Enter the reach number beginning at the lowest point of the proposed survey, number the reaches sequentially upstream. Enter river mile as it corresponds to the starting and ending points of the reach to the nearest 0.1 miles. The ending river mile of the lower reach is the beginning river mile of the adjacent, upstream reach, (eg., Reach 1, RM 0-1.1; Reach 2, RM 1.1-4.0; Reach 3, RM 4.0-5.2). Use designated EPA river reach miles if available; if not, begin the mileage mark at the mouth of the stream, starting with RM-O. If starting at the mouth is not possible the beginning RM should reflect this distance (eg. survey starts 5 miles from mouth then the beginning river mile should be RM = 5.0) *NOTE ON REACH NUMBERING*: Private land inholdings--If access is denied, treat the private land section as a separate reach. See diagram below.



2. Valley Form

Enter appropriate code (1-10) that best describes the valley form. Examples are: Wide, glaciated U shaped Valley; Steep, narrow V shaped valley; Broad, flat plain; Alluvial outwash; etc. (See Appendix C).

3. Valley Width Class

Enter the code which best describes the valley width. See Appendix C for illustrations. 1= <30 meters (<100ft.), 2= 30m-100m (100-300ft.) 3= 100m-200m (300-600ft.) 4= >200m (>600ft.)

4. Flow Regime Changes

Note any large tributaries that originate in watersheds of large or similar size to the proposed surveyed watershed. Reaches can be stratified by significant changes in flow, while other variables remain the same. Enter yes *Y* or no *N* if this is used for reach delineation purposes.

5. Sinuosity

Identify sinuosity class for each reach using topographic maps.

6. Average Reach Gradient

Note GROSS changes in gradient of the presumed channel reach breaks. Long homogeneous lengths of similar gradient may delineate a reach. However, the other observed parameters can temper the stratification. Gradient can be calculated by dividing the elevation gain (high elevation contour minus low elevation contour) by the lineal distance of stream.

7. Stream Canopy Closure

Circle the code for percent of the stream canopy closure created by any source (vegetation, topography, etc.) in the following categories:

1. 0 - 19%
2. 20 - 30 %
3. 31 - 60%
4. + 60%

This may be determined *either* in the office from canopy cover templates on aerial photo *and/or* paired aerial photographs under a stereoscope.

8. Other	Note any other criteria that you used to help make the reach stratification.
9. General Comments	Write down any comments important to the aquatic/ riparian resources. Good place to clarify some of the entries made above.

210.5 - *Outputs*. The Identification Level/Office Phase generates information for Forms A and B1. The information from Form A will be used along with Form B2 (field reach verification form) to complete one of several data summary tables. Information from Form B1 will be used to complete Form B2; once Form B2 has been completed, Form B1 is no longer needed. *NOTE*: Form B1 attributes do not have a field length--this information *will not* be entered into the data base.

220 - LEVEL II - RIPARIAN INVENTORY - FIELD PHASE

220.1 - *Requirement*. The Level II survey is the basic habitat inventory for determining the quality and quantity of fish habitat, and to obtain basic riparian and hydrologic condition. The objective of the Level II survey is to provide generally quantitative characterization of aquatic (fish/water) and riparian conditions at a watershed scale.

220.2 - *Standards*. Standards for the Field Phase are intended to obtain quantitative data. Specific standards for the procedure to accomplish the Field Phase are listed below. Data collected in the survey shall be at least as accurate as specified and all parameters listed will be included in the survey.

1. It is very important that the users of this handbook review and become familiar with the following paper: Hankin, D. and Reeves, G. 1988. *Use of Visual Methods for Estimating Fish Abundance and Habitat Areas in Small Streams*. This paper is a field guide which defines the standards, techniques, and quality controls needed in order to properly implement a Hankin and Reeves fish survey. This paper is included as Appendix D.

2. It must be emphasized that the field crew member who does the visual estimates (observer) should continue to make the estimates at least through several stream reaches. **DO NOT CHANGE ESTIMATORS MID-WAY THROUGH A REACH! IF A CHANGE IN CALLERS IS NECESSARY, CHANGE AT THE START OF A NEW REACH BREAK!** This is paramount in establishing the correction factor for visual estimates vs actual measurements. People judge distances differently, and it is necessary that deviation from actual length be consistent.

3. A system of photographs shall be established for the stream reach. A representative section of the stream reach and any significant features of interest, special habitats, problem areas, etc. within the reach shall be photographically documented. The beginning, ending and representitive habitat types for each reach should be documented with note to NSO and habitat type in the comments section of form C.

4. A working map will be developed during the office procedure that will facilitate and expedite the field procedures portion of the survey. This working map has been described in the 210.1 section of this manual. Field notes and observations shall be noted on this map, since this map will serve as the foundation for a final survey map to be included in the watershed analysis package.

220.3 - *Equipment Needed.*

- Level II Survey Forms (R6-2500/2600-21, 22, 23, 24, 25, 30), as appropriate.
- Mechanical pencils.
- Clipboard.
- Four (4)-inch-to-a-mile (1/2 quads, 1:15,840 scale) USGS quads as base maps.
- USGS quads and aerial photographs.
- 150-foot (50-meter) tape measure.
- Good quality, heavy duty scale stick.
- Camera.
- Water velocity meter or velocity headrod.
- Thermometer.
- Clinometer or abney level.
- Plastic strip flagging and grease pencil/marker for use as needed.
- Hip boots and felt or corkers.
- First Aid kit.
- Radio where needed.
- Snorkel, mask, wetsuit, drysuit, electroshocker, and block nets.

220.4 - *Procedure*. There are three phases needed to complete a Level II survey: (1) preplanning before starting field work (see level I); (2) field measurements (field phase) which include reach location data and riparian data for every reach sampled (Form B2, C1 and C2, & D); and (3) data entry, analysis and summarization or reporting.

FIELD DATA ENTRY INSTRUCTIONS:
FINAL REACH IDENTIFICATION FORM B2, R6-2500/2600-21

The purpose of this form is to identify FINAL reach stratification for a given section of homogeneous channel. Several parameters on this form are similar to those found on FORM B1. However, additional variables are measured/observed in the field to support the refined delineation of the reach. Common parameters between the two forms are: valley form, valley width, flow regime change, and average reach gradient. Additional field data include: channel entrenchment, stream shade, gradient, and dominant/subdominant substrate. Individual reach blocks in B2 shall be completed where applicable upon completion of last habitat unit in that reach.

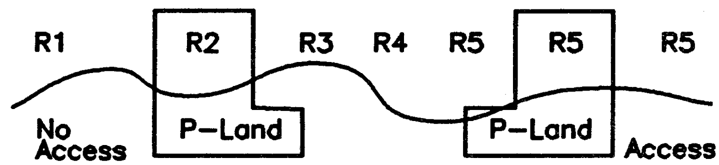
Parameters in this form should be collected while in the field. Reaches shall begin and stop on specific habitat units (e.g., pools, riffles, or glides) that have accompanying natural sequence numbers. After those terminal units have been identified, final reach stratification can occur. *It is imperative to stop or start a reach in a habitat unit that can be specifically identified on the ground and is a permanent, fixed feature (waterfall, road crossing, cliff, etc.).* Again note that each observer must measure 10% of units they've observed per stream; hence, the number of observed/ measured pairs is independent of stream reach. However, once an observer has committed to calling in a reach, they must complete that reach. Surveyors are encouraged to place metal tags on mature trees at the end of reach specifying date, surveyors names, and reach number.

Following the field reach verification, total VALLEY length will be measured between the starting and ending points of the reach; this will allow a FINAL sinuosity value to be derived from the data. This value will be displayed in a summary table. Note that VALLEY LENGTH will be measured by map wheel and ruler in the office following completion of the field work in order to re-calculate the final sinuosity due to any changes in reach delineations and lengths..

Fill out a Form B2 For Each Stream Reach:

(NOTE INSTRUCTIONS FOR ATTRIBUTES A - H ARE LISTED ON THE FORM A INSTRUCTIONS):

ATTRIBUTE	MEASUREMENTS/RECORDINGS
1. Reach Number	Enter the reach number beginning at the lowest point of the proposed survey, number the reaches sequentially upstream. *NOTE ON REACH NUMBERING*: Private land inholdings--If access is denied, treat the private land section as a separate reach. See diagram below. (FL:3 (e.g., 999))



2. Natural Sequence Order (NSO)	Enter the starting and ending NSO's for each reach ***(e.g., Reach 1 = NSO 1-55, then Reach 2 = NSO 56-etc.).*** This information is extracted from Form C, following final reach delineation. In the case of private land where no access has been granted, DO NOT assign any NSO's for the reach, (eg., in the above example, Reach 1, NSO = 1-203; Reach 2 (Private), NSO = *Blank*; Reach 3 (Public), NSO = 204-...). (FL:4 (e.g., 9999))
3. Flow	Enter actual measured flow recorded in cubic feet per second. At a minimum, take one measured flow at the starting point of the survey. If subsequent flows are taken, they should be measured at the beginning of new reach breaks. (FL:6 (e.g., 9999.00))
4. Channel Entrenchment	Use the following categories: deeply entrenched, (D); moderately entrenched, (M); or shallow entrenchment, (S). See Appendix E for channel profiles that match these categories. (FL:1 (e.g., 9))
5. River Mile	Enter river mile at both the starting and ending point of each reach. Use designated EPA river reach miles if available; if not, begin the mileage mark at the mouth of the stream, starting with RM-0 unless starting point is not at the mouth. The ending river mile of the lower reach is the beginning river mile of the adjacent, upstream reach, (eg., Reach 1, RM 0-1.1; Reach 2, RM 1.1-4.0; Reach 3, RM 4.0-5.2). Map wheels will be used to calculate river miles.(FL:5 (e.g., 9999.0))

6. Sinuosity Value

Sinuosity is calculated for each reach using a 4":mile map; map wheel measurement between two points on the map divided by straight line distance between both points: Rating is = or > 1.0. IT IS MORE IMPORTANT TO NOTE CHANGES OF SINUOSITY WITHIN A BASIN, THAN TO COMPARE SINUOSITY BETWEEN BASINS (for the purpose of this form). (FL:4 (e.g., 99.99))

7. Average Channel Gradient

Measure channel gradient as the survey crew proceeds upstream. Include several habitat types over the area that gradient is measured. Shoot gradients over a distance of no less than 150 feet or 45 meters. (FL:3 (e.g., 999))

8. Valley Length

The valley length will be determined following the field exercise and completion of Form C. This is a straight line distance between the two points delineating the upper and lower end points of the reach, utilizing a topographical map and ruler. Enter in miles. (FL:4 (e.g., 99.99))

9. Valley Form

Enter Valley Form code 1 through 10. Examples are: Wide, glaciated U shaped Valley (5); Steep, narrow V shaped valley (2); Broad, flat plain, Alluvial outwash (10); etc. (See Appendix C.) (FL:2 (e.g., 99))

10. Valley Width Class

Enter the code which best describes the valley width. Valley width is the horizontal distance between the side slopes of the surrounding hills or mountains that confine the valley. 1= <100 ft. (30m), 2= 100-300ft. (30-100m), 3= 300-600ft. (100-200m), 4= >600ft.(200m), See Appendix C for illustrations. (FL:1 (e.g., 9))

11. Stream Canopy Cover

Enter the code for final percent of the stream canopy closure from field observations. Use the canopy closure classification in the instructions for form B1. If densityometer is used state in comments. (FL:1 (e.g., 9))

12. Dominant/Subdominant Substrate

Enter the 2 most prevalent substrate types for the reach. See Attributes 7 & 8 on Form C for the substrate codes. (a-FL:2, b-FL:2)

13. Inner Riparian Zone Width

Enter the inner vegetation zone width, starting at the edge of the bankful channel. If only one zone is identified, enter 100. The outer zone is calculated from subtracting the inner zone from 100 feet. This may change at reach breaks only, not within the reach. (FL:3)

14. Comments

Write down any comments important to the aquatic/riparian resources. This is a good place to clarify some of the entries made above. (FL:240)

15. Observer/Recorder	Enter name of the observer (following DG format ie., J.SMITH) who makes the visual estimates for the reach. Note that the observer ***cannot*** change mid-reach. Enter the name of the recorder for the reach following dg format.
16. Date	Enter the date form was completed (YY/MM/DD).

FIELD DATA ENTRY INSTRUCTIONS:
RIPARIAN IDENTIFICATION - FORM C, R6-2500/2600-30

The Riparian Identification Form - The following items should be recorded on Form C for the reaches to be surveyed. Each Forest should establish a standard for "right bank" and "left bank" orientation. This orientation shall remain consistent over the forest once established. NOTE: USGS standard establishes orientation while looking downstream.

Each estimated dimensional variable will be measured at each "nth" unit. The measured information will be placed in the fields below each corresponding estimate. In addition, items 16-28 are to be entered on this line.

(NOTE INSTRUCTIONS FOR ATTRIBUTES A - G ARE LISTED ON THE FORM A INSTRUCTIONS):

Form C Instructions

ATTRIBUTE	MEASUREMENTS/RECORDING
I. Reach Number	Fill out while delineating on the ground, the reach number, starting from the downstream starting point, and working upstream. Utilize Form B2 to identify the reach. Reaches shall be numbered sequentially, starting with the downstream most reach (e.g., 1, 2, 3,..). NOTE THAT THE FINAL REACH NUMBER MAY CHANGE FOLLOWING VERIFICATION DURING THE FIELD PHASE. PRIOR TO COMPUTER DATA ENTRY, SPECIFIC DELINEATION MUST OCCUR, AND THE TRUE REACH NUMBER BE ASSIGNED TO THE RESPECTIVE HABITAT UNITS. When starting a new reach, record data on a new form C. This will facilitate data entry, and minimize data entry errors. **MAKE SURE NSO'S FROM B2 COINCIDE WITH THE NSO'S ON THE C FORM FOR EACH REACH.**
J. Sampling Frequency	Enter the frequency of sampling the *Nth* unit (e.g., if sampling habitat types at a 20% frequency, enter 5) for each habitat type. The * denotes the additional categories that require physical measurements. *Do not* fill in these categories in the non-measured habitat units. At a minimum, each observer will measure 10% or 10 measured pairs of sampled units for the entire stream.

1. Natural Sequence Order (NSO)	Enter the natural sequence order (See Appendix D, Hankin-Reeves paper). Habitat units should be entered in the same order as encountered in the field survey beginning with the first habitat unit, (e.g., 1,2,3,...). The numbering sequence shall remain consistent between reaches, (if Reach 1 ends at natural sequence #203, then Reach 2 shall begin at natural sequence #204). The only exception to this is a Private land reach where access has not been granted. In this case, a reach number is assigned to the private land, but no NSO's are identified. Sequential number of NSO's resumes in the *next* upstream reach, (eg., if Reach 2 is private land, no access, then NSO's are as follows: Reach 1 = NSO 1-203; Reach 2 = NSO none; Reach 3 = NSO 204-251...). All side channels (S) and tributaries (T) are assigned the next incrementally higher NSO and habitat number. When multiple habitat units (tributaries and side channels) converge upon the mainstem simultaneously, number them in a clock-wise order. See Miscellaneous Notes (pg. 2) for numbering protocol. Treat the side channel as an independent habitat unit. When a side channel or tributary is encountered, complete the data collection first for the main channel habitat unit, then collect data on the side channel or tributary. In the comments identify the unit at which the side channel leaves the main channel and returns. (FL:4 (e.g., 9999))

2. Habitat Type and Number

Enter the habitat unit type and number of that unit. Habitat type numbers will be ordered consecutively upstream, from the starting point through ending point of the survey. (eg., if reach 1 ends at P25, the next pool encountered in reach 2 would be P26). In order to consider a habitat type as a unit, the habitat wetted length must be greater than the wetted width. If the unit does not meet this criteria, **DO NOT** consider it a separate unit. For extremely long habitat units (e.g., riffles 900 feet long), consider stratifying them into smaller, more manageable lengths. Assign each of these stratified segments a *different* Natural Sequence order number and habitat number (eg. separate a long riffle into NSO 20 R4 - NSO 21 R5 - NSO 22 R6). In addition, consider braided channels as side channels: Identify a main channel and treat the secondary channels as side channels. All secondary channels will have an incrementally higher NSO than the NSO unit into which they flow. See Appendix F for a description/illustration of each habitat unit. Work with Forest personnel to develop a consistent standard for pools, glides, riffles, and side channels: this will result in lumping pool types and riffle types. More intensive surveys will generally recognize smaller units or more habitat types. Prefix the measured habitat unit with an "M" so these are apparent during data entry. Example: P22, R35, P23, MP23, R36,... This is more fully explained in Appendix D. For special cases, collect all the information required for Forms C1 and C2. In addition, enter onto for C only F = wetted length, width; D = channel length; S = wetted length, width, and depth; T = length, width, substrate, and temperature--place additional information in the comments sections. Only habitat types P, R, and G will have estimated/measured pairs. All dimensional variables for the other habitat units will be considered measured. (See Form C, #29 for discussion of additional information.) Additional information can be provided on the special cases forms (C1 and C2). (FL:5 (e.g., 99999))

P = Pool
R = Riffle
G = Glide
S = Side Channel
F = Special Cases (chutes, falls, etc.--Form C2)
D = Dry Channel (note only length)
T = Tributary
C = Culverts (Form C1)

3. Habitat Length

Enter the ocularly estimated wetted length for each habitat unit. *The length will be ocularly ESTIMATED at each unit and ESTIMATED and MEASURED at each Nth unit. Estimated and measured (E&M) values shall be reported to the nearest foot.* Subsequent fish sampling will be accomplished in some of these habitat units. (FL:5 (e.g., 9999.9))

4. Habitat Width	Enter the ocularly estimated mean wetted width for each habitat unit to the nearest foot. *The width will be ocularly ESTIMATED at each unit and ESTIMATED and MEASURED at each Nth unit.* (FL:4 (e.g., 999.9))
5. Max Depth	Enter the ocularly estimated maximum depth for each unit. *The maximum depth will be ocularly ESTIMATED at each unit and ESTIMATED and MEASURED at each Nth unit*; unless water conditions permit the measurement at each unit. If each unit is measured, enter this dimension as both "estimated" and "measured." This will artificially generate a correction value of I.O. Maximum depth can be easily measured at each habitat unit with a scale stick if the depths are typically less than 4 feet. (EFL:3 (e.g., 99.0))
6. Depth at Pool Tail Crest	Enter the estimated/measured depth at pool tail crest (riffle crest) for every pool habitat unit. This location is upstream of the point where the water surface slope breaks into the downstream riffle. Measure the maximum depth at this point along the width of the hydraulic control feature that forms the pool. This measurement is for calculating residual pool volume (e.g., maximum depth minus pool tail crest depth = maximum residual pool depth). *The depth will be ocularly ESTIMATED at each pool unit and ESTIMATED and MEASURED at each Nth pool unit.* Unless depth at pool tail crest can be easily measured at each pool tail with a scale stick. See Lisle's paper (1987) for additional information regarding residual pool volume. (EFL:3 (e.g., 99.0))
7. Stream Bed Substrate (Dominant)	Enter the ocularly measured dominant and subdominant substrates occupying *each unit* by area. Use the following size classes and qualifiers:

SA =Sand, Silt, and Clay	(<0.2cm, 0.08in)
GR =Gravel (pea to hardball size)	(>0.2cm-6.4cm, 0.08-2.5in)
CO =Cobble (hardball size to basketball size)	(>6.4cm-25.6m, 2.5-10in)
SB =Small Boulder	(>25.6cm-102.4cm, >10-40in)
LB =Large Boulder	(>102.4cm, >40in)
BR =Bedrock	(FL:2 (e.g., 99))

8. Stream Bed Substrate (Sub-dominant)	Enter the measured sub-dominant substrate occupying *each unit* by area. Use the above size classes and qualifiers.

9. Pieces LWD

Enter the ocularly estimated woody material within the bankfull channel for *each unit*. This includes live, leaning material that has the potential to fall into the stream. The leaning material must lean over the area defined by the bankfull width; if it leans, but is not within this area, do not include it as woody material. [Note in comments the approximate percentage (%) of total LWD that is potential (leaning) and not down.] Enter the number of pieces by size category, if > 99 then enter 99. If the WM does not meet the size criteria, but is 2 times longer than the bankfull channel width, then record the piece as small. Make note of rootwads and other woody material in the comments section of the form. Note that the diameters listed are *minimum* diameters. Use the following classes (brush, small and large) and qualifiers: (FL:2 (99))

East Side Forests:
(9) B = Diameter > 15 cm (6in), length > 6.5 m (20ft)
(10) S = Diameter > 30 cm (12in), length > 10 m (35ft)
(11) L = Diameter > 50 cm (20in), length > 10 m (35ft)

West Side Forests
(9) B = Diameter > 30 cm (12in), length > 8 m (25ft)
(10) S = Diameter > 60 cm (24in), length > 16 m (50ft)
(11) L = Diameter > 90 cm (36in), length > 16 m (50ft)

12,13,14. Total Cover

(12)a: Percent - Enter the code for the cover category that is ocularly estimated for *each unit* for the desired species and size class(es) of fish. What is cover for young of the year salmonids will not suffice for age 1+ fish. Visualize the wetted surface area of the unit from overhead and record the percentage class of this area that is occupied by cover: (FL:1 (e.g., 9))

1 = 0 to 5%	total cover
2 = 6 to 20%	total cover
3 = 21 to 40%	total cover
4 = > 40%	total cover

(13,14)b&c: Cover Type - Enter the dominant (14) and subdominant (15) cover types for *each unit*. Use the following cover codes: (FL:1 (e.g., 9))

U = Undercut banks
S = Substrate
D = Depth > 1 meter
H = Overhanging vegetation (<10" (0.3m) above the water surface)
W = Wood Material
T = Turbulence
A = Aquatic/Emergent Veg

15. Bankfull Width

Enter the MEASURED bankfull width (BFW) at each *Nth* pool tail crest. Bankfull is defined as the point where the streamflow would leave the channel under a high flow condition. On totally constrained channels, bankfull width will be the same as width. (EFL:4 (e.g., 9999))

16. Bankfull Depth

Enter the measured bankfull depth at each *Nth* pool tail crest. The measurement will be made at the same location as the pool tail crest. (EFL:3 (e.g., 99.0))

17. Embeddedness

Enter *Y* for Yes, *N* for No for each *Nth* habitat unit. This includes pools, riffles and glides. If the ocularly estimated cobble embeddedness in the unit is >35% by volume, enter *Y*. If there is no cobble, use gravel embeddedness. If substrates for the habitat unit DO NOT contain either gravel or cobble, insert the letter A. See Appendix G for illustration of embeddedness. (FL:1 (e.g., 9))

18,19. Streambank Substrate

Enter the dominant (19) and subdominant (20) substrates of the upper 1/3 of the bankfull channel streambanks for each *Nth* habitat unit. Use the codes for substrate as shown in #7 (substrate) above. See Appendix H for illustrations of streambank. (FL:2 (e.g., 99))

20. Streambank Ground Cover

Enter the percentage of ground cover for the upper 1/3 of the streambank for each *Nth* habitat unit either vegetatively or physically armored against scour from bankfull flow. Take an average of both banks and combine for a total percentage figure. Use the following percentage classes:

1 = 0-25%
2 = 26-50%
3 = 51-75%
4 = 76-100%

Armoring can be provided by bedrock, substrate materials, vegetation and their roots, woody material, mosses, etc. (FL:1 (e.g., 9))

21,22,23. Floodplain Vegetation (Zone 1)

(21) a: Enter the existing floodplain vegetation successional class within the inner zone for each *Nth* unit by the following codes (see Appendix I for illustration and definitions of successional stages). (FL:2 (e.g., 99))

DIAMETER CLASS

GF = Grassland/Forb Condition	NA
SS = Shrub/Seedling Condition	(1.0-4.9")
SP = Sapling/Pole Condition	(5.0-8.9"dbh)
ST = Small Trees Condition	(9.0"-20.9"dbh)
LT = Large Tress Condition	(21"-31.9"dbh)
MT = Mature Trees Condition	(> 32"dbh)

(21) a: As identified on Form B2, the riparian area can be stratified into 2 zones within a 100 foot lineal distance from the edge of bankfull width. Once a distance for both zones has been established, that distance must be maintained throughout the reach. (e.g., Zone 1 = 0-60 ft., Zone 2 = 60-100 ft.)

(22,23) b&c: Enter the dominant and subdominant species of vegetation growing on the streambank for each *Nth* unit utilizing the species categories listed in Appendix J. If species are in seral class GF, enter GF; if species are in seral class SS, enter SS with the corresponding height class code (e.g. SS3, if shrubs are between 5 and 10 feet tall), in addition, use the conifer or hardwood species list to identify dominant or subdominant species; if seral class SP, ST, LT, or MT, utilize the following species descriptors (also found in Appendix I). Shrub height classification is an optional field and applies only to seral classes GF and SS. Forests may add to this list to include additional vegetation species. (FL:3 (e.g., 999))

Hardwood:
HA = Alder
HB = Bigleaf maple
HC = Cottonwood, ash, poplar
HD = Dogwood
HE = Elderberry
HL = Liveoak, canyon
HM = Madrone
HO = Oak, Oregon white, California black
HQ = Quaking aspen
HT = Tanoak
HV = Vine Maple
HW = Willow
HX = Other

Conifer:
CA = Subalpine fir, mountain hemlock, whitebark pine
CC = Cedar, western red
CD = Douglas fir
CE = Subalpine fir - engelmann spruce
CF = Fir, silver and noble
CH = Hemlock, western
CJ = Juniper
CL = Lodgepole pine, shore pine
CM = Mountain Hemlock
CP = Ponderosa pine, Jeffrey Pine
CQ = Western white pine
CR = Red fir
CS = Spruce, sitka
CT = Port Orford cedar
CW = White fir, grand fir
CY = Yew
CX = Other

Shrubland height classes:
1 = 0'-2'; 2 = 2'-5'; 3 = 5'-10'; 4 = > 10'

Examples:

Eastside - Seral stage is Grassland, with grasses dominant and shrubs 3 feet tall subdominant: a: GF, b: GF, c: SS2. Or if seral stage is shrub/sapling dominant, with shrubs and saplings 30 feet tall and alder subdominant: a: SS, b: SS4, c: HA.

Westside - Seral stage is large trees with Douglas fir dominant and alder subdominant: a: LT, b: CD, c: HA.

24,25,26. Floodplain Vegetation (Zone 2)

Enter the vegetation successional class for each Nth unit for the outer delineated zone. Use successional classes and vegetation species identified in 22, 23, and 24 above.

27. Water Temperature

a. Take stream temperatures 3 times a day, at a minimum, of any main channel habitat unit (morning, noon, late afternoon), and of each tributary assigned an NSO; enter to the nearest degree.

b. Enter the military time at the time temperatures are taken (to the nearest hour, 1-24). (FL=4)

28-33. Optional Fields

Place any additional information collected at habitat units in these columns. Forests will need to set up a separate data table in Oracle to analyze this information.

34. Comments

Enter comments regarding any of the above evaluations and photos; or geomorphological, hydrologic, or biological observations either here on Form C, or on Form C3. For culverts use Form C1, and for falls, chutes, and dams use Form C2 to document specific information regarding these features. Stream gradient measurements should be made on a frequent basis and documented here. Shoot the gradients over an area that contains several habitat units (no less than 150 feet or 45 meters). Other suggested notable features to note are:

Fish passage: jams, barriers, fish habitat improvement opportunities, etc.

Watershed concerns: slides, erosion areas, streambank damage, watershed rehabilitation potential, etc.

Riparian ecosystem classification: potential riparian ecoclass. Some Forests have more fully developed eco- class types. Update with the appropriate ecosystem classification for the reach or unit.

Other: diversions, mining, dredging, filling, riprap, etc. Also include reaches that are within Wild and Scenic rivers and wilderness areas.

Tributaries: Note the habitat unit at the confluence, estimated discharge, gradient immediately upstream of mouth (30m), % contribution to the flow of the main stem, and temperature of mainstem (above trib) and tributary. ✓

End of Survey: Note the reasons for ending the survey at a given point. If possible mark beginning and end of reach with metal tag to tree and define in comments section.

This information will give the reviewer insight as to the reasoning for ending the survey, and will minimize the need to re-examine that point in the watershed.
NOTE: Description of underlined features should include the location and an objective description of situation. Photographs are helpful in recording notable features. General characteristics should be noted in comments section for other features noted.

FIELD DATA ENTRY INSTRUCTIONS:
SPECIAL CASES FORMS C2 AND C3, R6-2500/2600-23, 24 AND 25

These forms are to supplement information collected on culverts, falls, chutes and dams that have been noted in the Comments section on FORM C. The forms are self explanatory. If photos are taken of the feature, note the photo # and film roll # in the comments section of Form C, as well as in Attributes 13 and 10 of Forms C1 and C2.

FIELD DATA ENTRY INSTRUCTIONS:
FISH USE AND RELATIVE ABUNDANCE FORM D, R6-2500/2600-30

Form D is to be used to record fish information. The survey intensity may vary between Forests/ Districts. *Fish information should, at a minimum, be recorded at each 10th pool, 15th riffle and 20th glide and entered on Form D.* Snorkling, electrofishing, or seine methods may be used to gather this information. *NOTE*: This information will be used to identify fish species composition and range. It is not meant to provide population estimates.

(NOTE INSTRUCTIONS FOR ATTRIBUTES, A - H ARE LISTED IN FORM B1 INSTRUCTIONS):

Form D Instructions

ATTRIBUTE	MEASUREMENTS/RECORDING
I. Reach Number	Fill out only after the field survey has been completed.
J. Method	Enter the abbreviation for sampling technique: Seine (S), Snorkel (SN), Electroshock (E). (FL:2 (e.g., 99))
1. Natural Sequence Order (NSO)	Enter the natural sequence order as listed in Form C, Attribute #1. (FL:4 (e.g., 9999))
2. Habitat Type and Number	Enter the habitat type and number as listed in Form C, Attribute #2. (FL:5 (e.g., 99999))
3. Species	Enter the actual count (by species) of the fish observed by adult or juvenile categories at each sampled habitat unit. For age classes of fishes, distinguish between sub-legal and legal size fish for juvenilles and adults. See Appendix B for species abbreviations. Each species is identified by the first 2 letters of both the genus and species. This conforms to GIS standards for species identification. (FL:2 (e.g., 99))

4. Comments	Enter comments regarding any of the above evaluations and document photos; or geomorphological, hydrologic or biological observations.

230 - LEVEL III - IMPLEMENTATION/MONITORING/EVALUATION

230.1 - *Requirement*. The Level III surveys provide more detailed data for project work and monitoring of resource activities (i.e. timber sales, restoration/enhancement projects, grazing impacts, or range allotment planning). Often these surveys focus on specific reaches or stream sections. The information is later used for specific prescriptions or to monitor changes in habitat parameters due to project implementation with a moderate degree of precision. Utilizing this level of survey intensity gives a somewhat accurate inventory of fish populations and habitat preferences.

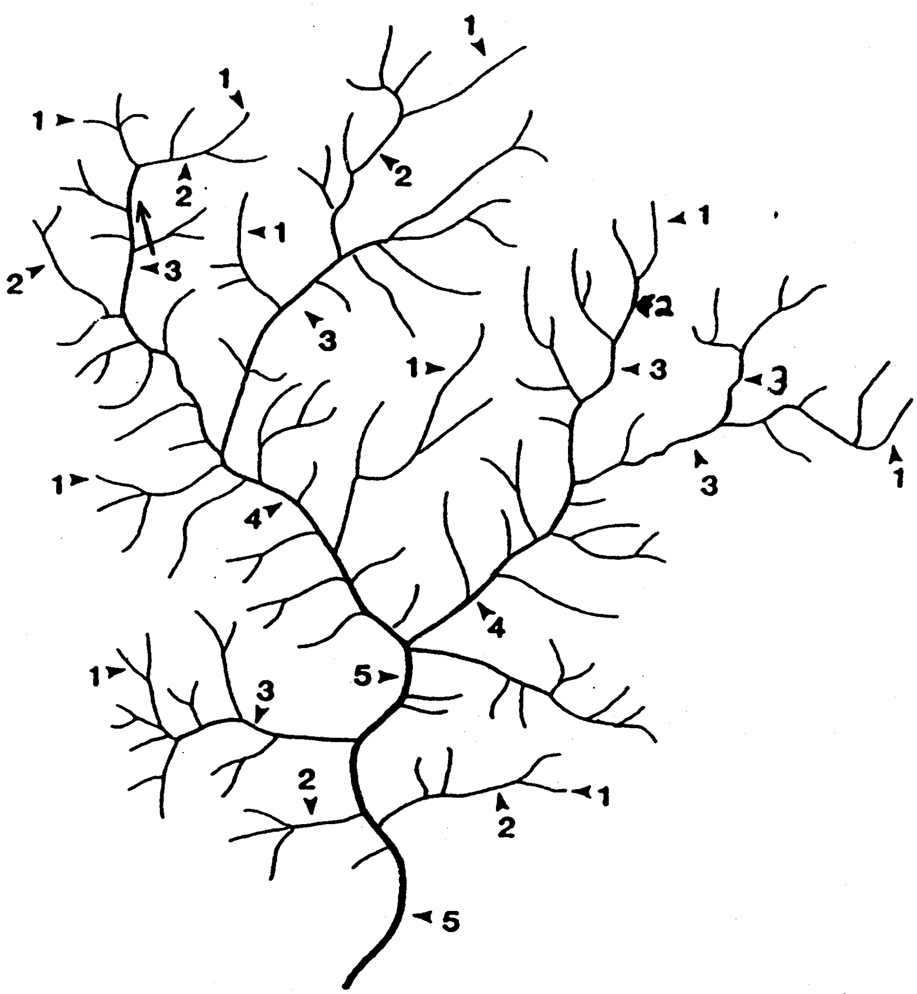
230.2 - 230.5 - *Future*. Level III standards will be developed in the upcoming fiscal year. Implicit with this higher resolution survey, is the need to define a minimum region-wide standard data set, and allow greater flexibility in defining forest or watershed specific parameters.

240 - LEVEL IV - RESEARCH

240.1 - *Requirement*. The Level IV surveys are usually conducted by groups or teams to provide high-quality data on aquatic/riparian habitat or fish populations. The information recorded under this intensity would be statistically-sound and provide detailed evaluation and monitoring of restoration projects, timber sales, grazing impacts, etc. Cause and effect relationships could be accurately documented (i.e., fish-sediment, water temperature-shade or correlating predictor models).

240.2 - 240.5 - *Future*.

APPENDIX A



STREAM ORDERS

Stream order: The designations (1, 2, 3, etc) of the relative position of stream segments in a drainage basin network: the smallest, unbranched, intermittent tributaries, terminating at an outer point, are designated order 1; the junction of two first-order streams produces a stream segment of order 2; the junction of two second-order streams produces a stream segment of order 3, etc. Use of small-scale maps (<2"/mile) may cause smaller streams to be overlooked, leading to gross errors in designation. Ideally designation should be determined on the ground or from large-scale air photos.

APPENDIX B

ABBREVIATIONS FOR FISHES IN OREGON AND WASHINGTON

Use the following 4 digit codes for describing the fish identified on Forest. Note the first 2 alpha characters are the first 2 letters of the genus, and the second 2 alpha characters are the first 2 letters of the species. For the Forest index, please note the common name for the secies. Below is a partial list of game species; be sure to identify non-game species on your forest.

CODE	GENUS AND SPECIES	COMMON NAME
Onne	Onchorhynchus nerka	sockeye salmon
Onts	Onchorhynchus tshawytscha	chinook salmon
Onke	Onchorhynchus keta	chum salmon
Ongo	Onchorhynchus gorbuscha	pink salmon
Onki	Onchorhynchus kisutch	coho salmon
Onmy	Onchorhynchus mykiss	steelhead, rainbow, redband
Oncl	Onchorhynchus clarki	cutthroat trout
Ontr	Onchorhynchus trutta	brown trout
Saco	Salvelinus confluentus	bull trout
Safo	Salvelinus fontinalis	brook trout
Prwi	Prosopium williamsoni	mountain whitefish

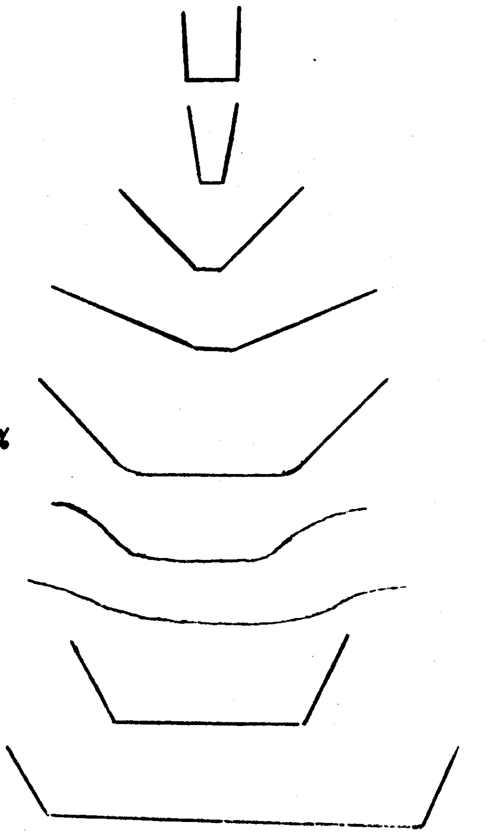
APPENDIX C

VALLEY CHARACTER

VALLEY FORM | **ILLUSTRATION**

(Enter Code Only!)

Code	Type	Side Slope
1 =	Box-like canyon	Steep: > 60%
2 =	Narrow V-shaped floor width < 100 ft.	Steep: > 60%
3 =	Moderate V-shaped floor width < 100 ft.	Moderate: 30-60%
4 =	Low V-shaped floor width < 100 ft.	Low: < 30%
5 =	U-shaped floor width > 100 ft.	Moderate to steep: > 30%
6 =	Through-like open short slope lengths	> 30%, mostly 30-60%
7 =	Broad, trough-like	Low: < 30%
8 =	Narrow flat-floored floor width 100-300 ft.	Moderate to steep: >30%
9 =	Moderate flat-floored floor width 300-600 ft.	Moderate to steep: >30%
10=	Wide flat-floored floor width > 600 ft.	Moderate to steep: >30%



VALLEY WIDTH CLASS

(Enter Code Only!)

Code	Width
1 =	< 30 meters wide (100 feet)
2 =	30-100 meters wide (100-300 feet)
3 =	100-200 Meters (300-600 feet)
4 =	> 300 Meters (> 600 feet)

APPENDIX D

Use of Visual Methods for Estimating Fish Abundance and Habitat Areas in Small Streams[1]

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[1] Based on: Hankin, D.G., and G.H. Reeves. 1988. Estimating total fish abundance and total habitat area in small streams based on visual estimation methods. Can. J. Fish. Aquat. Sci. 45: in press.

I. Introduction

There is an increasing awareness among fishery biologists of the need to approach the planning and implementation of resource management programs and habitat enhancement projects from a basin-wide persepective. Biologists have generally employed one of two methods to generate a basin-wide perspective of fish production and habitat quantity: (a) extrapolation from "representative" reaches or "index" areas, or (b) systematic selection of equal length sections of stream. It has been generally assumed that either of these methods can provide accurate estimates of basin features such as total habitat areas and fish numbers.

Recent evidence has shown that use of "representative" reaches can result in generation of inaccurate and misleading notions of basin-wide conditions, however. For example, Everest et al. (1986) attempted to estimate the total amount of habitat and total fish numbers in Fish Creek, Oregon, by extrapolation from five "representative" reaches. A survey based on a statistically valid sampling design that ensures that all habitat types are sampled was carried out concurrently. Extrapolation from the "representative" reaches resulted in an apparent serious over-estimation of total habitat area when compared to the statistically valid survey. Overestimation of total habitat area in turn led to overestimation of fish abundance. In another instance, Bisson (1988) estimated the number of fish in a small basin in Washington using different sets of "representative" reaches drawn from different portions of the stream. He found that estimated numbers of fish varied by several orders of magnitude depending on choice of "representative" reaches.

In this paper we present cost-effective sampling designs for estimating total habitat areas and total fish numbers in small streams based on visual estimation (Hankin and Reeves 1988). We consider practical application of these sampling designs in the field, and we also discuss procedures for construction of confidence intervals around calculated estimates. In addition to providing estimates of total habitat areas and fish abundance, use of these sampling designs can produce detailed maps showing the size, sequence of occurrence, and location of all stream habitat units. Data generated using these procedures may be used for identification of limiting factors and for inventory and monitoring purposes.

II. Estimating Total Habitat Areas

A. Classification of habitat units

This sampling design places substantial reliance on visual estimation of the areas of indentifiable habitat units. The first step in implementation of this design is therefore determination of what habitat unit types area of interest. We suggest use of definitions from Bisson et al. (1981) or those in the "Glossary of Stream Habitat Terms" (Habitat Inventory Committee, Western

APPENDIX D

Division of the American Fisheries Society 1985). Consistent definitions and criteria for classification of habitat unit types are vital to the success of a stream survey. Without such consistency, for example, it would be impossible to compare data collected by different observers in the same stream. Standardized definitions also allow comparison of habitat characteristics between streams.

Determination of the particular types of habitat units that are to be identified will depend on the purpose of a survey. Montioring efforts usually require a more detailed classification of habitat unit types than general inventories. For basic inventory purposes it may be adequate to classify habitat types into very general categories such as pools and riffles. For detailed monitoring purposes, however, it may be necessary to define additional categories such as glides, side channels, and special types of pool units (e.g. break, lateral scour and plunge pools). Monitoring of enhancement efforts may be directed at a specific habitat type that is to be created. Regardless of the purpose of a survey, the types of habitat types that are of interest must be identified <u>before</u> the survey is initiated.

Prior to field work, all habitat characteristics that are to be measured should be identified. As for selection of habitat unit types, additional habitat characteristics to be measured will depend on survey purpose. The sampling design we describe below allows collection of a large amount of data at individual habitat units. Data generally collected included unit length, mean unit width, maximum unit depth, number of pieces of wood in given size categories, and dominant substrate.

B. <u>Measurements at each unit</u>

Two people are required for data collection for this method. One person (the "observer") is responsible for actual data collection whereas the other is responsible for data recording (the "recorder"). All visual or "eye" estimates described below should be made <u>only</u> by the observer.

The observer begins at the first habitat unit in a stream, identifies its habitat unit type, and then <u>visually</u> estimates its length, mean width, and area (length x mean width). Other habitat characteristics may also be measured or estimated. Points of reference, such as tributary junctions, road crossings, etc., should be noted by the recorder so that location in the basin can be better identified when the survey is completed.

As for definition of habitat units types, it is imperative that standardized criteria are followed for all measurements, visual or other. For example, it is often difficult to judge an appropriate length measurement for a pool that is irregularly shaped at one end. We have adopted the rule that the "end" of the pool is the midpoint between the point at which the pool becomes irregular in shape and the irregular endpoint of the pool.

In a systematic sample of units within a given habitat type, accurate measurements of unit characteristics are made in addition to visual estimates. For example, suppose one wanted to obtain accurate measurements of area in 10% of all pools in some reach of a stream (i.e. a sampling fraction of 10% is desired). The first unit to be measured should be determined by drawing a random number between 1 and 10 and making an accurate measurement of pool area in the pool that is selected. Then, accurate measurements of pool area should be made in every tenth pool thereafter. The initial "random start" might be 7, for example, in which case accurate measurements of pool area would be made in pool units 7, 17, 27, etc..

Selection of valid systematic samples for accurate measurements of habitat unit characteristics requires attention to two details. First, independent random starts should be drawn for each different classified habitat unit type. Second, once the initial random start has been selected for a given habitat unit type, then all subsequent accurate measurements must be made at exactly the same (systematic) interval between units. For example, suppose that the initial random start were 7 and that every tenth pool unit thereafter was to be accurately measured, as above. If field work on day "one" ended at pool unit 44, then the first pool unit for accurate measurements on day "two" should be pool unit 47, and subsequent units would be 57, 67, etc..

Accurate measurements of habitat unit areas should be made according to the following procedure: (a) measure unit widths at fixed 1-2 m intervals along the length of the unit and calculate the mean of these width measurements; (b) multiply mean width by total unit length to determine habitat unit area. Note that choice of interval between width measurements should depend on the complexity of a given habitat unit. A 2 m fixed interval may provide an accurate measurement of mean width in a broad, flat, straight riffle unit, whereas a 1 m interval may be required for accurate measurement of mean width in a complex, irregularly shaped pool unit.

If subsequent estimation of fish abundance is also to be carried out in the survey, the individuals responsible for collecting physical data should also mark and identify those units that will later be sampled for fish. The procedure for selection of units for fish sampling is described in part III of this paper. Both the lower and upper boundaries of these units should be marked with highly visible plastic flagging that has the unit type and unit number marked on it.

C. Data entry and storage

Use of this samping design generally results in generation of large amounts of survey data. It is simplest to enter, store, and manipulate data in a computer spreadsheet such as LOTUS. [A spreadsheet will soon be available on the DG (Data General) system for U.S. Forest Service biologists.] Data for individual

APPENDIX D

habitat units should be entered on the computer in the same order in which units were encountered in the field survey (e.g. pool 1, glide 1, riffle 1, pool 2, glide 2, etc.). This procedure will retain the natural habitat unit location sequence for later mapping purposes, and the spreadsheet will allow easy sorting by habitat unit type regardless of order of data input. Most data manipulations and calculculations associated with use of this sampling design can generally be carried out within the spreadsheet format.

D. Calculations and formulas

The basic premise of this method is that if visual estimates of habitat unit areas are highly correlated with accurate estimates of habitat unit areas, then one can "correct" for the possible bias of visual estimates through calculation of a "calibration ratio". The calibration ratio represents an estimate of the true ratio of true habitat unit area as compared to visually estimated area. This calibration ratio is calculated based on n paired visual and accurate estimates made in selected habitat units using

(1) Calibration ratio = $\hat{Q} = \sum^{n} m_i / \sum^{n} x_i$

where m_i = true (accurately measured) area of unit i;

x_i = visual estimate of area of unit i; i = 1,2,...,n

$\hat{Q}$ is an estimator of the true (but unknown) ratio of the actual area of all units compared to corresponding visual estimates of the areas of all units. (The carat or "hat" over Q is used to indicate an estimated quantity.) Calibration ratios should be calculated on the basis of no less than 10 (i.e. $n \geq 10$) paired accurate measurements and visual estimates for each habitat unit type. That is, separate calibration ratios must be calculated for pools, riffles or other habitat unit types. Note that the number of paired accurate measurements and visual estimates for a given habitat type will depend on (a) the total number of units of that type, and (b) the sampling fraction for that habitat unit type. If a particular habitat unit type is quite rare, a much larger sampling fraction will be required to achieve the minimum sample size of 10 units than if a particular habitat unit type is quite common.

Visual estimates of habitat unit areas do not necessarily need to be "close to" the true (accurate measurements of) habitat unit areas, but it is important that visual estimates have a consistent relationship to true habitat unit areas. For example, if all visual estimates were exactly half of true areas, then it would be a simple (and accurate) matter to adjust all visual estimates by a calibration ratio of 2 to arrive at very accurate estimates of habitat unit areas.

It is advisable to plot the relationship between accurate measurements of habitat unit areas and corresponding visual estimates of areas in addition to calculating the calibration ratio.

Visual inspection of plotted data points may reveal outliers or coding errors that might not be otherwise noticed. Also, it is a good idea to check that the plotted data appear to pass through the origin. If plotted data do not appear to pass through the origin, then the formulas presented below may be seriously biased. (Alternative regression estimators should be used in that case, but they are not presented in this paper.)

Once the calibration ratio has been calculated and plotted data have been visually inspected, the total area of habitat for a given habitat unit type (M) can be estimated using

$$(2) \qquad \hat{M} = T_x\hat{Q}$$

where M = true total area of all units of a given type;

$T_x = \sum^{N} x_i$ = total of visual estimates of area for <u>all</u> units of a given type;

N = total number of units of a given habitat type

Equation (2) is a very natural and intuitive estimator, usually called a *ratio estimator*. Equation (2) states that the true total habitat area can be estimated as the product of (a) the total of the visual estimates and (b) the estimated ratio of true area to visual estimates of area.

A measure of the uncertainty of the estimated total area of a particular habitat type can be calculated from sample data using an estimator for the variance of equation (2). The variance of the estimated total, denoted by $V(\hat{M})$, can be estimated using

$$(3) \quad \hat{V}(\hat{M}) \approx \frac{N^2(N-n)}{Nn} \sum_{i=1}^{n} (m_i - \hat{Q}x_i)^2/(n-1)$$

Equation (3) is a large sample approximation for the variance of a ratio estimator and it may seriously underestimate the uncertainty of the estimated total habitat area if $n < 10$. For that reason, we recommend that $n \geq 10$.

Examination of equation (3) reveals that variance depends on two very different kinds of terms. First, variance (uncertainty) will be reduced simply as a function of sample size through the term (N-n)/Nn. As sample size, n, approaches the total number of units, N, clearly variance approaches zero. Thus, the sampling fraction (n/N) will influence variance. Second, the summation term essentially consists of squared differences between (a) true (accurate measurements of) habitat unit areas, m_i, and (b) predicted habitat unit areas, $\hat{Q}x_i$. If accurate estimates and visual estimates are highly correlated, and a plot of accurate estimates against visual estimates appears to pass through the origin, then

APPENDIX D

these squared differences will be small so that estimated variance will be small. In contrast, if visual estimates are inconsistently related to accurate measurements, then predictions of true habitat areas from visual estimates will be poor, squared differences will be large, and estimated variance will be large.

The strong dependence of estimator variance on a consistent relationship between true habitat unit areas and visual estimates of habitat areas makes it especially critical that observers follow a consistent technique in making their visual estimates. Carefully pacing off units at approximately 5 m increments requires substantial concentration and we recommend that our observers take periodic breaks to relax rather than making poor or inconsistent visual estimates of habitat areas. This requirement for consistency is also behind our recommendation that just a <u>single</u> observer be responsible for <u>all</u> visual estimates.

The total area of all units of all identified habitat types in a stream can be estimated simply by summing up individual estimates for individual habitat types (or individual habitat types within a particular reach of stream). Estimated variances are also additive because estimates of total habitat areas of particular habitat unit types are independent of one another (since they are based on entirely separate sample data).

Finally, approximate 95% confidence intervals for estimated total areas of habitat units can be constructed as

$$\hat{M} \pm 2 \cdot [\hat{V}(\hat{M})]^{0.5}$$

Table 1 presents results of application of this sampling design in a small Oregon coastal stream, Cummins Creek. In the Cummins Creek application, the stream was first stratified into a lower and a middle/upper reach. Sampling fractions were 10% (1 out of 10) in the lower reach and 5% (1 out of 20) in the middle/upper reach. Use of this method in Cummins Creek produced 95% confidence bounds for estimated total areas of pools and riffles that were about 13% and 16% of estimated totals, respectively.

E. <u>Maps of habitat unit locations and sizes</u>

Besides providing estimates of the total areas of particular habitat unit types, often with very small confidence intervals, this sampling design allows the construction of detailed maps of the locations and areas of all habitat units. Such maps could be used to compare habitat unit areas and sequences between seasons or years, or to evaluate the effects of various habitat alterations.

F. <u>Costs</u>

We estimate that it costs from $80 - $100 per mile to survey small basins using this technique. This cost estimate includes costs of (a) data collecttion, (b) computer data entry, and (c)

APPENDIX D

G. H. Reeves

Table 1. Total number of units (N), number of units accurately measured (n), sample-based estimates of ratios of accurately measured areas to visually estimated areas ($\hat{Q}$), estimated total areas (m^2) of all units ($\hat{M}$), estimated variances for estimated total areas ($\hat{V}(\hat{M})$), and 95% confidence bounds for estimated total areas (95% C. I.) for pools and riffles in lower, middle/upper, and all reaches combined of Cummins Creek during July 1985. Visual estimates of habitat unit areas were made for all units. (from: Hankin and Reeves 1988)

Pools

Reach	N	n	$\hat{Q}$	$\hat{M}$	$\hat{V}(\hat{M})$	95% C. I.
Lower	65	7	0.990	6,141	119,827	± 875
Middle/ Upper	134	6	1.029	8,284	448,315	± 1,721
All Reaches				14,425	568,142	± 1,938

Riffles

Reach	N	n	$\hat{Q}$	$\hat{M}$	$\hat{V}(\hat{M})$	95% C. I.
Lower	62	6	1.066	12,556	159,155	± 1,026
Middle/ Upper	124	7	0.926	19,208	3,846,554	± 4,799
All Reaches				31,764	4,005,709	± 5,146

data analysis. The cost will of course vary with crew experience, basin size, and the number of habitat unit types identified. In most systems, an experienced crew can cover 4-6 stream miles per day. Interestingly, larger systems may often be covered more quickly than smaller systems because habitat units are larger so that there are fewer per stream mile. Finally, the general requirement that sample sizes exceed 10 for each distinct habitat unit type means that large numbers of distinct habitat unit types will require a large number of accurate (and more costly) measurements of habitat areas.

G. Review of Procedures (* denotes optional procedure)

(1) Prior to field work:

a. Determine the types of habitat units that are to be identified.
b. Determine habitat unit characteristics that are to be measured or estimated at each unit.
c. Determine sampling fractions (1/k) for each habitat unit type (this will determine the number of units for which both accurate and visual estimates of habitat unit area are made).
d. Given prespecified values for k, which may differ between habitat unit types, choose independent random starts on the interval 1 through k for each distinct habitat unit type.
*e. If necessary or desirable, stratify basin into different areas or reaches on the basis of stream gradient or other distinctive feature(s). These different areas or reaches will constitute distinct location strata and should each be independently sampled.

(2) Field work:

a. Observer begins at first habitat unit, identifies its type, and collects necessary data. Observer makes visual estimate of habitat unit area for every identified habitat unit. Points of reference are noted by data recorder.
b. At the unit selected by the random start within each identified habitat type, and at every k units thereafter, the observer makes a visual estimate of habitat unit area, and the two person team makes an accurate estimate of habitat unit area.
*c. If necessary, observer marks units which are to be later sampled for fish. Units should be marked with highly visible flagging at the upstream and downstream ends of these units and flagging should have unit type and unit number written on it.

(3) Data entry and analysis:

a. Data are entered into spreadsheet in the natural order in which units were encountered in field work.

b. Distinct calibration ratios are calculated for each identified habitat unit type using equation (1).
c. Totals areas, associated variances and confidence intervals are calculated for each identified habitat unit type using equations (2) and (3).

III. Estimating the total number of fish

A. Selection of units

It is obviously impractical to estimate the total number of fish by sampling every stream habitat unit. Instead, we recommend selection of a systematic sample of habitat units (from within each habitat type), following those procedures presented for selection of units for accurate measurements in part II.B. Systematic selection of units does not require a preexisting map of the locations of all habitat units nor does it require knowledge of the total number of units of each habitat type. In additional, systematic samples will ensure that sample data are collected along the entire longitudinal gradient of the basin. As for units selected for accurate measurements of habitat areas, sampling within each distinct habitat unit type must begin with an independent random start.

The fraction of the units that are sampled need not be the same for every habitat type and may depend on unit type, fish species and habitat preferences as well as available time, funds and personnel. It is usually, but not always, best to have higher sampling fractions for those habitat types that appear to be preferred by the species of interest. For example, if the species of interest were 1+ juvenile steelhead trout or coho salmon, then pools should probably have a higher sampling fraction than riffles or glides. In this case one might sample 25% of all pools, 15% of all glides and just 10% of all riffles. It is extremely important to remember that all habitat unit types must be sampled even if fish are not "believed" present in some habitat types. There is only one method by which their absence in that habitat type may be verified: collection of sample data for that habitat type.

Units which are to be sampled for fish should have been previously marked by the two person team responsible for physical habitat measurements. Plastic flagging or other markers with unit type and number should have been placed at the upper and lower boundaries of selected units. If visual counts of fish are to be made by divers in selected units, then it is best to have a minimum of two hours between the time the units are marked and when they are actually snorkled. This delay should be sufficient to minimize any effects of disturbance on fish in habitat units.

APPENDIX D

B. Sampling fish populations

Estimation of fish numbers relies on essentially the same premise as estimation of habitat areas. If divers count a fairly consistent fraction of fish actually present in habitat units, then there should be a strong correlation between diver counts and the "true" (accurate estimates of) numbers of fish present. In this case visual estimates are made by divers using mask and snorkel and "accurate" estimates are made using a multiple pass electrofishing removal method estimator. By calculating a calibration ratio relating these accurate estimates to diver counts, based on a small sample of units in which both visual estimates and accurate estimates are made, one may "adjust" diver counts to estimates of true abundance in those units in which only visual estimates are made.

A team of two divers is used to count fish. Divers enter the water downstream from the selected unit and proceed slowly upstream. The divers position themselves near the midline of the unit and move parallel to one another using hand signals to coordinate their movements. Observed fish are identified to species or species/age class and counted. Fish counts are recorded with a lead pencil on a plexiglass slate that has had the surface roughened with sandpaper. Observations should all be made during times of day when visibility is best, generally between 0900 and 1700.

Correlations between diver counts and accurate estimates will generally vary with species, age-class and habitat type. For example, we found higher correlations between diver counts and accurate estimates for coho salmon in pools than for 1+ steelhead trout in pools (Hankin and Reeves 1988). These differences were attributable to differences between the two species in microhabitat distribution and behavioral responses to divers. Trout were closely associated with the bottom, whereas coho salamon were more surface-oriented and were thus easier to see. Trout were also more "skitterish" and sought cover more quickly than salmon, especially in smaller units. Because of these differences, divers scanned the bottom immediately upon entering units and counted trout before salmon.

Use of snorkeling to count fish has obvious limitations which may make it impractical for use in some situations. Water clarity is critical, the method is most effective in small streams, and there are generally limited numbers of individuals who are highly trained and skilled in this method of observation. We are currently exploring alternatives to snorkeling, but we have not yet developed any sound alternatives.

Of those units in which diver counts of fish numbers are made, we select a random subsample within which both diver counts and more accurate estimates are made. The theory of this method requires that the "accurate" estimates of fish abundance be equal to the "true" but unknown numbers of fish present. It is therefore **extremely** important that accurate methods produce

APPENDIX D

estimates of fish numbers that have very small confidence intervals.

C. Data entry and storage

Data on diver counts and accurate estimates made for selected units can be entered in the spreadsheet format in the same manner as those for physical habitat measurements. Additional computer programs may be necessary for estimation of population size for the "accurate" estimation method, however.

D. Calculations and formulas

A "calibration ratio" establishing the correspondence between accurate estimates (true numbers) of fish present, y_j, and diver counts, d_j, within a given habitat type may be calculated using

$$(4)\quad \hat{R} = \left(\sum_{J=1}^{n'} y_j\right) / \left(\sum_{J=1}^{n'} d_j\right)$$

where: y_j = true number of fish in unit j; j = 1,2,...,n' (estimated by use of a very accurate method);

d_j = mean count of fish by two divers in unit j;

n' = number of units in which both diver counts and accurate estimates are made.

As for estimation of habitat areas, distinct calibration ratios must be calculated for each habitat type and there should be a minimum of ten units within each habitat type for which both diver counts and accurate estimates are made (i.e. $n' \geq 10$).

Ideally, the units selected for accurate estimates in addition to diver counts should be a simple random or systematic subsample of those units in which diver counts are made. Occasionally, however, it may prove impractical or impossible to carry electrofishing equipment into some selected units. In that event, units reflecting the full range of size and complexity of those units found in the system should be included in the sample of size n'.

For units in which only diver counts have been made, the calculated "calibration ratio" allows adjustment of diver counts to give a better estimate of the true number of fish actually present. (Divers may only count half the fish that are actually present, for example, in which case the true calibration ratio would be 2.) The numbers of fish present in such units can therefore be estimated as the product of the mean diver count and the estimated calibration ratio using

(5) $\hat{y}_i = \hat{R}d_i$

where: $\hat{R}$ = calculated calibration ratio (equation (4);

d_i = mean of two diver counts in unit i.

If the total number of units in which diver counts are made is defined as n, and the total number of units in which both diver counts and accurate estimates are made is defined as n', then there will in general be (n-n') units in which fish numbers will be estimated using equation (5). In the remaining n' units, the "accurate" method of estimating fish numbers eliminates the need to use equation (5); the accurate estimates should be used for these units.

Finally, the total number of fish present in all units of a given habitat type may be estimated using

(6) $$\hat{Y} = N \sum_{i=1}^{n} \hat{y}_i/n$$

where: Y = (true) total number of fish in all units of a given habitat type;

N = total number of units of a given habitat type;

n = total number of units in which diver counts are made; i = 1,2,...,n.

Equation (6) is simple and intuitive. It basically consists of multiplying the mean estimated number of fish per habitat unit (= $\Sigma\hat{y}_i/n$) by the total number of habitat units (= N).

In some streams, the number of fish present in habitat units may be highly correlated with the sizes of habitat units. In that case, equation (6) will not give the best estimate of total fish abundance. Hankin (1984, 1986) discusses alternative estimators that will perform better than equation (6) if fish numbers are highly correlated with habitat unit sizes.

A measure of uncertainty for the estimated total number of fish in a given habitat type may be calculated using the following estimator for the variance of equation (6):

(7) $$\hat{V}(\hat{Y}) = \frac{N(N-n)}{n(n-1)} \sum_{i=1}^{n} (\hat{y}_i - \bar{y})^2 + \frac{N}{n} \sum_{i=1}^{n} \hat{V}(\hat{y}_i)$$

APPENDIX D

where: N = total number of units of a given habitat type
n = total number of units in which diver counts are made

$\hat{y}_i$ = estimated number of fish in unit i; i = 1,2,...,n

$\bar{y} = \sum^{n} \hat{y}_i / n$ = mean estimated number of fish per habitat unit.

and $\hat{V}(\hat{y}_i)$ = estimated variance of the estimated number of fish in unit i

$\hat{V}(\hat{y}_i)$ represents errors of estimation of fish numbers in individual habitat units. It may be assumed equal to zero for those units in which very accurate estimates are made or, alternatively, may be calculated on the basis of formulas appropriate for removal method estimation using electrofishing. (Remember that there are n' out of n units in which the accurate estimates have been made.)

For those units in which <u>only</u> diver counts are made (there are n-n' such units), $\hat{V}(\hat{y}_i)$ will depend on (a) variation between the two diver counts made in those units and (b) variance of the estimated calibration ratio relating accurate estimates to diver counts.

Between diver variance is denoted by $\hat{V}(d_i)$ and is estimated using

$$(8) \qquad \hat{V}(d_i) = ½ \sum_{k=1}^{2} (d_{ik} - d_i)^2$$

where: d_{ik} = count of fish by diver k in unit i; k = 1,2

$d_i = \sum_{k=1}^{2} d_{ik}/2$ = mean diver count in unit i

i = unit in n but <u>not</u> in n'

Variance of the estimated calibration ratio is calculated using

$$(9) \qquad \hat{V}(\hat{R}) = \frac{(N-n')}{Nn' \bar{d}^2} \sum^{n'} (\hat{y}_i - \hat{R}d_i)_2/(n'-1)$$

where: $\bar{d} = \sum^{n'} d_i / n'$ = "grand mean" diver count

APPENDIX D

Note that the summation in equation (10) is over the n' units for which paired diver counts and accurate estimates were made.

Finally, for those (n-n') units in which only diver counts have been made, variance of the estimated number of fish in such units can be calculated using

$$(10) \qquad \hat{V}(\hat{y}_i) = \hat{R}^2\hat{V}(d_i) + d_i\hat{V}(\hat{R}) - \hat{V}(d_i)\hat{V}(\hat{R})$$

These values would then be substituted in equation (7), above.

Although of complicated forms, the above formulas for calculating the variance of an estimated total number of fish in a given habitat type can be separated into two distinct parts. One component of variance arises due to what statisticians term first stage variance. If there were no errors of estimation of fish numbers within selected habitat units, but only a sample of n habitat units were selected from a total of N habitat units, there would be errors of extrapolation from the sample units to all of the units. These errors result from variation in the true numbers of fish between habitat units. If, for example, each unit had exactly the same number of fish, then there would be no variation in fish numbers between units and, as a result, first stage variance would equal zero. In contrast, if true fish numbers were highly variable across habitat units, then first stage variance would be large.

Most fishery biologists are not very familiar with the concept of first stage variance, but they are very familiar with what statisticians term second stage variance. Second stage variance reflects errors of estimation of fish numbers within selected units. If every habitat unit were sampled, then all of the errors of estimation would come from this stage of sampling since no extrapolation would be involved. Mark-recapture or removal method estimators of population size will in general result in smaller second stage variance than "calibration" of diver counts.

In our experience with sampling streams, first stage variance usually is a much more important source of error of estimation than is second stage variance. Also, if numbers of fish present in habitat units are poorly correlated with the sizes of habitat units, then first stage variance can only be reduced by sampling a large fraction of all habitat units. The use of divers for visual estimates of fish numbers in habitat units allows one to greatly increase the total number of units that are sampled for fish. Although this usually results in slightly greater errors of estimation of fish numbers within units (second stage variance), the substantial reduction in first stage variance that results more than compensates for these minor additional errors. To put it more simply, one makes a modest sacrifice of accuracy within individual habitat units to obtain a dramatic increase in accuracy of estimation of fish numbers in all habitat units.

APPENDIX D

Table 2 illustrates the results of applying these methods for estimation of juvenile coho salmon and 1+ steelhead trout numbers in pools and riffles of Cummins Creek. Diver counts were made in approximately 20% of all units and paired diver counts and exhaustive electrofishing/removal method estimates were made in about 8 units of each habitat type. Confidence bounds (not reported on Table 2) for the total abundance of salmon and trout in all pool and riffle units combined were approximately 22% and 17% of the estimated totals, respectively.

E. Costs

We have not determined the average costs of sampling fish populations using this sampling design. However, we have compared the probable performance of this design with a more typical stream survey that might be carried out exclusively using electrofishing methods for estimation of fish numbers in selected habitat units (Hankin and Reeves 1988). For the same total cost of sampling, we found that our visual estimation survey (with calibration) would result in variances that were from 1.7 to 3.3 times smaller than those that would be achieved in the more standard survey (electrofishing only). That is, for the same total survey cost, the visual estimation design was from 1.7 to 3.3 times as cost-effective. For the typical survey, fewer units can be sampled if only electrofishing is used to estimate fish numbers in selected habitat units. Although diver counts may be less accurate than electrofishing, divers can count fish much more rapidly and can therefore examine a much larger number of habitat units. This increased coverage of habitat units in turn leads to a substantial reduction in first stage variance and in total errors of estimation.

F. Review of procedures (* denotes optional procedure)

(1) Before field work:

a. Determine types of habitat units that are to be identified.

b. Determine sampling fractions for visual estimates of fish numbers for each habitat unit type. (These may differ with habitat unit type.) Select independent random starts for each habitat unit type. Units selected by these random starts should be marked by the team collecting physical data (Part II) as should subsequent units that appear in systematic samples drawn from each habitat type.

c. Determine approximate subsampling fraction for which both visual estimates and accurate estimates will be made. Select appropriate random starts for selection of these units from those selected and marked in (1)b.

*d. If necessary or desirable, stratify basin into different areas of reaches on the basis of gradient changes or other distinctive features.

APPENDIX D

G. H. Reeves

Table 2: Estimated abundances ($\hat{Y}$) of 1+ steelhead trout and juvenile coho salmon, total number of habitat units (N), sample sizes for diver counts (n), and estimated variances of abundance estimates ($\hat{V}(\hat{Y})$) in lower, middle and upper pools and riffles and in all pools, all riffles and all pools and riffles, in Cummins Creek, July, 1985. (from: Hankin and Reeves 1988).

Habitat Type/ Location Stratum	N	n	Coho Salmon $\hat{Y}$	Coho Salmon $\hat{V}(\hat{Y})$	Steelhead Trout $\hat{Y}$	Steelhead Trout $\hat{V}(\hat{Y})$
Lower pools	65	11	2,111	112,769	1,480	21,185
Middle pools	67	13	1,088	36,024	738	17,205
Upper pools	67	12	101	1,266	428	13,943
All pools			3,300	150,059	2,646	52,333
Lower riffles	62	10	576	40,407	527	24,505
Middle riffles	67	13	230	5,588	236	4,967
Upper riffles	57	9	0	0	0	0
All riffles			806	45,995	763	29,472
All pools and all riffles			4,106	196,054	3,409	81,805

APPENDIX D

(2) Field work

a. Divers proceed to unit selected as random start for each habitat type and count fish numbers in that unit and in subsequent units that appear in systematic samples. Record unit numbers and fish counts (individually) on data sheets as appropriate.

b. For units selected in (1)c above, use a multiple pass electrofishing removal method estimator to obtain an accurate estimate of true fish numbers in these units. (Diver counts are <u>also</u> made in these units).

(3) Data entry and analysis

a. Enter collected data in spreadsheet as for physical habitat data.

b. Calculate calibration ratios for each distinct habitat unit type, using equation (4).

c. Estimate true numbers of fish present in those units for which only diver counts are available using equation (5).

d. Estimate the total number of fish in all units of a given habitat type using equation (6).

e. Calcuate variance estimates using equations (7) - (10).

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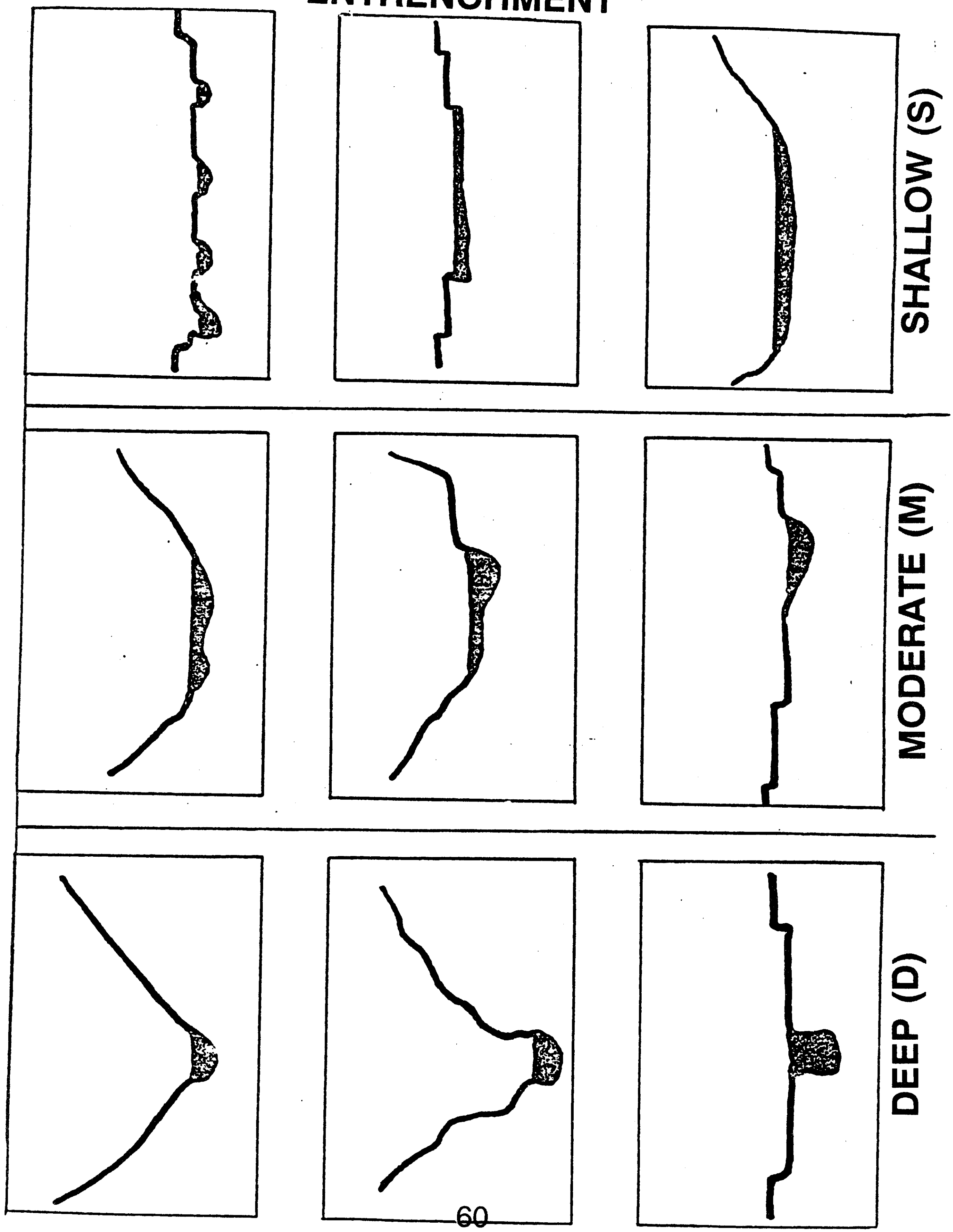
APPENDIX E

ENTRENCHMENT



APPENDIX F

AQUATIC HABITAT INVENTORY GLOSSARY

Cover: Anything that provides protection from predators or ameliorates adverse conditions of streamflow and/or seasonal changes in metabolic costs. May be instream cover, turbulence, and/or overhead cover, and may be for the purposes of escape, feeding, hiding, or resting. For use in Stream Inventory, count turbulence cover as only that area of turbulence,; for cover, vegetation of other material must be within 10 inches of the surface.

Embeddedness: The degree that larger particles (boulders, rubble, or gravel) are surrounded or covered by fine sediment. Usually measured in classes according to the percentage of coverage of larger particles fine sediments.

Glide: A portion of stream flowing smoothly and gently, with moderately low velocities (10-20cm/sec), and little or no surface turbulence. The longitudinal profile of the feature will be level, or slightly sloped downstream. No hydraulic control present.

Pool: (a) A portion of the stream with reduced current velocity, often with water deeper than the surrounding areas, and which is frequently usable by fish for resting and cover. (b) A small body of standing water, e.g. in a marsh or on the flood plain. May at times contain surface turbulence, but always has a hydraulic control present on the downstream end of the feature.

Reach: (a) Any specified length of stream. (b) A relatively homogeneous section of stream having a repetitious sequence of physical characteristics and habitat types. (c) A regime of hydraulic units whose overall profile is different from another reach.

> Specific Reach: A length of channel uniform with respect to selected habitat characteristics or elements (discharge, depth, area, slope, population of hydraulic units), fish species composition, water quality, and type and condition of bank cover.

Riffle: A shallow rapids where the water flows swiftly over completely or partially submerged obstructions to produce surface agitation, but standing waves are absent.

Stream Order: See accompanying Appendix A for illustration.

Stream Bank: The portion of the channel cross section that restricts lateral movement of water at normal water levels. The bank often has a gradient steeper that 45 degrees and exhibits a district break in slope from the stream bottom. An obvious change in substrate may be a reliable delineation of the bank.

> Lower Bank: The periodically submerged portion of the channel cross section from the normal high water line to the water's edge during the summer low flow period.

> Upper Bank: That portion of the topographic cross section from the break in the general slope of the surrounding land to the normal high water line.

Riparian Vegetation: Vegetation growing on or near the banks of a stream or body of water on soils that exhibit some wetness characteristics during some portion of the growing season.

Hydraulic Control: The top of an obstruction to which stream flow must rise before passing over, or a point in the stream where the flow is constricted.

Riparian Area: The area between a stream or other body of water and the adjacent upland identified by soil characteristics and distinctive vegetation. It includes wetlands and those portions of flood plains and valley bottoms that support riparian vegetation.

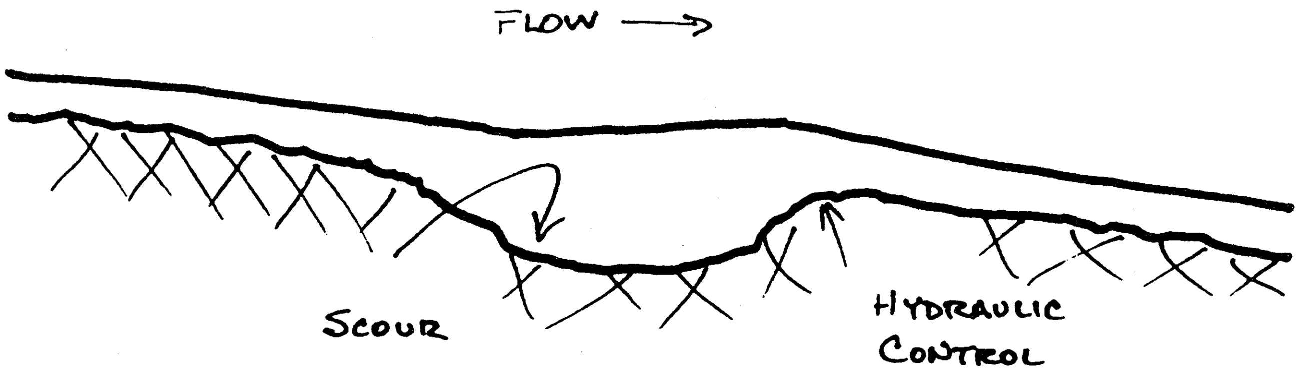
Side Channel: Lateral channel with an axis of flow roughly parallel to the mainstem and which is fed by water from mainstem; a braid of river with flow appreciably lower than the main channel, or in poorly defined watercourses flowing through partially submerged gravel bars and islands along the margins of the mainstem.

Sinuosity: (a) The ratio of channel length between two points on a channel to the straight distance between the same two points. (b) The ratio of channel length to down valley length. Channels with sinuosities of 1.5 or more are called meandering.

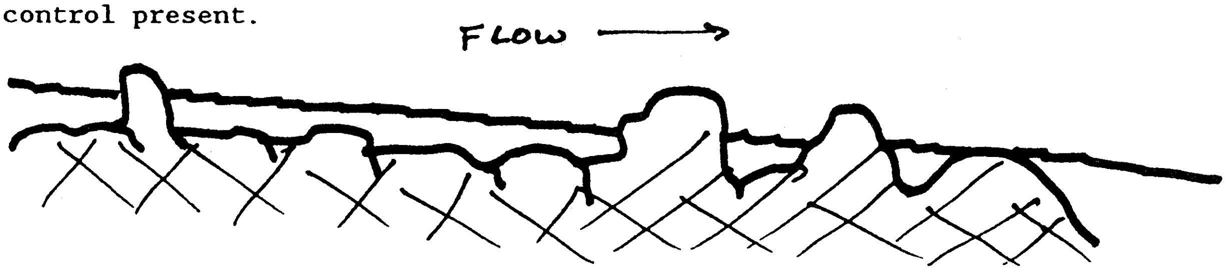
Turbulence: The motion of water where local velocities fluctuate and the direction of flow changes abruptly and frequently at any particular location, resulting in disruption of laminar flow. It causes surface disturbance and uneven surface level, and often masks subsurface areas because air bubbles are entrained in the water.

APPENDIX F

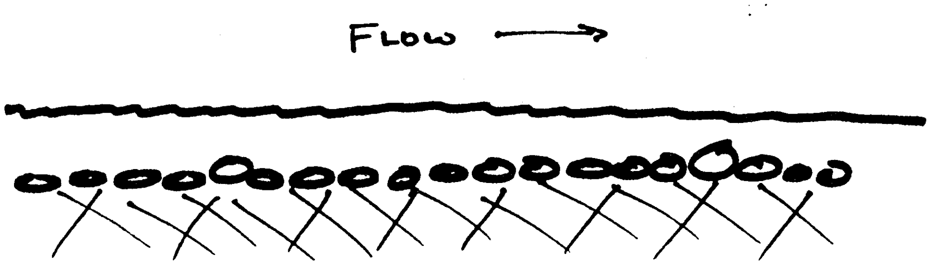
Pool: A feature of the stream generally containing reduced velocities, with water generally deeper than surrounding areas. Usually a pronounced area of scour, created by an impingement of or obstruction in the channel. Always has a hydraulic control present on the downstream end of the feature.



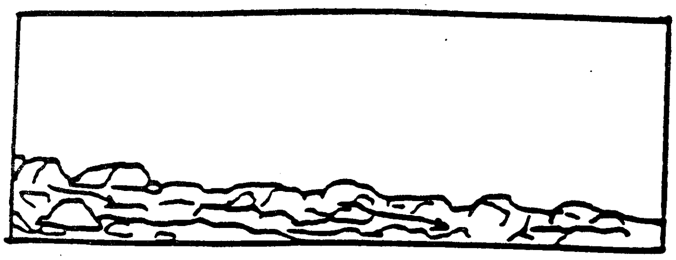
Riffle: A feature of the stream of swift flowing turbulent water; can be either deep or shallow. Exposed substrates are generally present. Features are generally cobble or boulder dominated. No hydraulic control present.



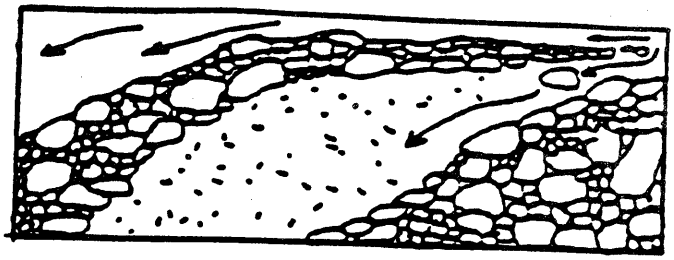
Glide: A feature of the stream generally flowing smoothly and gently across a uniform channel bottom. Generally contains lower velocities, with little to no surface turbulence present. The longitudinal profile of the feature is generally level, or slightly sloped downstream. No hydraulic control present.



APPENDIX F

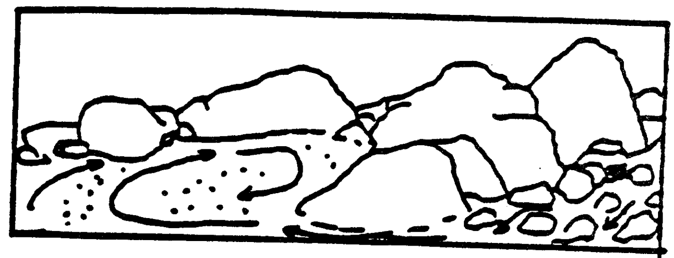


Riffle

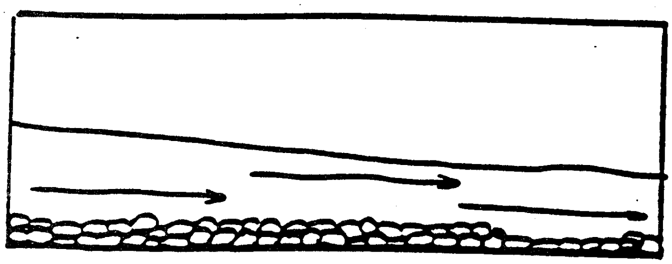


Side Channel

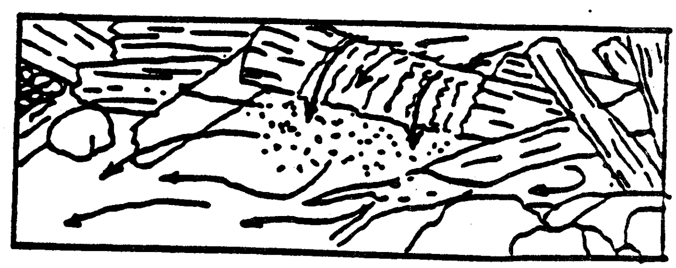
Riffle



Pool



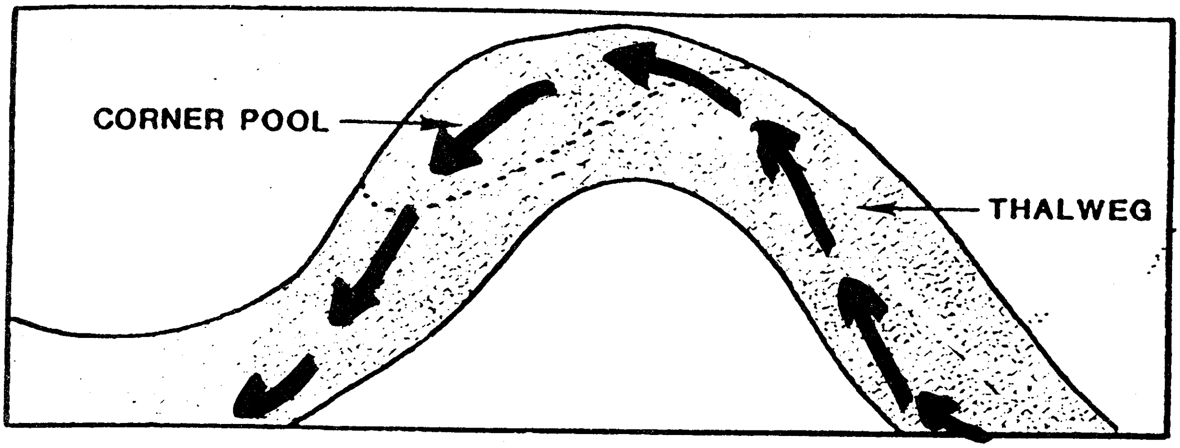
Glide



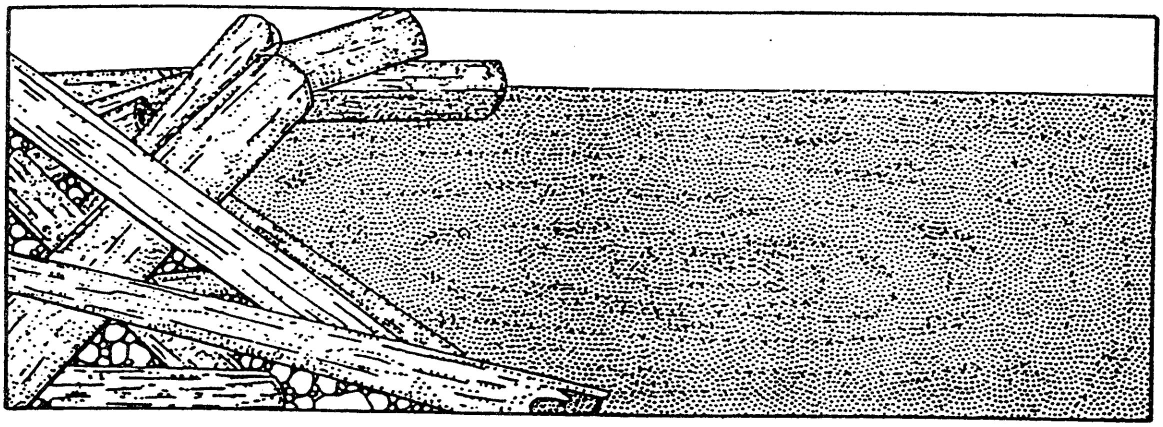
Pool

Fundamental habitat units used to describe habitat condition (from Bisson et al. 1982).

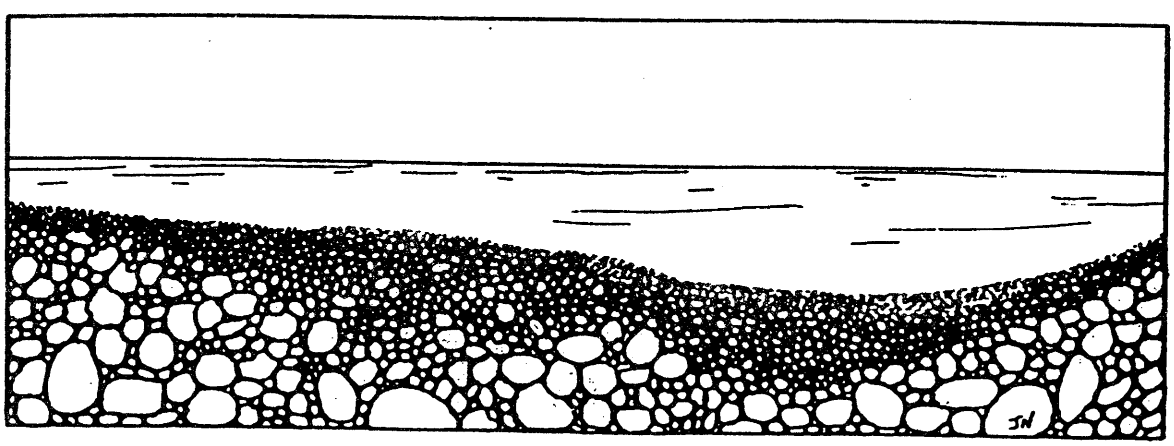
APPENDIX F



A lateral scour pool resulting from a shift in channel direction.



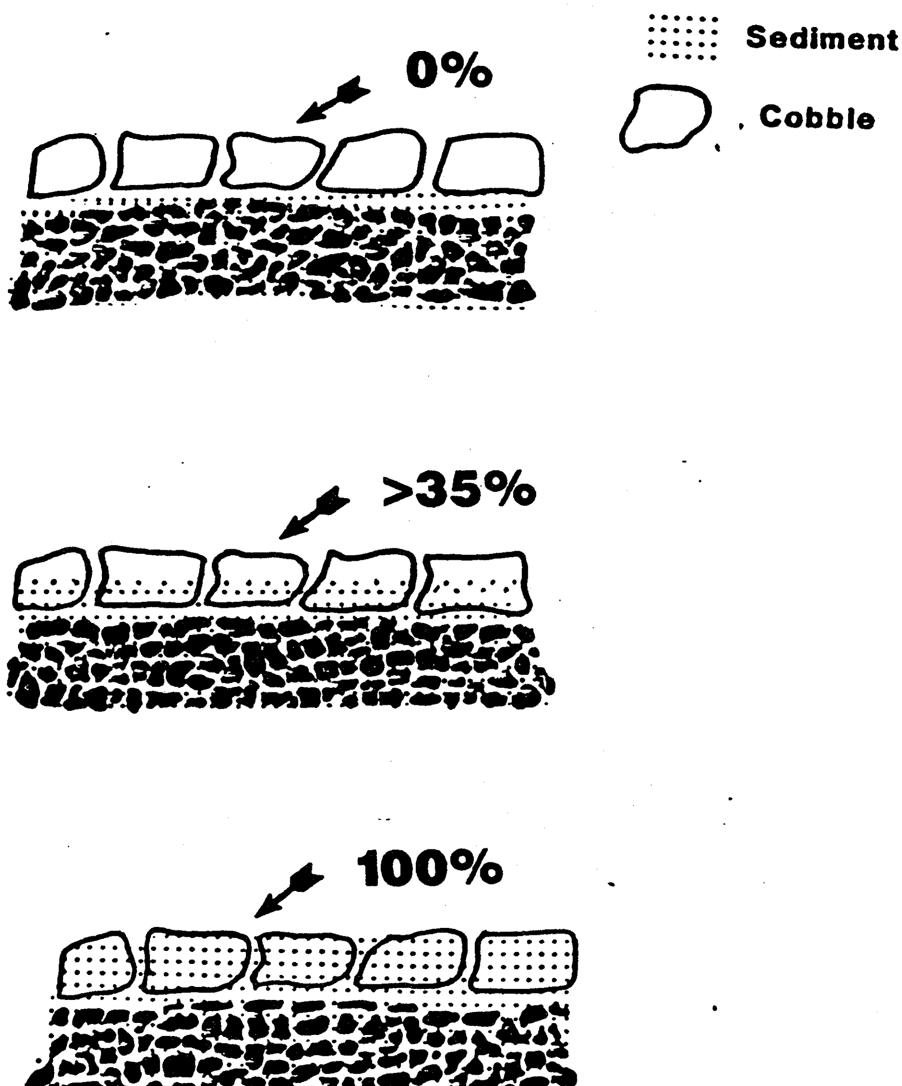
Water impounded upstream from a complete or nearly complete channel blockage, typically caused by a log jam, beaver dam, rockslide, or stream habitat improvement device (boulder berm, gabion, log sill, etc.)



A wide shallow pool of low turbulence. Sometimes used synonymously with glide.

APPENDIX G

EXAMPLE: GRAPHIC REPRESENTATION OF COBBLE EMBEDDEDNESS

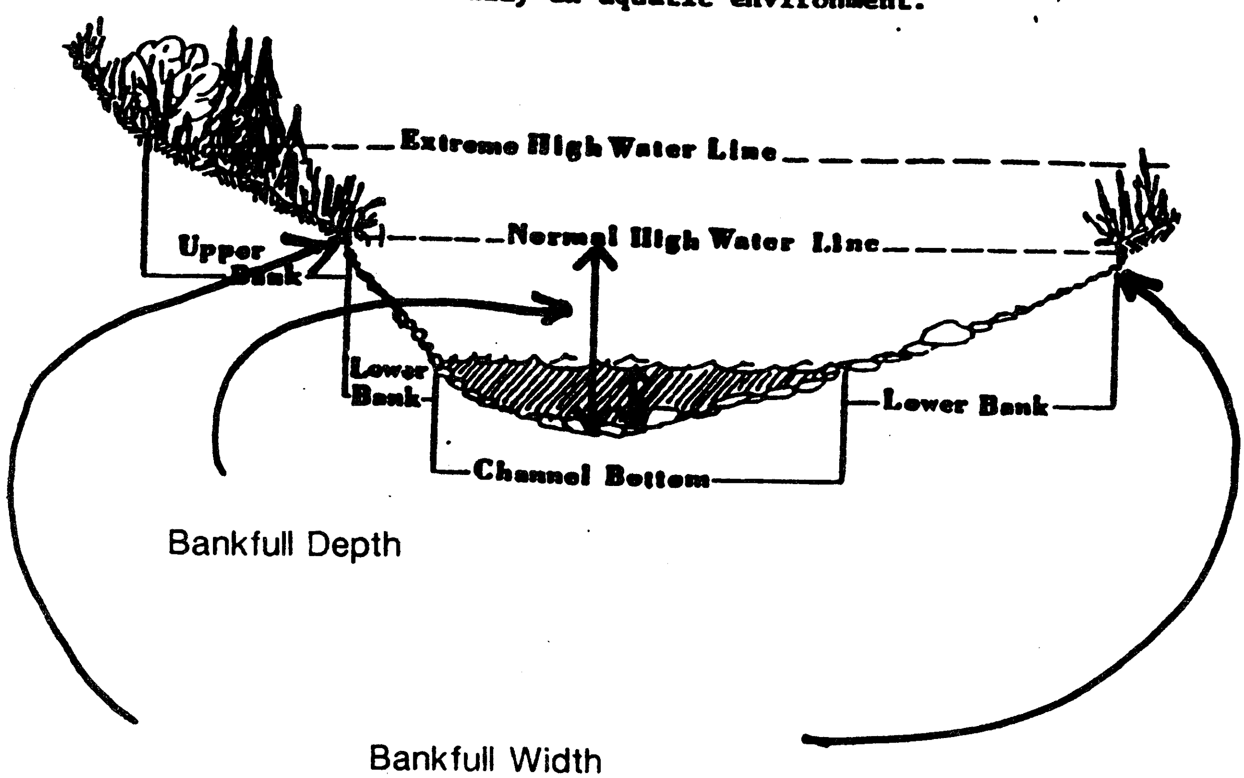


APPENDIX H

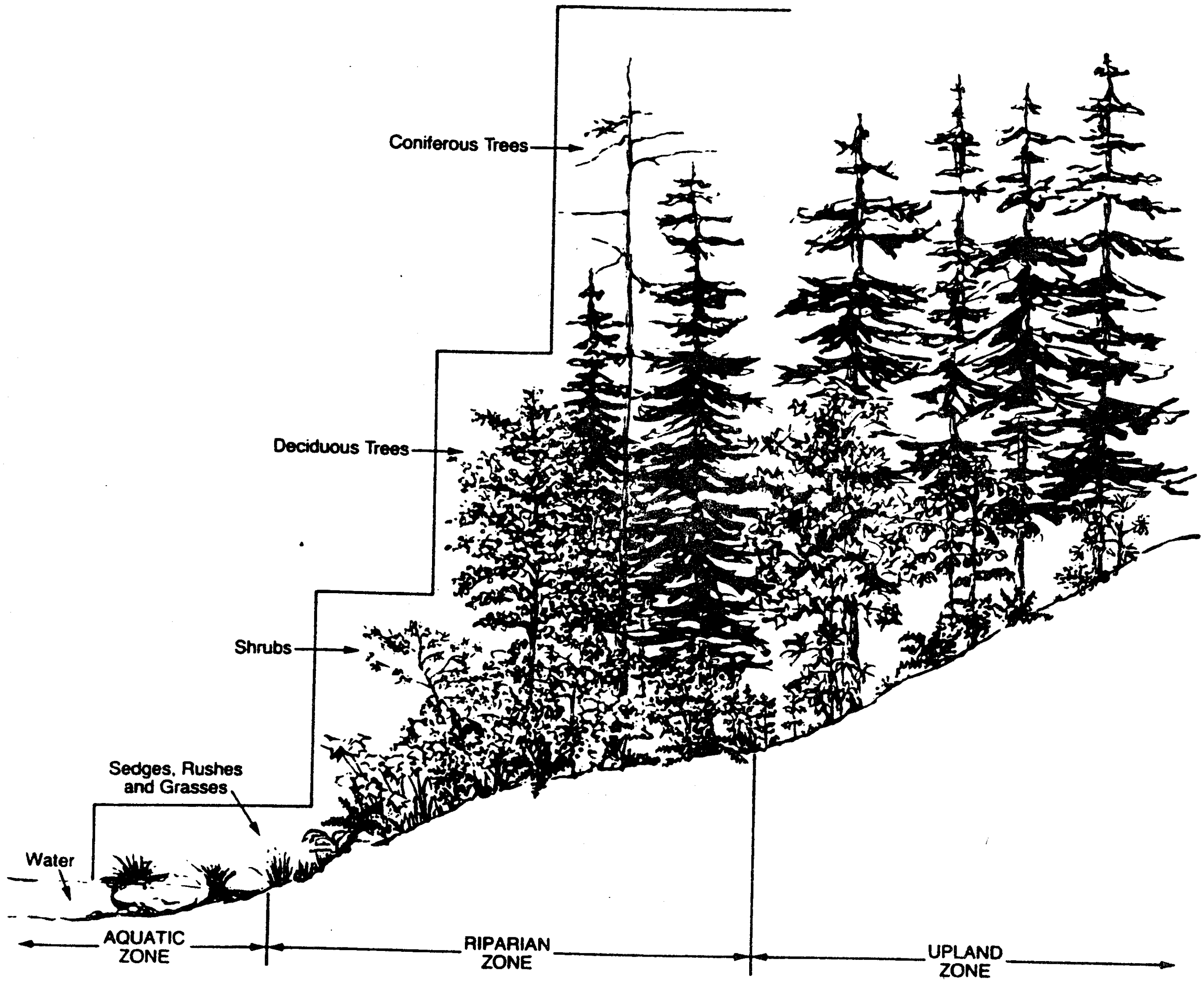
Upper Bank - That portion of the topographic cross section from the break in the general slope of the surrounding land to the normal high water line. Terrestrial plants and animals normally inhabit this area.

Lower Banks - The intermittently submerged portion of the channel cross section from the normal high water line to the water's edge during the summer low flow period.

Channel Bottom - The submerged portion of the channel cross section which is totally an aquatic environment.



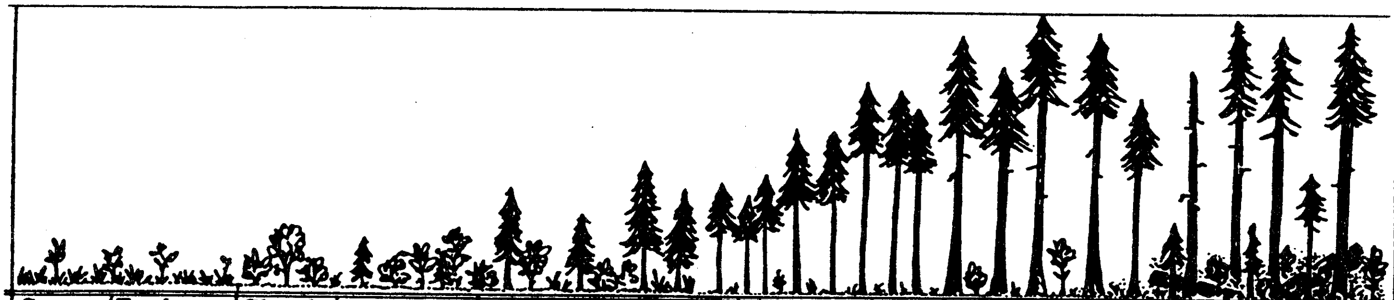
APPENDIX H



—Riparian zones have vegetation that requires large amounts of free or unbound water and are transitional between aquatic and upland zones.

APPENDIX I

Successional Pattern of Stand Conditions



Grass/Forb	Shrub/ Seedlings	Pole/Sapling	Small Trees	Large Sawtimber, Large Trees	Old-growth
Approximate stand age (years) 0	5	15	30	80	200 – 700
	Height Class 1: < 2' 2: 2'-5' 3: 5'-10' 4: > 10'	Size: < 8"	Size: 8"-20.9"	Size: 21"-32"	Size > 32"
GF	SS	SP	ST	LT	MT

Code:

GF = Grass/Forb Condition:
The grass-forb stand condition lasts 2-5 years and occasionally as long as 10 years. Shrubs and some trees that sprout are not yet dominant.

SS = Shrub/Seedling Condition:
The shrub stand condition often lasts 3-10 years but may remain for 20-30 years if tree generation is delayed. Tree regeneration may be common, but trees are generally less than 10 feet tall and provide less than 30 percent of crown cover.

SP = Sapling, Pole Condition:
The open sapling-pole condition occurs when trees exceed 10 feet in height and are less than 8 inches in dbh.

ST = Small Tree Condition:
The pole condition has very little ground vegetation because of closed crown canopy. Average stand d.b.h. is 8 inches to 20.9 inches.

LT = Mature Stand Condition:
The mature condition is characterized by trees with and average d.b.h. of 21 inches to 32 inches d.b.h.

MT = Old-growth Condition:
Old-growth stand conditions are characterized by decadence of live trees, snags, down woody material, and replacement of some of the long-lived pioneer species such as Douglas-fir by climax species such as western hemlock. Stands often have two or more layers with large diameter overstory trees commonly older than 200 years. Size is generally greater than 32 inches in d.b.h.

APPENDIX I

PARTIAL LISTING OF
SPECIES CODES FOR CONIFER AND HARDWOOD SERAL STAGES

C	**Conifer Forest**
CA	Subalpine fir, mountain hemlock, whitebark pine open parks
CC	Cedar, Western Red
CD	Douglas-fir
CE	Subalpine fir - engelmann spruce closed forest (not parks)...
CF	Fir, silver and noble
CH	Hemlock, western
CJ	Juniper
CL	Lodgepole pine, shore pine (climax or stable seral)
CM	Mountain hemlock
CP	Ponderosa pine, jeffery pine
CQ	Western white pine
CR	Red fir (Shasta red)
CS	Spruce, sitka
CT	Port Orford cedar
CW	White fir, grand fir
H	**Hardwood Forest**
HA	Alder
HB	Bigleaf maple
HC	Cottonwood, as, bottom land, overflow bottom land
HL	Liveoak, canyon
HM	Madrone
HO	Oak, Oregon White, California black
HQ	Quaking Aspen
HT	Tanoak

APPENDIX J

USDA Forest Service
Region 6

Stream Survey Management
Basin Summary

Page 1 of 1
18-FEB-92

**Stream Name : SMOKEY CREEK
Year : '91

Reach No.	Mile From - To	NSO From - To	Snsty	Length (Ft.)	% Area	% Volume	WD Ratio	Pools/ Mile	% Pools
1	0 - .3	1 - 36	1	1406.0	19.5%	20.2%	4.53	46.7	26.7%
2	.3 - .7	37 - 65	1	2043.0	37.8%	29.3%		30.0	61.1%
3	.7 - 1.6	66 - 128	1	4294.4	42.7%	50.5%	4.03	31.1	25.9%
				7743.4				35.9	19.6%

132 columns by 66 lines

APPENDIX J

USDA Forest Service	Stream Survey Management	Page 1 of 1
Region 6	Calibration Ratios Summary	18-FEB-92

**Stream Name : SMOKEY CREEK
Year : '91

Reach	Length Corrections			Width Corrections		
No.	Pools	Riffles	Glides	Pools	Riffles	Glides
1	.9755	.9343	1.0478	1.1195	.9407	1.400
2	.9755	.9343	1.0478	1.1195	.9407	1.400
3	.9755	.9343	1.0478	1.1195	.9407	1.400

80 columns by 66 lines

APPENDIX J

USDA Forest Service Region 6	Stream Survey Management A Form Comments Summary	Page 1 of 1 18-FEB-92

**Stream Name : SMOKEY CREEK
Year : '91

80 columns by 66 lines

APPENDIX J

USDA Forest Service Region 6	Stream Survey Management B Form Comments Summary	Page 1 of 1 18-FEB-92

**Stream Name : SMOKEY CREEK
Year : '91

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APPENDIX J

USDA Forest Service Region 6	Stream Survey Management C Form Comments Summary	Page 1 of 1 18-FEB-92

**Stream Name : SMOKEY CREEK
Year : '91

80 columns by 66 lines

APPENDIX J

USDA Forest Service
Region 6

Stream Survey Management
D Form Comments Summary

Page 1 of 1
18-FEB-92

**Stream Name : SMOKEY CREEK
Year : '91

80 columns by 66 lines

APPENDIX J

USDA Forest Service	Stream Survey Management	Page 1 of 1
Region 6	Measured Comments Summary	18-FEB-92

**Stream Name : SMOKEY CREEK
Year : '91

80 columns by 66 lines

APPENDIX J

USDA Forest Service | Stream Survey Management | Page 1 of 1
Region 6 | Confidence Interval Summary | 18-FEB-92

Habitat Areas in SqFt, plus or minus Confidence

**Stream Name : SMOKEY CREEK
Year : '91

Reach	Pools (Sq.Ft.)	+ or - Confidence Interval	Glides (Sq.Ft.)	+ or - Confidence Interval	Riffles (Sq.Ft.)	+ or - Confidence Interval
1	2772	631.87	1622		6938	1553.19
2	1222		220		24845	
3	5873	130.15			22253	1536.78

80 columns by 66 lines

APPENDIX J

USDA Forest Service
Region 6

Stream Survey Management
Fisheries Habitat Summary

Page 1 of 1
18-FEB-92

**Stream Name : SMOKEY CREEK
Year : '91

Reach	Mile From	- To	Length (Ft.)	LWD /Mile	Large /Mile	Small /Mile	Brush /Mile	Area	% P	% R	% G	% S	% F	%*	Cover Dom*	Sbd*
1	0	.3	1406.0	193.3	0	63.3	130.0	11840.7	24.3%	60.7%	14.2%	0.8%	0.0%	3	H	S W
2	.3	.7	2043.0	262.5	22.5	110.0	130.0	22915.1	4.6%	94.5%	0.8%	0.0%	0.0%	3		
3	.7	1.6	4294.4	115.6	7.8	38.9	68.9	25853.7	20.9%	79.1%	0.0%	0.0%	0.0%	4		
			7743.4					60609.4								

*If more than one entry is listed per reach, there was an equal number of each entry.

132 columns by 66 lines

APPENDIX J

USDA Forest Service
Region 6

Stream Survey Management
Fish Distribution

Page 1 of 1
18-FEB-92

**Stream Name : SMOKEY CREEK
Year : '91

Fish Species	Total Miles Present	Present in Reach(es)	Stream Length to Upper Limit of Distribution by NSO	Upper Limit NSO
ONCL	1.6	1,2,3	1.4	127

80 columns by 66 lines

APPENDIX J

USDA Forest Service
Region 6

Stream Survey Management
Hydrology Summary

Page 1 of 1
18-FEB-92

**Stream Name : SMOKEY CREEK
Year : '91

Reach	Miles	Snsty	Avg Grd	Ch En	Vy WC	Cn Cv	Flow (CFS)	Length (Ft.)	Area (Sq.Ft.)	Volume (Cu.Ft.)	Avg. Width (Ft.)	Bnk Fll W/ D Rto	Resid Depth	Subtrate* Bed D	Subtrate* Bed S	Subtrate* Bank D	Subtrate* Bank S	Gd* Cv	Em* bd	Mx Tp (°F)	Time
1	.3	1	4	S	4	3	.24	1406.0	11749.7	9974.4	10.9	4.53	1.7	CO	GR	SA	GR	4	N	58	1100
2	.4	1	8	M	2	4		2043.0	22915.1	14472.7	10.2		1.1	CO	SB	SA	GR	4	N		
																	SB		Y		
3	.9	1	10	S	4	4		4294.4	25853.7	24957.2	7.7	4.15	1.2	CO	GR	SA	GR	4	N	56	1230
																			Y		
								7743.4	60609.4	49404.4											

*If more than one entry is listed per reach, there was an equal number of each entry.

132 columns by 66 lines

APPENDIX J

USDA Forest Service
Region 6

Stream Survey Management
Reach Characterization

Page 1 of 1
18-FEB-92

**Stream Name : SMOKEY CREEK
Year : '91

Reach No	River Mile From	River Mile To	Vlly Form	Sinusty	Ent	Substrate* Dom	Substrate* Subdom	Grade	Valley Length	Wdth Clss
1	0.0	0.3	4	1	S	GR	CO	4%		4
2	0.3	0.7	3	1	M	CO	GR	8%		2
3	0.7	1.6	4	1	S	CO	SB	12%		4

*If more than one entry appears per reach, there was an equal number of each.

132 columns by 66 lines

APPENDIX J

USDA Forest Service
Region 6

Stream Survey Management
Relative Fish Abundance by Reach

Page 1 of 1
18-FEB-92

**Stream Name : SMOKEY CREEK
Year : '91

Reach	Species	Adult #	Adult %	Juvenile #	Juvenile %
1	ONCL	0	0.0%	23	100.0%
	ONMY	5	20.0%	20	80.0%
	ONTR	1	7.7%	12	92.3%
2	ONCL				
3	ONTR				

80 columns by 66 lines

APPENDIX J

USDA Forest Service | Stream Survey Management | Page 1 of 1
Region 6 | Special Features Summary | 18-FEB-92

**Stream Name : SMOKEY CREEK
Year : '91

Reach	Mile From	Mile To	NSO From	NSO To	Falls	#/Mile	Chutes	#/Mile	Dams	#/Mile	Culverts	#/Mile
1	0	.3	1	36							1	3.3
3	.7	1.6	66	128							1	1.1

Totals

Falls	Chutes	Dams	Culverts
			2

132 columns by 66 lines

APPENDIX J

USDA Forest Service
Region 6

Stream Survey Management
Riparian Vegetation Summary, Zone 1

Page 1 of 1
18-FEB-92

**Stream Name : SMOKEY CREEK
Year : '91

Reach	Mile From	To	Zone Width	Floodplain Vegetation, Zone 1 GF	SS	SP	ST	LT	MT	GF* D	GF* S	SS* D	SS* S	SP* D	SP* S	ST* D	ST* S	LT* D	LT* S	MT* D	MT* S
1	0	.3	50	100%						GF	HV										
2	.3	.7	80	100%						GB	HV										
3	.7	1.6	100	25%		75%				GF	HV			HV	HA						

If more than one entry is listed per reach, there was an equal number of each entry.

132 columns by 66 lines

APPENDIX J

USDA Forest Service
Region 6

Stream Survey Management
Riparian Vegetation Summary, Zone 2

Page 1 of 1
18-FEB-92

**Stream Name : SMOKEY CREEK
Year : '91

			Zone	Floodplain Vegetation, Zone 2						GF*		SS*		SP*		ST*		LT*		MT*	
Reach	Mile From	To	Width	GF	SS	SP	ST	LT	MT	D	S	D	S	D	S	D	S	D	S	D	S
1	0	.3	50	100%						GF	HV										
2	.3	.7	20	100%						GB	HV										

If more than one entry is listed per reach, there was an equal number of each entry.

132 columns by 66 lines

APPENDIX J

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USDA Forest Service                                          Stream Survey Management                                          Page 1 of 1
Region 6                                                          C Form Dump                                                    18-FEB-92

**Stream Name : SMOKEY CREEK
      Year  :  '91

Reach No :       1
                                    1  1    1 1   1    1            1   1   1   1  2  2  2  2  2   2        2  2      2   2      3    3  3  3
  1 2        3     4      5  6 7    8   9  0  1    2 3   4    5            6   7   8   9  0  1  2  3  4   5        6  7      8   9      0    1  2  3
-------------------------------------------------------------------------------------------------------------------------------------------------
  1 R1      30.0   4.0    .3    GR   CO           3 H  S                                                                     111  107     R06F23A
  2 G1      16.0  40.0    .7    GR   CO           3 H  S                                                                     111  107     R06F23A
  3 R2      70.0   4.0    .5    CO   GR           2 S  U                                                                     111  107     R06F23A
  4 P1      30.0   9.0    .9  .1 GR  SA           2 W  S                                                                     111  107     R06F23A
  5 R3      33.0   3.5    .4    SA   CO           2 S  W                                                           58  1101  111  107     R06F23A
  6 P2      18.0   7.0   1.2  .3 SA  CO           2 W  U                                                                     111  107     R06F23A
  7 C1      68.0   4.2                                        ROUND PIPE  4  N  Y  20  11  3  2  6  4                        111  107     R06F23A
  8 F1      30.0   8.0  40.0                                              4     Y  12   5 12          FALLS                   111  107     R06F23A
                           .                                            .                                          .
                           .                                            .                                          .
                           .                                            .                                          .
                           .                                            .                                          .
                           .                                            .                                          .
 37 P14     23.0   9.0   1.1  .1         CO              SA    2 S                                                               111  107     R06F23A
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USDA Forest Service                                          Stream Survey Management                                          Page 1   of 1
Region 6                                                          C Form Dump                                                    18-FEB-92

**Stream Name : SMOKEY CREEK
      Year  :  '91

Reach No :      2
                                    1  1    1 1   1    1            1   1   1   1  2  2  2  2  2   2        2  2      2   2      3    3  3  3
  1 2        3     4      5  6 7    8   9  0  1    2 3   4    5            6   7   8   9  0  1  2  3  4   5        6  7      8   9      0    1  2  3
-------------------------------------------------------------------------------------------------------------------------------------------------
 38 R16     20.0  15.0    .1    CO   SB  1             S                                                                     111  107     R06F23A
 39 G6      20.0   5.0    .6    CO   GR           3 H  S                                                                     111  107     R06F23A
 40 R17    170.0   8.0    .8    CO   SB  2  1     3 H  W                                                                     111  107     R06F23A
                           .                                            .                                          .
                           .                                            .                                          .
                           .                                            .                                          .
                           .                                            .                                          .
                           .                                            .                                          .
 66 R30    105.0   7.0   1.5    CO   SB 8 7 1     4 H  S                                                                     111  107     R06F23A
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APPENDIX J

USDA Forest Service Region 6	Stream Survey Management ASCII Dump	Page 1 of 1 18-FEB-92

**Stream Name : SMOKEY CREEK
Year : '91

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APPENDIX K

STREAM AND TRIBUTARY DELINEATION

Nationally, the US Geological Survey and the Water Resources Council have established a coordinated watershed delineation and coding system which is referred to as the Hydrologic Unit Codes (HUC). This system is hierarchical and is comprised of Region, Subregion, Accounting Unit, and Cataloging Unit. The Accounting Unit is generally referred to as a river basin and the Cataloging Unit is usually known as a subbasin. An example of this type of coding is:

Region	Pacific Northwest	17
Subregion	Upper Columbia River	1707
Accounting Unit	Deschutes River Basin	170703
Cataloging Unit	Upper Deschutes River Subbasin	17070301

The Forest Service has added an additional 2 levels of finer resolution to the HUC coding system to define specific watersheds within a Forest. The structure for these two fields (watershed and subwatershed) is displayed below.

Watershed	Tumalo Creek	17070301 02
Subwatershed	Bridge Creek	17070301 02A

Due to the limitations of the TRI system, subwatersheds can be divided into a maximum of 25 subwatersheds denoted by a letter of the alphabet. The letter "O" cannot be used to designate a subwatershed because of the potential to mistake it for zero. All districts should have a good quality watershed map showing the location of all watersheds and subwatersheds with current information.

The Region 6 Standardized Stream Survey Methodology has adopted additional criteria to further delineate streams. This allows specific identification of each unique stream and tributary.

Under NFS Code on Form A there are four spaces for stream mile measurements to identify the specific stream within the NFS watershed (2 digit code) and subwatershed (1 letter code). These four spaces are used to record measured stream miles upstream of the confluence with the next highest (hierarchical order) stream. ALL MILEAGES UNDER THE NFS CODE SHOULD START AT THE MOUTH OF THE MAINSTEM WHICH FORMS THE MAJOR NFS WATERSHED (2 digit code). Do not start mileage measurements at the mouth of the subwatersheds (1 letter code).

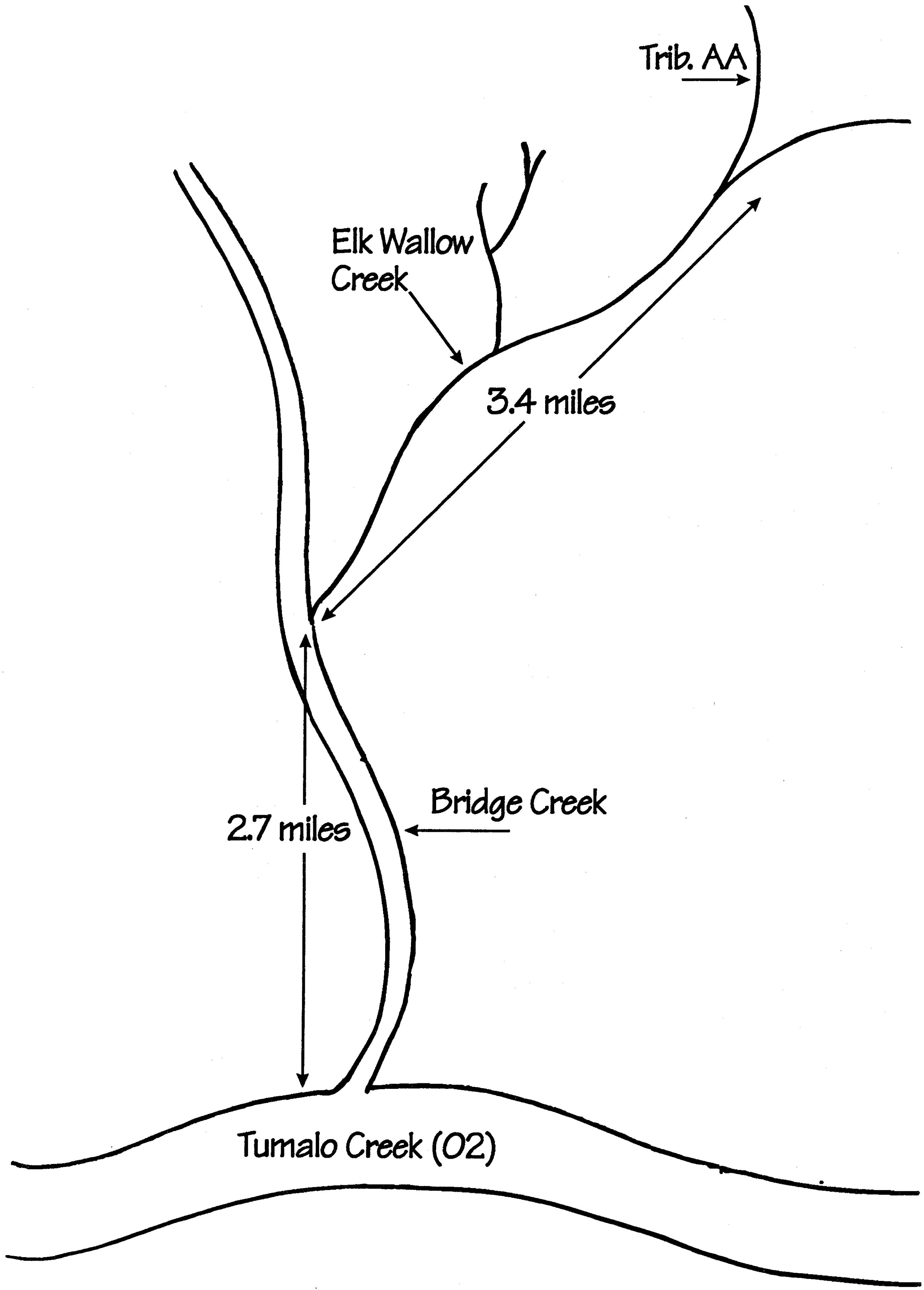
To further expand on the above example, Tributary AA is a stream to be surveyed this field season. This unnamed tributary flows into Elk Wallow Creek at river nile *3.4*, which then flows into Bridge Creek at river mile *2.7* (refer to diagram). The four fields must have 4 digits (2 before and two after the decimal) in order for the program to accept them during data entry. Using the above river mileages, stream delineation coding would look something like this:

17070301,	**02,**	**A,**	**02.70,**	**03.40,**	______,	______
HUC code	Watershed code	Sub-basin code	River miles			

This procedure can be taken an additional two steps to further delineate other tributaries. These mileage measurements designate nodal points at confluences of streams. These nodes will later be integrated into GIS.

To ease clarification, the tributary that has the greatest distance (and is the closest to the watershed boundary) from the mainstem confluence to the headwaters will be considered as the mainstem.

In cases where the mouth of the mainstem is an estuary or lake, estimate the stream mileages for tributary junctions along your best guess of what would be the main channel (based on topographical features).


Trib. AA
Elk Wallow Creek
3.4 miles
2.7 miles
Bridge Creek
Tumalo Creek (02)

STREAM IDENTIFICATION FORM A

R6-2500/2600-10

Page: __of__

Date:___/___/___
YY/Mmm/DD

A. State ______ B. County ______ C. Forest ______ D. District ______

E. Stream Name: ____

F. Watershed Code ___, ___, ___, ___ NFS ___, _; ____.__, ____.__, ____.__, ____.__

G. USGS Quad: ____

H. Survey Date: _____/________/_____
Year/ Month /Day

I. Name: ____

---

1. Watershed Area ____________ Acres (Hectares)
2. Stream Order ____
3. Stream Class ____
4. Fish Species ___, ___, ___, ___, ___, ___, ___, ___

   Data Source: ____

5. Flow Data:

   Data Source: ____

6. Water Quality Data:

   Data Source: ____

7. Macroinvertebrate Data:

   Data Source: ____

8. Previous Surveys:

   Data Source: ____

9. Historical Land Use Data:

   Data Source: ____

10. Coordination: ____

11. Comments: ____

PRELIMINARY REACH IDENTIFICATION FORM B1 (OFFICE)
R6-2500/2600-11

Page: __of__
Date:___/___/___
YY/Mmm/DD

A. State ______ B. County ______ C. Forest ______ D. District ______
E. Stream Name: ____________________
F. Watershed Code ___, ___, ___, ___ NFS ___, _; _____._, _____._, _____._, _____.
G. USGS Quad: ____________________
H. Survey Date: _____/_______/_____
Year/ Month /Day

1. Reach # ___ RM ___ to ___
2. Valley Form ________
3. Valley Width Class 1__2__3__4__
4. Flow Regime Change ________
5. Sinuosity H___M___L___S___
6. Average Reach Gradient ________
7. Stream Canopy Closure 1__2__3__4__
8. Other ________
9. General Comments: ________

1. Reach # ___ RM ___ to ___
2. Valley Form ________
3. Valley Width Class 1__2__3__4__
4. Flow Regime Change ________
5. Sinuosity H___M___L___S___
6. Average Reach Gradient ________
7. Stream Canopy Closure 1__2__3__4__
8. Other ________
9. General Comments: ________

1. Reach # ___ RM ___ to ___
2. Valley Form ________
3. Valley Width Class 1__2__3__4__
4. Flow Regime Change ________
5. Sinuosity H___M___L___S___
6. Average Reach Gradient ________
7. Stream Canopy Closure 1__2__3__4__
8. Other ________
9. General Comments: ________

1. Reach # ___ RM ___ to ___
2. Valley Form ________
3. Valley Width Class 1__2__3__4__
4. Flow Regime Change ________
5. Sinuosity H___M___L___S___
6. Average Reach Gradient ________
7. Stream Canopy Closure 1__2__3__4__
8. Other ________
9. General Comments: ________

1. Reach # ___ RM ___ to ___
2. Valley Form ________
3. Valley Width Class 1__2__3__4__
4. Flow Regime Change ________
5. Sinuosity H___M___L___S___
6. Average Reach Gradient ________
7. Stream Canopy Closure 1__2__3__4__
8. Other ________
9. General Comments: ________

1. Reach # ___ RM ___ to ___
2. Valley Form ________
3. Valley Width Class 1__2__3__4__
4. Flow Regime Change ________
5. Sinuosity H___M___L___S___
6. Average Reach Gradient ________
7. Stream Canopy Closure 1__2__3__4__
8. Other ________
9. General Comments: ________

FINAL REACH IDENTIFICATION FORM B2 (FIELD) Page ___ of ___
R6-2500/2600-21

A. State ______ B. County ______ C. Forest ______ D. District ______
E. Stream Name: ______
F. Watershed Code ___, ___, ___, ___ NFS ___, _; ___.___, ___.___, ___.___, ___.___
G. USGS Quad: ______
H. Survey Date: _____/________/______
Year/ Month /Day
I. Name: ______

1. Reach # ___ 2. NSO ____ to ____
3. Flow ______
4. Channel Entrenchment D___M___S___
5. River Mile ____ to ____
6. Sinuosity value ______
7. Average Channel Gradient ______
8. Valley Length ______
9. Valley Form ______
10. Valley Width Class 1___2___3___4___
11. Stream Canopy Closure 1__2__3__4__
12. Dominant/Subdominant a.)____b.)___
Substrate
13. Inner Riparian Zone Width______
14. Comments______

15. Observer: ______
Recorder: ______
16. Date: __/__/__
YY/MM/DD

1. Reach # ___ 2. NSO ____ to ____
3. Flow ______
4. Channel Entrenchment D___M___S___
5. River Mile ____ to ____
6. Sinuosity value ______
7. Average Channel Gradient ______
8. Valley Length ______
9. Valley Form ______
10. Valley Width Class 1___2___3___4___
11. Stream Canopy Closure 1__2__3__4__
12. Dominant/Subdominant a.)____b.)___
Substrate
13. Inner Riparian Zone Width______
14. Comments______

15. Observer: ______
Recorder: ______
16. Date: __/__/__
YY/MM/DD

1. Reach # ___ 2. NSO ____ to ____
3. Flow ______
4. Channel Entrenchment D___M___S___
5. River Mile ____ to ____
6. Sinuosity value ______
7. Average Channel Gradient ______
8. Valley Length ______
9. Valley Form ______
10. Valley Width Class 1___2___3___4___
11. Stream Canopy Closure 1__2__3__4__
12. Dominant/Subdominant a.)____b.)___
Substrate
13. Inner Riparian Zone Width______
14. Comments______

15. Observer: ______
Recorder: ______
16. Date: __/__/__
YY/MM/DD

1. Reach # ___ 2. NSO ____ to ____
3. Flow ______
4. Channel Entrenchment D___M___S___
5. River Mile ____ to ____
6. Sinuosity value ______
7. Average Channel Gradient ______
8. Valley Length ______
9. Valley Form ______
10. Valley Width Class 1___2___3___4___
11. Stream Canopy Closure 1__2__3__4__
12. Dominant/Subdominant a.)____b.)___
Substrate
13. Inner Riparian Zone Width______
14. Comments______

15. Observer: ______
Recorder: ______
16. Date: __/__/__
YY/MM/DD

Page:___ of_____
Date:___/___/___
YY MM DD

RIPARIAN IDENTIFICATION FORM C
R6 2500-22/2600-22

A. State ______ B. County ______ C. Forest ______ D. District ______ E. Stream Name: ______
F. Watershed Code ___, ___, ___, ___ NFS ___, _; ___.___, ___.___, ___.___, ___.___ G. USGS Quad: ______
H. Survey Date: _____/________/_____
Year/ Month /Day
I. Reach Number:______________ J. (Sampling frequency: Pool ____; Riffle ____; Glide ____)
(* Indicates information to be gathered at the Nth unit only)

1. Nat. Seq. Ord. #	2. Hab. Type & Num. P,R,G, S,F,D,T	3. Hab. Lngth ft.	4. Hab. Width ft.	5. Max. Depth 0.1ft	6. Depth @Pool Tail Crest 0.1ft	7. Substrate Dom. SA,GR, CO,SB, LB,BR	8. Substrate S-dom. SA,GR, CO,SB, LB,BR	9. # Piece LWD B Brush	10. # Piece LWD S Small	11. # Piece LWD L Larg	12. Total Cover %=0,5 20,40 code 1-4	13. Total Cover Dom. U,S,D H,W,T A	14. Total Cover S-dom U,S,D H.W,T A	**15** Bank full Width ft.	**16** Bank full Depth ft.	**17** Embedd edness >35% Y/orN	**18** BankSubstrat SA,GR, CO,SB LB,BR Dom.	**19** BankSubstrat SA,GR CO,SB LB,BR S-dom	*20** Bank Grnd Cover 1-4	**21** Floodplain 1 Vegetation class a.	**22** Floodplain 1 Vegetation Dom. b.	**23* Floodplain 1 Vegetation Sdom c.	**24** Floodplain 2 Vegetation class a.	**25** Floodplain 2 Vegetation Dom. b.	**26** Floodplain 2 Vegetation Sdom c.	+++++27++++++ Water Temp. (3X/day) °F or °C (circle one) Degree	Time	28 Optional Fields	29	30	31	32	33	34 Comments

FloodP.veg codes= GF,SS,SP,ST,LT,MT
Shrubland ht.=1(0-2') 2(2-5) 3(5-10) 4(>10')

Conifer Codes = CA,CC,CD,CE CF,CH,CJ,CL,CM,CP,CQ,CR,CS,CT,CW,CY,CX
Hardwood Codes= HA,HB,HC,HD,HE,HL,HM,HO,HQ,HT,HV,HW,HX

SPECIAL CASES FORM C1 (FIELD)
R6-2500/2600-23

Page: __of__
Date:___/___/___
YY/Mmm/DD

A. State ______ B. County ______ C. Forest ______ D. District ______
E. Stream Name: ____________________
F. Watershed Code ___, ___, ___, ___ NFS ___, _; ___.___, ___.___, ___.___, ___.___
G. USGS Quad: ____________________
H. Survey Date: _____/________/_____
Year/ Month /Day

---

1. Reach # _____ 2. Natural Sequence Order # _____ 3. Culvert # ______

4. Type of structure (check)
Round Pipe Box Arch Open Arch Open Box Eliptical

5. Length of Structure ________(ft) 6. Diameter or width ________ (ft)
7. Gradient of Structure ____________% 8. Are Baffles Present? __________
9. Jumping distance into culvert from pool: Height ______
10. Pool present below structure (circle) Yes No
11. Pool Length ______, Width ______, Depth ______ 12. Stream Seg. Id. ______
13. Stream above culvert: Width ______, Gradient ________
14. Obs/Rec ________ (3 digit code)

---

1. Reach # _____ 2. Natural Sequence Order # _____ 3. Culvert # ______

4. Type of structure (check)
Round Pipe Box Arch Open Arch Open Box Eliptical

5. Length of Structure ________(ft) 6. Diameter or width ________ (ft)
7. Gradient of Structure ____________% 8. Are Baffles Present? __________
9. Jumping distance into culvert from pool: Height ______
10. Pool present below structure (circle) Yes No
11. Pool Length ______, Width ______, Depth ______ 12. Stream Seg. Id. ______
13. Stream above culvert: Width ______, Gradient ________
14. Obs/Rec ________ (3 digit code)

---

1. Reach # _____ 2. Natural Sequence Order # _____ 3. Culvert # ______

4. Type of structure (check)
Round Pipe Box Arch Open Arch Open Box Eliptical

5. Length of Structure ________(ft) 6. Diameter or width ________ (ft)
7. Gradient of Structure ____________% 8. Are Baffles Present? __________
9. Jumping distance into culvert from pool: Height ______
10. Pool present below structure (circle) Yes No
11. Pool Length ______, Width ______, Depth ______ 12. Stream Seg. Id. ______
13. Stream above culvert: Width ______, Gradient ________
14. Obs/Rec ________ (3 digit code)

SPECIAL CASES FORM C2 (FIELD)
R6-2500/2600-24

Page: __of__
Date:___/___/___
YY/Mmm/DD

A. State ______ B. County ______ C. Forest ______ D. District ______
E. Stream Name: ____________________
F. Watershed Code ___, ___, ___, ___ NFS ___, _; ___.__, ___.__, ___.__, ___.__
G. USGS Quad: ____________________
H. Survey Date: _____/________/_____
Year/ Month /Day

---

1. Reach # _____ 2. Natural Sequence Order # _____
3. Falls/ Chute/ Dam (circle one) # ________
4. Special Case Number: ____________
5. Stream Survey Mile: ________ 6. Topo map elevation: ___________
7. Size: Length _______ Width ______ Height ______
8 Gradient: _______%
9. Is pool present below structure (circle one) Yes No
10. Pool Length ______ Width ______ Depth _______
11. Stream Seg. Id: ____________________
12. Obs/Rec: ____________________
13. Comments: ____________________

---

1. Reach # _____ 2. Natural Sequence Order # _____
3. Falls/ Chute/ Dam (circle one) # ________
4. Special Case Number: ____________
5. Stream Survey Mile: ________ 6. Topo map elevation: ___________
7. Size: Length _______ Width ______ Height ______
8 Gradient: _______%
9. Is pool present below structure (circle one) Yes No
10. Pool Length ______ Width ______ Depth _______
11. Stream Seg. Id: ____________________
12. Obs/Rec: ____________________
13. Comments: ____________________

---

1. Reach # _____ 2. Natural Sequence Order # _____
3. Falls/ Chute/ Dam (circle one) # ________
4. Special Case Number: ____________
5. Stream Survey Mile: ________ 6. Topo map elevation: ___________
7. Size: Length _______ Width ______ Height ______
8 Gradient: _______%
9. Is pool present below structure (circle one) Yes No
10. Pool Length ______ Width ______ Depth _______
11. Stream Seg. Id: ____________________
12. Obs/Rec: ____________________
13. Comments: ____________________

COMMENTS FORM C3 (FIELD)
R6-2500/2600-25

Page: __of__
Date:___/___/___
YY/Mmm/DD

A. State ______ B. County ______ C. Forest ______ D. District ______
E. Stream Name: ____
F. Watershed Code ___, ___, ___, ___ NFS ___, _; ___.___, ___.___, ___.___, ___.___
G. USGS Quad: ____
H. Survey Date: _____/________/_____
Year/ Month /Day

Reach #	NSO #	Habitat Type and Number	Comment

FISH USE AND RELATIVE NUMBERS FORM D
R6-2600-30

Page: __of__
Date:___/___/___
YY/Mmm/DD

A. State ______ B. County ______ C. Forest ______ D. District ______
E. Stream Name: ____________________
F. Watershed Code ___, ___, ___, ___ NFS ___, _; ___.___, ___.___, ___.___, ___.___
G. USGS Quad: ____________________
H. Survey Date: _____/________/_____
Year/ Month /Day
I. Reach Number _____

J. METHOD: Seine (S) Snorkel (SN) Electroshock (E) Visual (V)

NOTE: * ADULT: 1 = 1-5 fish, 2 = 5-10 fish, 3 = > 10 fish
NOTE: * JUVEN: 1 = 1-25 fish, 2 = 25-75 fish, 3 = > 75 fish

1) NSO	2) HABITAT TYPE AND NUMBER	3) SPECIES	3a) JUV	3b) ADULT	4) COMMENTS

Stream Inventory Reports/Report Writing

Interpretive reports are a key element of any inventory. Data without a report is next to useless, and will simply occupy file space for a number of years and either be discarded or archived. To ensure this doesn't occur, **annual interpretive reports** for inventories completed during the field season **are required.**

Following is a recommended outline along with a list of items that should be considered in developing the report. Note that each item should be considered, but not necessarily addressed. Local conditions and needs will dictate the items included. This is not an exhaustive list and the Forests are encouraged to add details necessary to accurately portray local conditions.

The ingredients for a good usable report includes enough detail to describe the current situation in terms understandable to the intended audience, without being verbose. Displaying tables and graphs without good interpretation is almost as useless as not writing a report in the first place, and interpretation goes far beyond simply regurgitating the figures displayed. This is an art in itself and requires the expertise gained with on the job experience. At a minimum, review and input from a journey level professional is required to ensure adequacy of management implications, and interpretations.

Finally, report presentation is also important. Taking the extra steps to bind and illustrate (ie, a picture is worth a thousand words) can spell the difference between being used, or gathering dust in a corner. An economical spiral binding together with photo's, graphs and charts is sufficient in most cases.

INDEX

STREAM INVENTORY REPORT FORMAT

I. COVER PAGE

STREAM NAME
STREAM SURVEY REPORT

<u>Surveyors</u>:

<u>Survey Dates</u>:

<u>Survey Distance</u>:

Class I
Class II
Class III
Total

<u>LOCATION</u>:

<u>County</u>:

<u>Forest</u>:

<u>District</u>:

<u>TRI Compartments</u>:

<u>Drainage</u>:

<u>Tributary to</u>:

<u>Mouth Location</u>:

<u>WATERSHED</u>:

<u>NFS Watershed No.</u>:

<u>Watershed area</u>:

<u>Stream Order</u>:

<u>Stream Class</u>:

<u>Stream Length</u>:

<u>FISHERIES</u>:

<u>Fish Observed</u>:

<u>Fish Distribution</u>: See survey map

II. EXECUTIVE SUMMARY

A. Issues, Concerns and Opportunities

1. Threatened, Endangered, and Sensitive (TE&S) species
   a. Species presently on the USF&W T&E list
   b. Species on the Region's sensitive species list
   c. Species identified as potential TE&S

2. Land Management Plan standards and guidelines
   a. Fish habitat
   b. Riparian habitat
   c. Watershed

3. Desired future condition
   a. Land Management Plan descriptions of fish and riparian habitats
   b. Biologist description of fish and riparian habitat

4. Fish habitat, riparian habitat and watershed improvement/rehab. opportunites.

5. Critical fish habitat and riparian habitat parameters

6. Other direct, indirect and cumulative effects either beneficial or adverse

B. Discussion of Existing Situation

1. Brief discussion of existing situation

2. Comparison of existing situation to pertinent issues and concerns.

C. Management Conclusions

1. Interpretation of how the existing situation relates to issues and concerns.
   a. Magnitude and importance
   b. Implications on resources and resource program

2. Suggest solution
   a. Opportunities: recommend best solution and consider others
   b. Identify workforce needs, time factors and costs

III. BASIN SUMMARY

A. Introduction

past history
ownership
access

B. Watershed/Geomorphology:

basin orientation
tributaries (peren/inter)
seeps and springs
valley bottom config
side slopes %
soil types and conditions
palmate or pinnate
flow regime
timber mgt. & road activities
floodplain width
vegetative cover (kinds)

C. Riparian habitat:

general conditions
types of rip. veg.
previous, current, or planned harvest activity
canopy/shade
presence of wetlands
beaver activity (if any)

D. Fisheries

P:R:G ratio
effective cover
fish passage
spawning gravel quantity and quality
pool quantity and quality
large woody debris quantity and complexity
relative fish abundance and distribution

E. Management Implications

1. Compare data with standards and guidelines in Forest Land Management Plan and desired future condition for fish habitat, riparian habitat, and watershed (does it meet?). This will likely be in the areas of sedimentation, large woody debris, pools, shade, temperature, and ?. If it doesn't meet the standards, what are the possible reasons.

2. Identify effects of land management activities and natural events (ie. floods and land mass movements).

3. Survey wasn't site specific enough (i.e. didn't pick up plunge pools and that was all that you had).

4. Identify needs and opportunities for fish habitat, riparian habitat, and watershed improvement/rehabilitation

IV. Reach Summaries:

A. Introduction

past history
ownership
access

B. Watershed/Geomorphology:

basin orientation	reach length
tributaries (peren/inter)	flow regime
seeps and springs	timber mgt. & road activities
valley bottom config	floodplain width
side slopes %	vegetative cover (kinds)
soil types and conditions	palmate or pinnate

C. Riparian habitat:

general conditions
types of rip. veg.
previous, current, or planned harvest activity
canopy/shade
presence of wetlands
beaver activity (if any)

D. Fisheries

P:R:G ratio	spawning gravel quantity and quality
effective cover	pool quantity and quality
fish passage	large woody debris quantity and complexity
	relative fish abundance and distribution

E. Management Implications

1. Identify parameters and compile data needed to evaluate the standards, guidelines and desired future condition for fish habitat, riparian habitat, and watershed in your Forest Land Management Plan (does it meet?). This will likely be in the areas of sedimentation, large woody debris, pools, shade, temperature, and ?. If it doesn't meet the standards, what are the possible reasons.

2. Identify effects of land management activities, natural events (ie. floods and land mass movements).

3. Survey wasn't site specific enough (i.e. didn't pick up plunge pools and that was all that you had).

4. Identify needs and opportunities for fish habitat, riparian habitat, and watershed improvement/rehabilitation

V. Summary Tables

photo copies of summary table printouts from FOXPRO

VI. Maps:

reach breaks	tributaries	barriers
roads	harvest areas	meadow/wetlands
major slides or land failures		

Make this map legible and neat. Don't color code anything unless you plan on never making a copy of it.

VII. Photographs

VIII. Appendices

List of pertinent standards, guidelines, and desired future conditions from LMP

Stream inventory procedure information: brief description, date and version number of the stream inventory handbook

A. Summary of fish habitat, fisheries, riparian habitat and watershed

reach length
valley configuration
stream gradient
pool/riffle/glide ratio
meadows/wetlands/sidechan.
pool habitat/cover/size
barriers
floodplain width
riparian habitat units
flow
side slopes
substrate comp.
shade
fish pop. and species
spawning habitat
riparian habitat
overstory comp.
large woody debris
rehabilitation and enhancement opportunities (where?)
heavy equipment access

B. Conclusions

interpretation and management implications

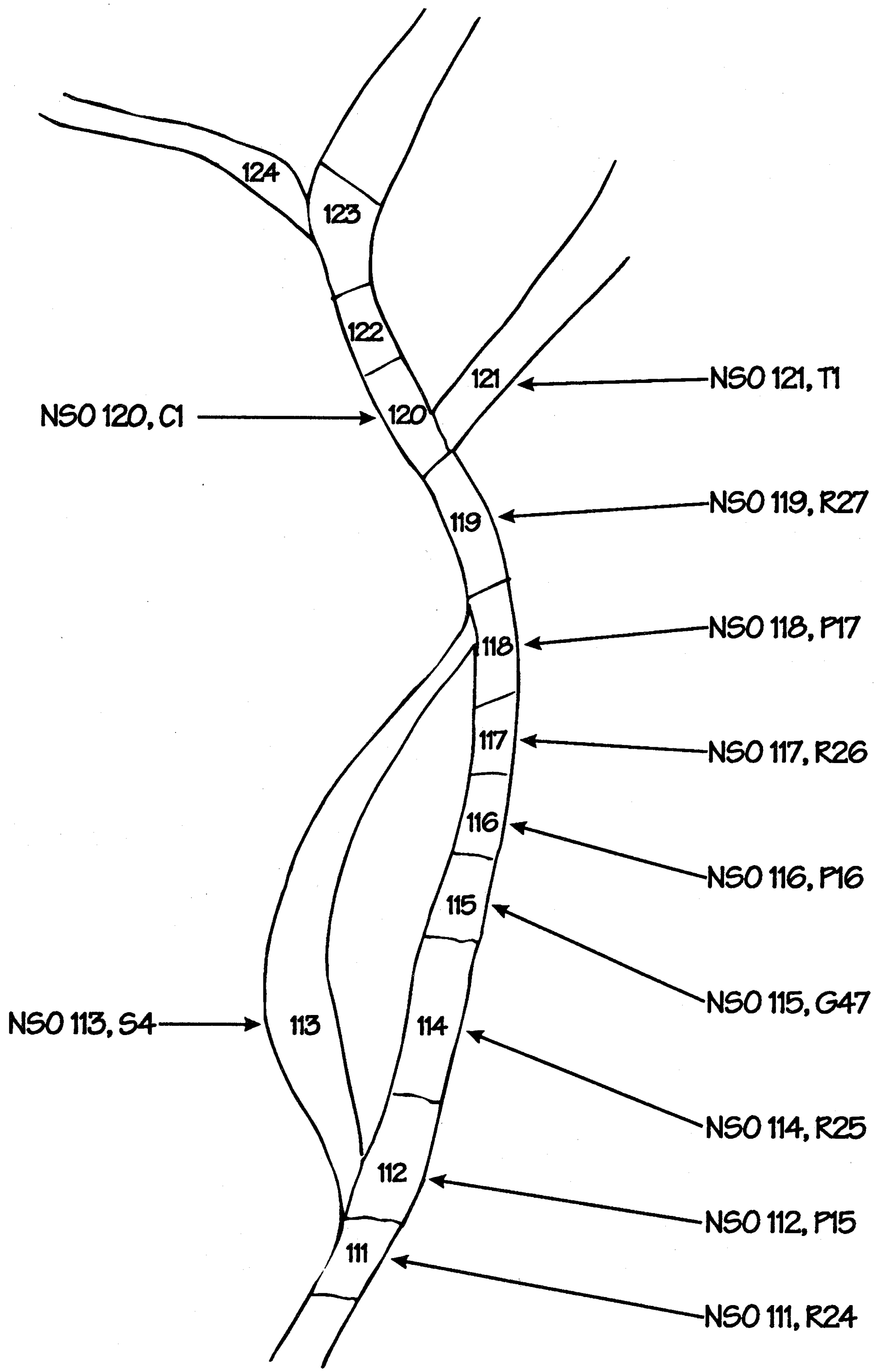
FORM C

Introductory Paragraph: Forests need to establish standards for "left bank" and "right bank" orientation. Note that the USGS standard establishes orientation while looking downstream.

Tributaries: Forests shall determine the significance for determining inclusion or exclusion in the survey. Note that tributaries identified at 1:24,000 USGS Quad Scale will be used in GIS for determining node location.

Maximum Depth: Forest shall determine if depths will be measured, or estimated and measured (same as width and length variables). If all depths are measured, this value will need to be entered in the software as both estimated and measured values at each Nth unit. At all "non-Nth" units, enter the actual measured value as ONLY the estimated value. This will establish a correction factor of 1.0 for the depth.

Habitat Unit Delineation



Page:___ of_____
Date:___/___/___
YY MM DD

RIPARIAN IDENTIFICATION FORM C
R6 2500-22/2600-22

A. State ______ B. County ______ C. Forest ______ D. District ______ E. Stream Name: ______
F. Watershed Code ___.___.___.___ NFS ___._:___.___.___.___.___ G. USGS Quad: ______
H. Survey Date: _____/_______/_____
Year/ Month /Day
I. Reach Number: 2 J. (Sampling frequency: Pool ____; Riffle ____; Glide ____)
(* Indicates information to be gathered at the Nth unit only)

1. Nat. Seq. Ord. #	2. Hab. Type & Num. P,R,G, S,F,D,T	3. Hab. Lngth ft.	4. Hab. Width ft.	5. Max. Depth 0.1ft	6. Depth @Pool Tail Crest 0.1ft	7. Substrate Dom. SA,GR, CO,SB, LB,BR	8. Substrate S-dom. SA,GR, CO,SB, LB,BR	9. # Piece LWD B Brush	10. # Piece LWD S Small	11. # Piece LWD L Larg	12. Total Cover %=0,5 20,40 code 1-4	13. Total Cover Dom. U,S,D H,W,T A	14. Total Cover S-dom U,S,D H,W,T A	**15** Bank full Width ft.	**16** Bank full Depth ft.	**17** Embeddedness >35% Y/orN	**18** BankSubstrat SA,GR, CO,SB LB,BR Dom.	**19** BankSubstrat SA,GR CO,SB LB,BR S-dom	*20** Bank Grnd Cover 1-4	**21** Floodplain 1 Vegetation class a.	**22** Floodplain 1 Vegetation Dom. b.	**23* Floodplain 1 Vegetation Sdom c.	**24** Floodplain 2 Vegetation class a.	**25** Floodplain 2 Vegetation Dom. b.	**26** Floodplain 2 Vegetation Sdom c.	+++++27++++++ Water Temp. (3X/day) °F or °C (circle one) Degree	27 Time	28 Optional Fields	29	30	31	32	33	34 Comments
111	R24	50	12	1.1		LB	BR	0	0	3	3	S	W																					
112	P15	62	13	5.5	1.1	LB	CO	0	2	1	2	D	S																					
112	MP15	65	14	6.1	1.0									19	10	N	LB	SB	2	GF	GF	HA	ST	HA	HW									
113	S4	415	8	2.2																														
114	R25	45	10	0.9		SB	LB	0	1	1	1	U	S													48	07:00							
115	G47	43	9	2.1		CO	GR	0	2	0	1	U	S																					
115	MG47	40	10	2.2										15	6	N	SB	LB	1	LT	CE	HA	ST	CD	HC									
116	P16	35	9	4.5	1.0	LB	CO	1	1	1	2	D	W																					
117	R26	36	9	1.5		SB	CO	0	2	0	3	U	T																					
117	MR26	34	8	1.2										14	7	N	CO	SB	3	SS	SS2	HW	SS	SS3	HA									
118	P17	40	12	7.1		SB	LB	0	1	1	4	T	H																					SIDE CHANNEL S4 RETURNS TO CRK.
119	R27	52	10	1.1		CO.	BR	1	1	2	2	S	W																					
120	T1	5	6			BR	CO																			52	0720							
120	C1																																	See C1 Form

FloodP.veg codes= GF,SS,SP,ST,LT,MT
Shrubland ht.=1(0-2') 2(2-5) 3(5-10) 4(>10')

Conifer Codes = CA,CC,CD,CE CF,CH,CJ,CL,CM,CP,CQ,CR,CS,CT,CW,CY,CX
Hardwood Codes= HA,HB,HC,HD,HE,HL,HM,HO,HQ,HT,HV,HW,HX