Contract Report (non-refereed)

Furse, M. T.; Dawson, F.H.; Henville, P.; Irons, G.P.; Gunn, R.J.M.; Winder, J. M.. 1998 *Countryside Survey 2000. Module 2: survey of freshwater habitats. Field handbook v.2.0.* NERC/Centre for Ecology and Hydrology, 154pp. (CEH: Project Report Number C01294) (Unpublished)

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

COUNTRYSIDE SURVEY 2000

FIELD HANDBOOK

MODULE 2: SURVEY OF FRESHWATER HABITATS

M T Furse, F H Dawson, P Henville, G P Irons, R J M Gunn and J M Winder
Institute of Freshwater Ecology
River Laboratory
East Stoke
Dorset BH20 6BB

Version 2.0, 8th June 1998

1 INTRODUCTION

1.1 The Historical Background

Land use studies may be classed in terms of: data collection and monitoring; land management interactions; land optimisation; and prediction. The first of these is essential in order to update land use databases and to ensure that the outputs from the other activities are both current and relevant.

NERC has carried out three major surveys of GB to sample data from the natural environment; all were based on the application of the ITE Land Classification System. The first was in 1977/78 with an emphasis on recording ecological data, especially vegetation and soils. The second was in 1984 and concentrated on the mapping of land cover and landscape features. The third, Countryside Survey 1990 (CS1990), recorded all the features of both previous surveys and included collections of aquatic macro-invertebrates for first time.

In all surveys, a sample unit of 1 x 1 km square has been used. In 1978, eight squares were drawn from each of the 32 ITE Land Classes giving a total of 256 sites; this was increased by 50% in 1984 so that 12 squares were visited in each class (384 sites in total and including those squares surveyed in 1978). In CS1990, a total of 508 squares was surveyed being a repeat of the earlier samples and the additional squares were allocated in proportion to land class size. Of these squares, 361 were successfully sampled in 1990 for aquatic macro-invertebrates of running watercourses.

Data collected from these surveys have been used to characterise the land classes, leading to a better understanding of the classification and to its wider use as a stratification for ecological sampling. A comparison of the land cover and landscape data from the two surveys has allowed quantitative assessments of recent changes in the countryside.

Analysis of land cover and landscape data from 1978, 1984 and 1990 suggests that changes are continuing to take place in the countryside. It is important to provide current datasets for scientific evaluation of ecological systems in the countryside, and to monitor the changes that are taking place to identify current trends and processes. NERC is committed to monitoring changes in the rural environment and 1998 is seen as an appropriate date for re-survey.

CS1990 was reported in 1993 and provided much needed information to Government departments and their agencies, non Government organisations and others involved in the formulation of countryside policy. For example, the Hedgerow Incentive Scheme (which pays farmers to manage hedgerows) was introduced following publication of the survey results. Subsequently, departments have started to use Countryside Survey data to help fulfil obligations in relation to:

- UN Rio Declaration and Agenda 21 (UK Sustainable Development Strategy 1994; Indicators of Sustainable Development 1996)
- UN Convention on Biological Diversity (UK Biodiversity Action Plan 1994; Steering Group Report 1995; Species/Habitat Actions Plans)
- EU Habitats and Species Directive (SACs, SSSIs/ASSIs)
- EU Reform of Common Agriculture Policy (Agri-environment schemes, ESAs, Countryside Stewardship)
- UK Environment White Paper 1990
- UK Rural White Paper 1995.

In particular, the Rural White Paper (England) 1995 includes the following important statement:

"The Government will carry out a repeat of Countryside Survey in the year 2000."

NERC (ITE and IFE) will conduct a further sample survey in 1998 (as part of CS2000) to collect land cover, landscape and vegetation data from sites visited in previous years. This project will adopt the approach used in previous NERC surveys, but will be enhanced by the inclusion of additional research activities, information capture at a greater level of detail, and increased research collaboration and liaison. The sample number will be increased by 60 additional sites to 568. In particular, the project will contribute to the capture of land use data using satellite imagery and a land cover map of Britain will be constructed. This will be especially valuable in linking the "top-down" remote sensing approach with the "bottom-up" field survey, through the ITE Land Classification System. This two-tier approach will provide additional ground-truth data, allow wider projection of the field survey results and will enhance the detection of pattern in the landscape.

An important lesson that has been learned from previous NERC surveys is that variation in field procedures is a major contributory factor when assessing the statistical accuracy of change data. It is therefore important that every attempt is made to standardise procedures between observers and, during CS2000, quality control will be undertaken in several ways to maintain consistency of approach. A thorough knowledge of a clear and informative Field Handbook is a vital prerequisite.

The purpose of this Handbook is to set out guidelines to be used during survey. Inevitably circumstances will arise which are not fully covered here; it is important that field procedures should be as consistent as possible. Where atypical or doubtful circumstances arise, surveyors are instructed to contact senior staff at the IFE River Laboratory for further instructions if possible. If this is not possible then explanatory notes on the special procedures adopted should be written at the foot, or on the reverse of the 1:10,000 scale site maps provided.

1.2 The Sampling Framework

During the planning stages of Countryside Survey 2000 (CS2000) there has been consideration of sample numbers in connection with several of the component modules. This has involved re-assessment of the existing (CS1990) sample as well as the need for additional 1 km squares.

In the development of CS2000 Module 1 (Survey of broad habitats and landscape features), funded jointly by DETR and ITE, ITE have addressed two main issues:

> *Issue 1 - there is a need to re-sample previously surveyed squares to maintain the time-series data set, and to obtain details (flows) of change between dates.*
>
> *Issue 2 - there is a need to report on "country units" (a. Scotland and b. England with Wales) separately, using only squares which lie in the country for which estimates are to be made.*

1.2.1 Issue 1: Development of the existing ("core") sample

In CS1990, 508 1 km squares were sampled in England, Scotland, Wales and the Isle of Man. The sample of squares was drawn at random from a grid of squares in the 32 ITE Land Classes. These classes were created using underlying environmental attributes and crossed country (E, S and W) boundaries. Country estimates were derived from the mean characteristics of all squares in each class, irrespective of their country location.

It is intended to re-survey all 508 squares that were visited in 1990, except two on the Isle of Man for which replacement mainland sites will be selected..

1.2.2 Issue 2: Selection of new sites for country unit estimates

ITE have selected 30 additional survey squares in order to assist with this requirement.

1.3 Further Information

Further information on the background to the survey of freshwater habitats in CS1990 and CS2000 can be obtained from the Institute of Freshwater Ecology, River Laboratory, East Stoke, Wareham, Dorset, BH20 6BB and on CS1990 and CS2000 in general from the Institute of Terrestrial Ecology, Merlewood Research Station, Grange-over-Sands, Cumbria, LA11 6JU.

2. PLANNING SITE VISITS

The IFE field surveyors will visit each of the 1km squares identified in advance by the IFE Project Leader as having a permanent or intermittent watercourse present in it.

Each square will previously have been visited and surveyed by an ITE field team. The visit by IFE surveyors will take place within four weeks of the ITE visit whenever feasible. The ITE teams will have fore-warned landowners that a follow-up visit by IFE will take place.

ITE have site co-ordinators in each of their six major laboratories and each will be responsible for the management of several pairs of field surveyors operating from that base station. Co-ordinators will maintain records of the squares that have been surveyed and any problems or deadlines encountered.

In order that IFE may be kept informed of the progress made by ITE surveyors the following information has been requested from the six co-ordinators:

- Lists of all survey squares completed (weekly if possible please)
- Lists of squares or part squares where access has been denied (as occasion arises)
- Information on specific dates on which surveying must take place or must be completed or dates when the square, or part of it, must not be accessed (as occasion arises)
- Plot sheets from all Field Assessment Booklets (FABS) of new squares (i.e. not repeat squares from 1990) showing the position of the streamside W and S plots, (as the new squares get completed)
- Updated plot sheets of landowners with their addresses and/or telephone numbers (weekly please)

The freshwater survey of each square is reckoned, on average, to take about two hours to survey. The day-to-day working arrangements are in the hands of the IFE Survey Co-ordinator (Hugh Dawson) and will be guided by the following principles:

- The survey teams are expected to be reasonably flexible in their working arrangements and, similarly, the Survey Co-ordinators will be sympathetic to requests for leave of absence for special occasions, when possible.
- Travelling time is expensive both in terms of overall project time and finance. Every attempt should be made to avoid returning to a site more often than is necessary, even if this involves some evening work. There will be no overtime payments but any large accumulations of overtime will be compensated by 'time off in lieu'.
- The costing of the project is based on some of the squares being surveyed on a daily travel basis (with no overnight subsistence). Surveyors are expected to use day travel whenever it is reasonable to do so.
- There are at least three ways of planning survey arrangements e.g. (i) daily travel from the River Laboratory or CEH Bush for local squares (ii) one week away for

a small number of squares or (iii) two or three weeks away for a larger group of squares (with work being undertaken at weekends, by arrangement).

To minimise variation between surveys due to seasonal differences, previously visited squares will be surveyed in the same order as was done in 1990. New squares will be surveyed at the same time as their nearest neighbour (as resources allow).

3 EQUIPMENT

The equipment required to undertake the freshwater survey is listed in Table 3.1.

Table 3.1 List of survey equipment

Item	Per team	Per person	Personal items
Health and Safety			
Mobile telephone	✓		
First Aid Kit	✓		
Rucksacks	✓		✓
Personal waterproof clothing			✓
Sun hat			✓
Sun cream			✓
Insect repellant	✓		
Whistle		✓	
Torch	✓		
Survival blanket	✓		
Hard hat	✓		
Life Jacket and spare CO_2 cylinders	✓		
Bactericidal soap and tap water	✓		
Protek anti-septic cream	✓		
Antiseptic wipes		✓	
Hand gloves		✓	
Shoulder length gloves	✓		
Penknife	✓		
Means of identification		✓	
Letter of authority		✓	
Navigation and location			
Global Positioning System (upland squares)	✓		
Spare batteries for GPS and torch	✓		
Compass	✓		
Road atlas	✓		
Maps to locate sites (1:50,000)	✓		
Maps of the site (1:10,000)	✓		

Table 3.1 (continued)

Item	Per Team	Per person	Personal items
General			
Waders		✓	
Pens, pencils and rubber	✓		
Magic Markers/broad felt tip pens	✓		
Scissors	✓		
Waterproof labels	✓		
Clipboards		✓	
Storage trays (grey plastic)	✓		
Camera and spare film and batteries	✓		
Paper towels	✓		
Macro-invertebrate (RIVPACS) sampling			
Survey sheets (for RIVPACS environmental	✓		
Two pond-nets with graduated handles	✓		
18" x 12" plastic bags	✓		
1.3 litre polythene pots with tight fitting lids	✓		
PVC tape for sealing pot lids	✓		
Formaldehyde	✓		
Stop watch	✓		
River Habitat Survey			
Survey sheets	✓		
Laminated spot-check key	✓		
Range poles	✓		
Site notice boards	✓		
Chalk	✓		
Range finders	✓		
9" x 7" resealable plastic bags for plants	✓		
Floras	✓		
Alder Survey			
Guidance leaflets	✓		
Diatom survey			
Plastic trays	✓		
Toothbrushes	✓		
Teaspoon	✓		
150ml sample bottles	✓		
Buffered formaldehyde (pH 7)	✓		

Table 3.1 (continued)

Item	Per Team	Per person	Personal items
Chironomid pupal exuviae survey			
Hand-net	✓		
12" x 8" plastic bags	✓		
Chemical survey			
Filter holder	✓		
Filter papers (0.45mμ cellulose membrane)	✓		
Syringe	✓		
Spare gaskets for filter holder	✓		
Forceps	✓		
Fine black marker pen	✓		
IGLOO storage box	✓		
1l bottle for water sample	✓		
150ml acid washed water sample bottle	✓		
150 ml decon washed water sample bottle	✓		
10ml blue capped water sample bottle	✓		

Surveyors are expected to look after the equipment, not least because much of it has to be used for other work or returned to the customer. If accidental damage does occur, then the surveyors should contact either the IFE Project Leader (Mike Furse) or Field Survey Co-ordinator (Hugh Dawson) before a replacement is purchased. All damaged equipment must be returned to the River Laboratory for inspection and possible repair.

4. GENERAL FIELD SURVEY PROCEDURE

4.1 Preliminary Procedures

On arrival at the square, surveyors should have a quick look round (where access permits), assess likely problems and generally acquaint themselves with the area.

Having assessed the nature of the square, the surveyors should attempt to confirm permission for access to the whole square, before commencing any part of the survey (see Chapter 5).

4.2 Distribution of Duties

The two ITE surveyors will be designated as person A and person B for the purposes of this section of text. **The following allocation of duties is a recommendation but may be varied according to local circumstances**

Surveyors A and B

Either or both of the surveyors may be involved in seeking permission for access from landowners.

The maco-invertebrate sample should be collected first and should be taken by surveyor B with the assistance of surveyor A. Surveyor B should next record the RIVPACS environmental data, again with the assistance of surveyor A who may be consulted when determining the substratum cover composition.

The replicate macro-invertebrate sample, if required, should be collected next and should be located immediately upstream of the first sample. Separate environmental data should also be collected.

A total of 10% of sites will have replicate samples collected. In half of these, surveyor B will take both macro-invertebrate samples and in half the first sample will be collected by surveyor B and the second by surveyor A.

At replicate sites each surveyor should separately record the environmental data for the first sample and should not confer over substratum composition. The environmental data for the second sample should only be recorded by surveyor B.

At replicate sites, the head of the environmental form should be marked as either the first or the replicate sample and with the name of the surveyor recording the data. Thus the three forms would be separately marked in one of the following ways:

First sample. Surveyor B (give surveyor's name)
First sample. Surveyor A (give surveyor's name)
Replicate sample. Surveor B (give surveyors name).

It is not necessary to record this detail at non-replicate sites.
Surveyor A

Surveyor A should undertake the following tasks:

- the River Habitat Survey, including the diseased alder survey
- if she/he has completed the River Habitat Survey then she/he should assist surveyor B with any outstanding tasks
- collect replicate diatom, chironomid pupal exuviae and chemical samples at 5% of flowing water sites for quality control purposes

All chemical samples should be taken upstream of the macro-invertebrate sampling site to avoid collecting sediment disturbed by the macro-invertebrate sampling.

Surveyor B

Surveyor B will undertake all other sampling and data recording. At flowing water sites this includes:

- collecting the diatom sample
- collecting the chironomid pupal exuviae sample
- collecting and filtering the water sample
- collecting replicate diatom, chironomid pupal exuviae and chemical samples at a further 5% of sites (in addition to those listed above as sampled by Surveyor A) for quality control purposes

All chemical samples should be taken upstream of the macro-invertebrate sampling site to avoid collecting sediment disturbed by the macro-invertebrate sampling.

At dry sites Surveyor B will assist Surveyor A with the River Habitat Survey

4.3 Organising the Sampling and Surveying Process

Having established permission to sample the surveyors should first find the macro-invertebrate sampling point.

All other survey procedures relate to the this position.

Each surveyor should be aware of the range of the 50m section of watercourse which extends from 25m upstream of the centre of the macro-invertebrate sample area to 25m downstream of that point.

In section "U" of the RHS form, the River Habitat surveyor is required to record the impacts observed in this 50m reach as well as in the 500m survey section as a whole. The surveyor taking diatom and chironomid pupal exuviae samples will need to collect them from this 50m reach.

The location of the River Habitat Survey should have been selected in advance using information on the 1;10,000 and 1:50,000 maps provided and following the rules set out in section 6.3.3. The chemical sample should be taken before the diatom sample so that the distilled water from the water sample bottles can be retained for collecting the diatoms that are brushed or shaken from stream-bed particles or aquatic plants.

4.4 Photographs

Photographs are required of both the macro-invertebrate sampling point and the River Habitat Survey reach.

The two photographs have slightly different purposes.

The macro-invertebrate photograph will be used to re-locate the site for the next possible Countryside Survey and should be sufficiently wide angled and composed to show any prominent natural or man-made features that will identify the location accurately for future surveyors.

The chalkboard should be in the photograph and should be marked with the letter M (for macro-invertebrate sample) and the land class and square number and should be of the form:

The River Habitat Survey photograph should show the typical character of the river along the 500m survey section. The chalkboard should again be included but should now only show the land class and square number and hence be of the form:

Sometimes the same photograph can serve both purposes, in which case the chalkboard should be labelled as for the macro-invertebrate site (i.e the “M” should be shown. Record the photograph taken using the checklist on the back of the 1:10,000 site map.

5 PERMISSIONS

NERC and the project sponsors require that all surveys should be carried out with the knowledge and consent of the landowner or farmer or of the agent of one or both (collectively referred to as the landowner hereafter). There are several reasons why permissions to survey should be sought. The most obvious is to gain legal access to all parts of the square. It is also important to ensure the goodwill of the landowner, not only to avoid an embarrassing confrontation, but to gain useful background information (see Farmer/landowner Information Sheet) and to assist recording data.

By way of an introduction, letters have been sent to all known landowners saying that the survey is taking place and asking them to expect a visit from ITE surveyors. Separate letters have also been sent to 'the occupier' of farms which are likely to own land in the new sample sites.) Letters have also been sent to the Headquarters of all organisations which are likely to have interests (e.g. NFU, CLA, NT, FC, etc.).

The letters do not make specific reference to the follow-up visit by IFE staff but the ITE surveyors have been asked to do this verbally when they make contact with landowners immediately prior to their own surveying. However, IFE surveyors cannot assume that all landowners have been notified of their impending visit.

Letters and advance contact notwithstanding, landowners will also expect the IFE teams to call on the day to establish that they are in the area and confirm that the arrangements for survey are satisfactory.

An updated list of known names and addresses from the preceding ITE surveyors' visit will be provided to the IFE surveyors. They will also be provided with details of any problems or special requirements concerning access to land in any particular survey square.

Where the River Habitat Section extends beyond the boundary of the survey square the landowners may not be the same as those owning land within the square but IFE surveyors may be able to learn their identity from contacts with the landowners within the square.

It is very important that all necessary permissions are confirmed whenever possible before commencing survey.

Experience has shown that some form of permission can nearly always be gained on the day of survey, but surveyors may prefer to make some sort of prior contact (however this latter approach may lead to delays, letters, phone calls, etc.).

Every attempt should be made to contact farmers rather than their staff where appropriate but if no contact can be made the field surveyors should undertake the fieldwork. As a general rule, but especially if surveying without having made prior contact with the landowner, the field surveyors should make themselves and their purpose known to anyone they encounter during surveying who appears to have a reasonable right to know this information.

Surveyors should always carry their means of identification.
If permission to access land is refused, the following procedures should be adopted:

1. If access is denied to all parts of a square then all attempts at field recording should be abandoned and reports made to the Survey Co-ordinator as soon as possible (a replacement square will be drawn at random).

2. If access is granted to the macro-invertebrate site but denied to parts of the River Habitat Survey section then the RHS should be abandoned, unless the area concerned is easily surveyed from the opposite bank where permission is available. Advice should be taken on who else might be informed of the survey as a matter of courtesy, e.g. anglers, shooting syndicates, grazing clerks.

Surveyors should be courteous and polite at all times and should always comply with the wishes or instructions of the landowners.

6 FIELD SAMPLING PROGRAMME

6.1 Background

The field sampling programme will comprise five elements, of which the following four elements will be undertaken by the IFE field surveyors:

- an aquatic macro-invertebrate survey
- a River Habitat Survey (incorporating alder disease and diagnostic chemical surveys)
- a diatom survey
- a chironomid pupal exuviae survey

In addition ITE surveyors will conduct an "Ecofact-type" macrophyte survey comprising the recording of the floral composition of up to five 10m x 2m stream river corridor transects in each survey square. Each transect will be divided into two adjacent 10 x 1m components, one running along the landward edge of the water course and the other instream of the water's edge.

The IFE surveyors will take samples in two types of 1km squares:

- squares previously included in the 1990 survey
- new squares included in the 1998 survey for the first time

The squares sampled in 1990 are themselves divided into two types:

- 361 squares successfully sampled for aquatic macro-invertebrates in 1990
- 42 squares which had no flowing watercourse in 1990 but which had marked watercourses shown on both the 1:10,000 and 1:50,000 (Landranger) Ordnance Survey maps.

The new squares to be surveyed in 1998 also comprise two types:

- A maximum of two replacement squares for squares from the Isle of Man which were included in the 1990 survey but excluded from the 1998 survey for logistic reasons
- A maximum of thirty squares added to the 1990 survey set in order to provide more reliable single country estimates of land cover and biological information

In total, IFE surveyors will sample/survey 435 1km squares for one or more of the component elements of the freshwater module of CS2000.

6.2 Field Maps

6.2.1 Information provided to field surveyors

IFE field surveyors will be provided with two enlarged copies of the 1:10,000 map of each 1km square to be surveyed. The two maps will show the following information

- the location of the aquatic macro-invertebrate sampling site
- the ownership of land within the square, including contact names and addresses

Each map will be marked with the land class number and square number of the survey square. The additional information provided on maps will vary according to whether or not the square was included in the 1990 survey.

Repeat 1990 square: The map will be marked in red with the location of the 1990 aquatic macro-invertebrate sampling site. This site will be labelled "M". In the 42 cases where all streams in the square were dry in 1990, the first preference aquatic macro-invertebrate sampling site will be the "M" site.

New 1998 square: The preferred macroinvertebrate sampling site will be marked "M". In case the "M" site is found to be dry and in order to maximise the number of squares in which macro-invertebrate samples are collected, reserve "M" sites will also be marked. These will be labelled "MR" and will be prioritised by numbers (i.e. MR1, MR2 ... MRn, in order of priority).

6.2.2 Information to be provided by the field surveyors

On the reverse of each map the field surveyors **must** complete the following information:

Name of sampler A: Invertebrate sampler		:
Name of sampler B: RHS Surveyor		:
Running watercourse present		: YES/NO*
Macroinvertebrate sample collected		: YES/NO*
Number of sample pots		:
Macroinvertebrate site code (eg M, MR, etc see map)		:
River Habitat Survey completed		: YES/NO*
RHS 50m section containing invert site (eg 1,6, 9 etc)		:
Diatom sample collected		: YES/NO*
No. of stones scaped for diatoms:	Boulders	:
	Cobbles	:
	Pebbles	:
or No. of emergent plants scaped (name species)		:
or No. of submerged plant bits shaken (name species)		:
or No. of spoons of silt/sand collected		:
or No. of handfuls of gravel washed		:
Pupal exuviae sample collected		: YES/NO*
Water sample collected		: YES/NO*
Invertebrate site photograph taken		: YES/NO*
Separate RHS site photograph taken		: YES/NO*

* Delete as applicable

Additional information is required for replicate sites, confirming that all the additional samples have been collected.

On the map itself the field surveyors should mark the following information:

- the upper and/or lower limits of the RHS using symbols "U" and "L" respectively
- the location of the diatom sampling site using the symbol "D"
- the location of the chironomid pupal exuviae site using the symbol "C"

RHS: Because the RHS section may extend beyond the limits of the 1km map it may not be possible to mark both the upper ("U") and lower ("L") limits of the section. In a small number of cases neither the upper nor lower limit of the section may be in the survey square. In these cases

the upper limit should be marked in pencil on the appropriate 1:50,000 OS maps provided to the surveyors for square location.

Diatoms: A single "D" should indicate the centre of the diatom sampling site.

Exuviae: The pupal exuviae may be collected from more than one location within the stipulated distance from the macro-invertebrate sampling site. The mid-point of the pupal sampling section should be marked with a single "C".

At replicate sites only the position of the first samples should be marked.

6.3 Sampling Procedures

6.3.1 Health and safety

Field surveyors have been provided with a range of equipment, including Proteks anti-septic cream, in order to promote their safety during field work. These should be carried during all field visits and used as appropriate.

Field surveyors should maintain regular, pre-arranged contact with the IFE River Laboratory in order that their progress and location is known. Mobile telephones are provided for this purpose.

Sites first sampled for macro-invertebrates in 1990 were considered to be safe to sample at that time. However conditions may have changed since that time. Recommended sampling locations for the new squares have not previously been visited. The field surveyors should not undertake sampling in any location which they consider to endanger their health and safety. In such circumstances they should contact the IFE River Laboratory as soon as possible to provide details of their decision.

Where the depth of watercourse and/or substratum renders wading in the watercourse too dangerous for sampling, macro-invertebrate samples should be collected from the riverbank, if safe, using recommended procedures, and diatom sampling should be abandoned.

The appropriate IFE codes of conduct are provided at the end of this handbook.

6.3.2 Macro-invertebrates

General

A single macro-invertebrate sample should be collected from a location marked on the 1:10,000 map of the survey square. This would normally be at location "M" except that, if this location is dry the sample may be taken from a reserve site at the new 1998 squares only.

At the new 1998 squares the map will be marked with the single letter "M" at the preferred sampling point. If this site is found to be dry when visited by the surveyors then they are requested to visit each of a set of reserve sites in numerical order until a running water course is found. Reserve sites will be marked as MR1, MR2 etc on the field map. If all sites are dry then the RHS should be conducted on a section of river including the preferred macro-invertebrate sampling point "M".
Sampling should not take place at any location not marked on the the map.

Sampling should only take place if the watercourse has continous flow or standing water over a section of watercourse extending from 25m above the sampling site (or the normal source of the

stream, if shorter) to 25m below the sampling site (or to the confluence of another flowing watercourse, if shorter). **If this situation does not pertain then the sampling site should be considered dry.**

Field surveyors will have received training in the collection of macro-invertebrate samples and associated environmental data prior to field surveying.

Full details of the macro-invertebrate sampling techniques and associated field environmental data collection are given in Appendix 1. These are taken directly from the following protocol document:

Murray-Bligh, J A D, Furse, M T, Jones, F H, Gunn, R J M, Dines, R A and Wright, J F (1997) Procedure for collecting and analysing macroinvertebrate samples for RIVPACS. Joint publication by the Institute of Freshwater Ecology and the Environment Agency, 162pp.

The key features of the macro-invertebrate and environmental sampling techniques are as follows:

Macro-invertebrate sampling

For the purposes of macro-invertebrate sampling the *sample area* **must be** a single area of stream-bed whose major habitat types can be sampled within the recommended sampling period. It will normally vary from 5 to 15m according to stream width. It **must not be** a collection of separate sampling points within an extended length of river, for instance to include both riffles and pools in an attempt to increase the variety of animals captured.

The sample shall be collected using a standard FBA pond-net of the type provided. None of the pre-selected sample sites will require sampling by dredge sampler or corer.

The sampling duration shall be three minutes of active sampling supplemented, where circumstances permit, by two forms of manual search (Figure 6.1)

The objective of sampling shall be to obtain the widest range of animals possible from within the sample area by sampling all accessible habitats in proportion to their relative areas of cover (Figure 6.1). Note that, because pond-netting will be used for all sample collecting, main sampling method C (Figure 6.1) varies from that given by Murray-Bligh *et al.* (1997).

On completion of sampling, the sample should be emptied into a medium guage, 18" x 12" polythene bag as provided. Intermediate emptying of the net after each minute's active sampling is strongly recommended and is essential if the net becomes so full as to preclude efficient sampling.

40% formalin solution, as provided, should be added to the sample bag until the liqour in the bag is equivalent to 4% aqueous formaldehyde. The precise amount of formalin needed varies from sample to sample but is in the region of 50 - 100ml per plastic bag. It is better to err on the side of excess.

Figure 6.1 Summary of sampling procedures (modified from Murray-Bligh *et al*., 1997).

1st part: MANUAL SEARCH

Seek and collect individual animals from the water surface.

Spend a total of one minute on the manual search, split between parts 1 and 3

↓

2nd part: MAIN SAMPLE

Collect by either A, B or C

A - shallow/wadeable

3 minute active pond-net sample collected by a combination of kicking and sweeping, depending on the nature of the substratum, current and habitats, for benthos and free-swimming animals.

All habitats sampled in proportion to their cover.

B - too deep to kick sample whole site, but possible to sample at least some of the main channel with a long handled pond-net

3 minute active pond-net sample collected by a combination of kicking and sweeping for benthos and free-swimming animals.

Attempt to sample all habitats in proportion to their cover, although this may not be possible for habitats in the main channel

C - impossible to sample material from the main channel using a long-handled pond-net

3 minute sweep with pond-net to collect free-swimming animals and those from vegetation, *but not the benthos*.

↓

3rd part: MANUAL SEARCH

Search and collect individual animals from submerged rocks, logs or vegetation.

Spend a total of one minute on the manual search, split between parts 1 and 3

A clear pencil-written label should be placed in the sample bag. The label should contain the following information:

type of sample: "macro-invert"
square number: land class/square number (e.g. 7/38, 31/1028 etc)
date : day-month-year (e.g. 07-08-98, 01-10-98, 12-06-98 etc).

At replicate sites the labels should also include either "first sample" or "second sample" as appropriate.

The plastic bag should be firmly tied and placed inside a 1.3 litre storage bottle (as provided) and the lid of the bottle tightly closed. A extra sharp twist of the lid is then recommended. Apply PVC tape around the lid to form a seal and to prevent the lid becoming loose during transport.

The bottle should be clearly labelled on the outside, using a black magic marker (provided), with the same information as given on the internal label.

The sample may be split into two or more bags/bottles if too large to fit within a single container. All parts of the sample should be labelled as above, together with the additional information "Part one of two" or "Part two of two" or "Part one of three" etc. Samples should very rarely require more than one container. Single containers should be adequate for the large majority of sites.

THOROUGH LABELLING OF SAMPLES IS ESSENTIAL

Surveyors should take at least six polythene bags, two sample pots and two bottles of 40% formaldehyde to the survey square in case the inveterbrate sample is very large. Twice this number of items should be taken to replicate sites.

For transport, samples should be stored upright in the grey stacking trays provided.

Environmental data collection

Environmental data should be recorded for each macro-invertebrate sample. The special circumstances for replicate sites are given in section 4.2 and must be thoroughly read and understood..

For the purposes of environmental data collection, the sample area is defined as the full width of the watercourse for the full length sampled for macro-invertebrates.

The significance of the different definitions of *sample area* given for macro-invertebrate sampling and environmental data collection is that sections of the watercourse too deep for invertebrate sampling are, nevertheless, included in width depth and substratum evaluations.

The environmental data shall be entered on the sample area form (Figure 6.2). The following instructions apply:

River Name : To be filled in later at the River Laboratory
Site Name : To be filled in later at the River Laboratory

Figure 6.2 The form for recording environmental data in the macro-invertebrate (RIVPACS) sample area

All other information to be filled in by the surveyors in the field

Square number: Use the format 28/1041, where 28 is the land class and 1041 the square number.

NGR : Use an eight digit numeric National grid reference (nine digit in the extreme north) locating the site to the nearest 100m east and north.

Sample date : Use the format: day-month-year (e.g. 07-08-98, 01-10-98, 12-06-98 etc)

Sample method: Enter either:

Kick/sweep	=	disturbing the substratum with feet plus sweeping amongst plants
Kick	=	Substratum disturbance but no sweeping
Sweep	=	Sweeping amongst plants but no substratum disturbance
Other		Specify (category unlikely to be needed)

Sample time : Enter time of active pond-netting (i.e. exclude search time). In almost all or all cases the time will be three minutes

Photograph : A photograph is required of each sampling site. The photograph should include a numbered site board. If possible it should also include a fixed natural or man-made feature of the site which can be helpful in re-location.

Proportionality: Answer no if the full width of the river for the full length of the sample area is not sampled. Only a simple explanation is required (e.g. "Not left-hand-bank. Too deep". NOTE: left/right banks are determined looking downstream).

The following measurements must be made at a point along the sample area which is typical of that area (i.e. represents the modal condition). The graduated pond-net handle can be used for width, depth and surface velocity measurements.

Water width : The full width of water in the sample area, not the channel width should be recorded. (For full details see Appendix 1, Section 2.6.1).

Water depth : Three measurements are required at quarter, half and three-quarter width. For consistency it is recommended that all measurements are taken starting from the right-hand-bank (looking downstream). (For full details see Appendix 1, Section 2.6.2).

Surface velocity The measurements refer to the typical surface velocity in the main flow channel. Dead water areas and atypically fast flowing areas should be avoided. (For full details see Appendix 1, Section 2.6.5).

Substratum : Visual estimates of four categories of particle size are required (Figure 6.3 provides guidance on particle size allocation). Estimates must be based on a bird's-eye view of the superficial stream-bed layer and should include both particles which are visible and those which would be visible in the absence of plant-growth.

Figure 6.3 Guide to substratum particle sizes

The percentage cover of the stream-bed occupied by each of the four size categories should be recorded. **THE FOUR VALUES SHOULD ALWAYS TOTAL 100%.**

Estimates should exclude bedrock which is recorded on a separate part of the recording form.

A peat stream-bed should be recorded as silt.

Clay can either be areas of soft fine particles or a continuous sheet.

Fuller details of the methodology of recording are given in Appendix 1, Section 2.6.3 and give guidance on when to record silt as present and how to deal with deep or discoloured watercourses where the stream-bed is not visible. It also contains a practice sheet for estimating percentage cover.

Other habitats : The percentage cover of four other categories of habitat are required for the full width of the sample area for the full length sampled biologically:

BEDROCK: Enter the proportion of the total stream-bed in the sample area covered with bedrock. Include areas under plant growth.

FILAMENTOUS ALGAE: Enter the proportion of the total stream-bed in the sample area obscured by filamentous algae. This category excludes diatom growth on stones.

MOSS: Enter the proportion of the total stream-bed in the sample area covered by mosses of all kinds.

HIGHER PLANTS: Enter the proportion of the stream-bed in the sample area covered with, or obscured by all kinds of plants other than algae and mosses.

6.3.3 River Habitat Survey

General

The River Habitat Survey, including the alder disease survey and chemical sampling, will follow the standard national protocol adopted by the Environment Agency and given in the following publication:

Environment Agency (1997) River Habitat Survey. 1997 field survey guidance manual, incorporating SERCON. Unpublished Environment Agency Manual.

This manual is reproduced almost in its entirety in Appendix 2.

The only modification to the standard procedure is in section U of the page headed "Additional SERCON Component". In the revised format (Figure 6.4) impact categories 7, "Channelization",8 "Management for flood defence" and 9, "Man-made structures"are sub-divided and category 12, "Others" are added to match the categories used in the 1990 Countryside Survey. The presence of these features must be recorded for the 500m section as a whole and also for the 50m length of watercourse 25m either side of the centre of the macro-invertebrate sampling area. containing the macro-invertebrate sampling point. This is also to provide continuity with 1990.

Figure 6.4 The revised "SERCON" form for River Habitat Survey.

Sampling procedures

The River Habitat Survey section will be of 500m (wherever possible) and will be centred (wherever possible) on the selected macro-invertebrate sampling site "M" (or one of the reserve sites, "MRn"). The survey will be undertaken irrespective of whether there is flow or not in that section of the watercourse and, hence, whether or not a macro-invertebrate sample was collected.

In some circumstances it may not be possible to centre the survey on the macro-invertebrate sampling site nor to survey a full 500m. A number of reasons for this are envisaged and rules for dealing with each circumstance have been devised (Figure 6.5).

Field surveyors should seek advice from senior IFE staff if any other circumstances are encountered.

Chemical sampling

In line with standard IFE procedures a single chemical sample will be taken during the River Habitat Survey. The sample will be collected at the macro-invertebrate sampling point using the following procedure:

Before taking the sample, rinse the 1 litre sample wide-neck bottle 3 times with river water taken from a flowing area of the survey site. At subsequent sites wash the bottle in a similar manner at least 3 times before taking the sample.

Filter sample on site, use the site name board or closed clip board to act as stable clean surface for bottles.

Filtered sample requirements:

1 x full sample bottle (60 – 150 ml) for pH conductivity, alkalinity and soluble phosphate,
1 x sample bottle in sealable plastic bag for trace metals, this may be only partially filled
1 x 10ml blue-capped tube for major cations.*Stage 1: Labelling of sample bottles*

- All sample bottles should be labelled externally, before becoming wet) using a black magic marker, with the land class and number of the survey square (e.g 1/6). At replicate sites bottles should be labelled either "1st" or "rep".

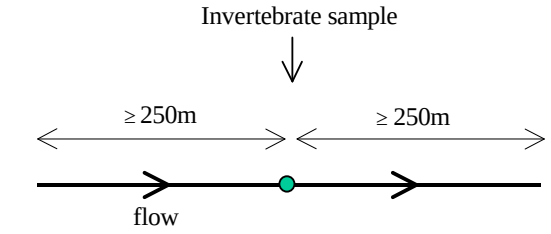
Stage 2: Assembly of filtration apparatus

Unscrew filter holder, <u>ensure that the "O" ring in each half is present</u> [this is very important, as if they are absent a good seal is not made and the resultant filtrate will be useless].

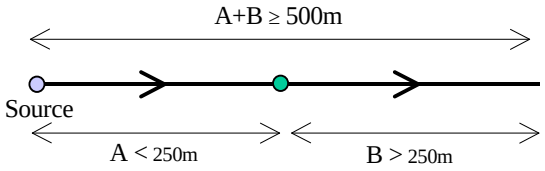
- Rinse both halves of filter apparatus with distilled water from one of the sample bottles
- Centre a filter membrane on the lower threaded half of the filter using a pair of forceps.
- Screw the two halves together making a tight seal against the "O" ring.

Do not use any form of grease on filter holder threads or "O" ring.

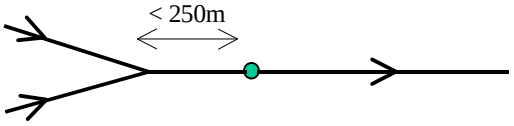
Figure 6.5 Instructions on surveying standard and non-standard watercourses.



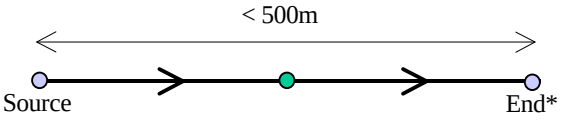
No problem. Standard RHS.



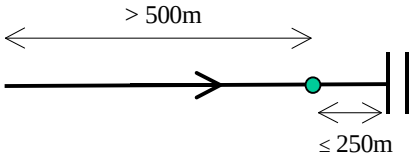
Survey from source for 500m downstream.



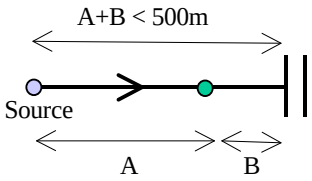
Survey strongest upstream tributary. If equal strength, take Right hand trib. looking u/s.



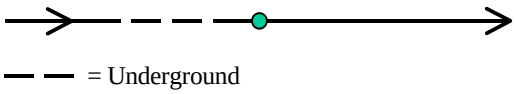
Sample available length.
*Either sea or the end of a drain.



Survey from confluence u/s for 500m.



Survey from the source along the watercourse and then down the big river to a total survey length of 500m.



The underground section will be part of the 500m survey section. Assume the underground section flows in a straight line between disappearing and reappearing and record it as culverted.

Figure 6.4. Instructions on surveying standard and non-standard sections of watercourses.

Stage 3: Distilled water rinse x 2 (to wash filter medium)

- Remove cap from the sample bottle and place rim up, on the stable surface, to avoid contamination

- Using the syringe draw up distilled water from the sample bottle

- Insert the syringe into the inlet marked 'top', then with outlet over sample bottle gently exert pressure on the plunger

Do not exert excessive pressure as this might rupture the filter.

- Discard the filtrate, repeat procedure once more.

Stage 4: Filtering field water sample.

- Empty the distilled water from the sample bottles, shaking downwards bottle to remove the majority of residual water

- Fill the syringe from 1 litre water sample bottle and filter as above into the empty sample bottles, rinse and discard this filtered water. Repeat this twice for each bottle

- Filter the sample bottles to brim, and the 10 ml vial to the 10 ml graduation, screw tops on tightly.

IF filter become blocked change the filter membrane by repeating procedure from stage 1.

After filtering, check the filtered sample for suspended material eg. from a ruptured filter paper

IF suspended material present repeat from stage 1.

Stage 5: Transportation of sample bottles and storage of filtered samples.

- Keep unused bottles clean eg. in plastic box

- Avoid contamination by mud from boots or clothes

- Place filtered samples with freezer pack(s) in insulated "IGLOO".

6.3.4 Diatom survey (TDI)

General

A single diatom sample will be collected, where possible in each watercourse sampled for aquatic macro-invertebrates.

The sample should be taken within 25m of the macro-invertebrate sampling point and preferably upstream of that point in order to avoid the impact of the disturbance of macro-invertebrate sampling upon the diatom sample.

Sampling procedures

Pages 31 – 33 have been intentionally removed

[If none of the preceding substrata are present then, as a last resort, the diatoms should be sampled from gravel (>2mm - 16mm).

Sample five replicate handfuls of gravel selected at random from throughout the collection area. Try to collect superficial gravels to avoid collecting additional silt.

The first handful should be placed in a white tray containing approximately 75 ml of either stream or distilled water. The diatoms should be removed from the stem by stirring. Alternatively the gravel could be shaken in a polythene bag containing a little stream or distilled water

Remove the gravel from the tray/bag and repeat the process for all the other strands. Transfer the water from the tray/bag (which should now be brown and turbid due to the presence of diatoms) into the 150ml sample jar using the hand-net first to filter out larger particles].

6.3.5 Chironomid Pupal Exuviae Technique (CPET) Survey

General

A single chironomid pupal exuviae sample will be collected, where possible, in each watercourse sampled for aquatic macro-invertebrates.

The sample should be taken within 25m of the macro-invertebrate sampling point and preferably upstream of that point in order to avoid the impact of the disturbance of macro-invertebrate sampling upon the exuviae sample.

Sampling procedures

The following background information and sampling instructions, which have been amplified to meet the specific requirements of this survey, are taken from the standard protocol recommended by the system's devisor:

Wilson, R.S. (1996) A practical key to the genera of pupal exuviae of the British Chironomidae (Diptera:Insecta) with an account of the CPET method of water quality monitoring. 98pp., Wedmore: Wilson, self published.

"The collection of floating chironomid *[non-biting midge]* exuviae provides a sampling technique that is appropriate for slow and deep or shallow and fast rivers. It can be used on small streams under 1m wide and also on large rivers such as the Thames or Rhine. It is also easy to use on canals.

CPET is an analysis technique based on exuvial samples and is therefore capable of monitoring rivers from source to mouth. The data may be used to monitor whole rivers or river sections, over either a long or a short term.

CPET analysis may be used to evaluate the habitat diversity and ecological quality of a water body, and show base-line data as well as assessing the extent and type of pollutional stress. Characteristic exuvial assemblages are associated with certain forms of environmental stress.

When an adult chironomid emerges from the water and flies off, it uses the floating pupal exuviae as a launching platform. All the floating exuviae in a stretch of water are then moved by

wind and water currents to accumulate along the shore, or against obstructions such as weed-beds, where they may be collected with a fine-meshed hand-net *[as provided*]. As the exuviae are non-living, they accumulate randomly, and any one collection represents those exuviae which have emerged in the recent past. Moreover, as they are generally indistinguishable from the other flotsam (e.g. leaves, twigs etc) that accumulate in similar places, there is no operator bias in collecting them.

All that is required is to collect a sufficiency of flotsam to include at least 200 exuviae."

In practice the following procedure is recommended:

- identify accumulations of flotsam in backwaters, eddies, along the water's edge or amongst macrophyte growths
- using the hand-net provided make five separate, continuous, five second sweeps amongst the flotsam (use 5 x 2sec pond-net sweep if flotsam otherwise out of reach)
- after each sweep, tip the collected material into a 12" x 8" polythene bag (as provided), or a larger 18" x 12" bag as provided for macro-invertebrate samples, invert the hand-net a shake vigorously
- it is not necessary to shake off every last exuvium or piece of flotsam, but wash the hand-net thoroughly in the stream after sampling to avoid cross-contamination of sites
- add a small quantity 10-25ml of undiluted formalin solution, as provided for fixing the macro-invertebrate sample
- place a clear, pencil-written label in the sample bag. The label should contain the following information:

  type of sample: "pupae"
  square number: land class/square number (e.g. 13/438, 32/1152 etc)
  date : day-month-year (e.g. 01-09-98, 31-10-98 etc)

  At replicate squares the label should include either "first sample" or "replicate" as appropriate.
- tie the bag firmly, excluding as much air as possible, and place inside a second bag which should also be tied firmly to avoid leaks. Store the bags carefully in the grey stacking tray avoiding placing anything on them which might make them leak. Leaking bags should be stored in externally labelled ("pupae", "square no.") macro-invertebrate sample pots.
- store the sample in the same grey stacking trays used to store the macro-invertebrate samples

In order to obtain sufficient specimens the various five-second sweeps may need to be taken in more than one location within 25m of the macro-invertebrate sampling point

If no suitable flotsam can be found then the sampling should be abandoned - **but take note, the exuviae are much more numerous than you would believe possible and sweeping along any surface may bring a few specimens.**

6.3.6 General

Field survey teams are reminded that completion of all parts of the various field forms is required.

Remember that, even in the most difficult conditions, an educated "guesstimate" in the field will almost always be as good or better than a dummy value invented later, in the laboratory, by some-one who has never visited the site.

Remember too that it is easy to cross-contaminate samples from residual specimens retained on nets and toothbrushes from previous site visits.

Always wash pond and hand nets as thoroughly as possible after sampling at each site and also before sampling the next site.

Each toothbrush should only be cleaned thoroughly using the recommended procedure (Section 6.3.4: Sampling Procedures) before using at a subsequent site.

6.4 Quality Control

The following quality control measures will operate

- all surveyors undertaking River Habitat Surveys will be holders of the Environment Agency certificate for this technique
- all field surveyors will be trained in the techniques of macro-invertebrate, diatom, chironomid pupal exuviae and chemical sampling prior to undertaking the survey
- the component members of field sampling teams will be regularly swapped to make sure that teams to not start to develop different sampling techniques than each other
- ten per cent of all flowing water sites will have replicate macro-invertebrate, RIVPACS environmental, diatom, chironomid pupal exuviae and water samples collected from them
- half the replicate samples will be taken by the same surveyor who took the first sample and half by the alternate surveyor to test for inter- and intra-operator variability
- replicate samples will be checked early to identify poor performers, if any
- approximately 7% of River Habitat Surveys will be audited by re-surveying by experienced IFE staff

Appendix 1: Detailed field protocols for collecting RIVPACS compatible macro-invertebrate samples and associated environmental data.

Abstracted from:

Murray-Bligh, J A D, Furse, M T, Jones, F H, Gunn, R J M, Dines, R A and Wright, J F (1997) Procedure for collecting and analysing macroinvertebrate samples for RIVPACS. Joint publication by the Institute of Freshwater Ecology and the Environment Agency, 162pp.

Note: The original section numbering from the source document is retained in this appendix

2.6 Obtaining sample environmental data

All measurements of site environmental parameters relate to the conditions in the whole sampling area, i.e. the full width of the watercourse along the whole length of the sampling area, even if parts of it are inaccessible for sampling. The standard procedures described below must be used to collect these data to ensure its compatibility with RIVPACS.

When collecting environmental data, the objective should be to measure the modal conditions in the Sampling Area at the time of sampling. Avoid isolated features such as boulders or narrows, which would cause the measurements to be atypical of the Sampling Area as a whole. Choosing the best place to measure these is easier when the Survey Area is restricted to a relatively discrete range of physical conditions.

Some of the environmental measurements will have to be estimated if the stream is too deep or dangerous to wade across. The estimates must be actual values and not inequalities (such as >60 cm or 60+ cm).

2.6.1 Stream width

The stream width should reflect the predominant conditions in the sampling area. Measure the stream width at right-angles to the channel. Measure the width of the water surface, not the stream channel, and include water under overhanging banks; see Figure 2.5. If temporary islands form in the channel because of low flow, include them in the measurement. Choose a place to measure the width that gives an approximately modal value for the site. Alternatively, where the modal width is difficult to estimate and it is safe and easy to cross the river, an average of more than one measurement from the vicinity of the sampling area can be used, although this should not normally be necessary.

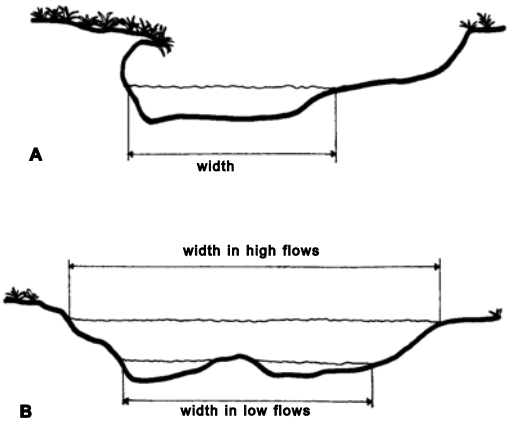


Figure 2.Measuring stream width: A, measure the width of the water, not the width of the channel, and measure water beneath overhanging banks; B, include gravel bars and other temporary islands when measuring width during low flows.

Where both banks can be reached by wading, use either a metre rule, an accurately marked pond-net handle or river-crossing pole, or a tape measure. Metre rules may be attached to a stout length of wood to act as a river-crossing staff. On wide or deep rivers, either estimate the stream width, making use of nearby bridges (although sites should not be in the immediate vicinity of bridges), or use a rangefinder that has been calibrated (see Section 3.4.7). Wherever possible, width should be measured rather than estimated. Guesses can be surprisingly inaccurate, even for narrow rivers. As a last resort, whilst standing near to the river bank, measure the distance to an object along the bank that appears to be as far away as the opposite bank. As a minimum, estimate widths of less than one metre to the nearest 10 cm; widths of between one and two metres to the nearest 20 cm; and widths between two and ten metres to the nearest 50 cm; and widths greater than ten metres to the nearest metre.

2.6.2 Depth

The depth should reflect the predominant conditions in the sampling area.

Depth should be based on the average of measurements from approximately a quarter, half, and three-quarter distance along a transect across the stream in the Sampling Area. Do not measure depth where it is atypical of the site, for instance over or close to boulders. In periods of low flow, the depth at a quarter and three quarters channel width will be measured closer to mid-channel than at other times. When a temporary island appears in mid-channel, the depth there will be zero, and should be recorded as such (see Figure 2.6). Where the stream is wadeable, record the depth to the nearest centimetre. Depth may also be measured against gradations marked accurately on a pond-net handle or river-crossing staff or against a metre rule with its narrow edge facing into the current. Although not mandatory, it is recommended that the individual measurements on which the average depth is based are recorded, so that changes in the cross-sectional profile can be detected: for this, the depths must always be measured along the same transect.

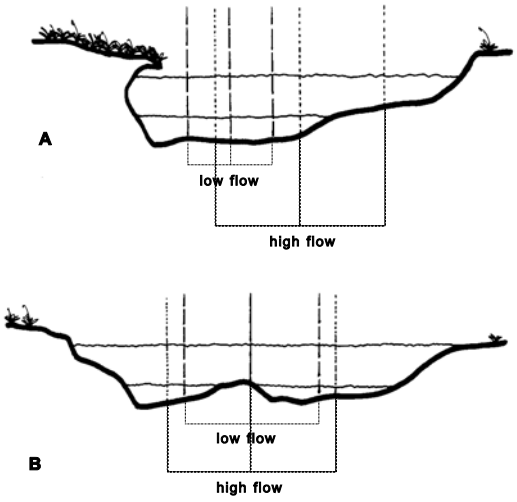


Figure 2.6 **Measuring stream depth**: A, position of depth measurements may vary with flow; B, the middle depth measurement may be zero in low flows if temporary islands such as gravel bars form.

Where the depth has to be estimated, record depths to 1 m to the nearest 10 cm, and greater depths to the nearest 50 cm. It is difficult to estimate depth in deep rivers. The predictive equations of RIVPACS are based on logarithmic values, so they are robust enough to withstand a reasonably wide range of error in the greater depth range.

2.6.3 Substratum characteristics

The composition of the stream bed must be assessed over the whole Sampling Area, i.e. the full width of river along the whole length sampled, even if someparts of it are inaccessible for sampling. Estimates should represent a bird's eye view. They should only include particles on the surface of the stream bed, including the equivalent superficial layers under macrophytes. A fine layer of silt or clay through which the shape of the underlying stones can be seen should be typed according to the underlying substratum, but if the shapes of the underlying stones are not distinct, the silt or clay should be recorded instead. Compacted clay should be recorded as clay, even when broken-up into gravel-sized fragments.

Record the percentage cover of the categories in Table 2.3, *ignoring areas of bedrock*. The sum of the four percentages must be 100%. The size categories can be marked on sample data sheets, clip-boards, or pond-net handles, for comparison in the field.

Table 2.3 Substratum particle size categories recorded for RIVPACS

Category	**Longest axis (mm)**	**Description**
silt/clay	<0.06	soft in texture and not abrasive to the hands when rubbed
sand	0.06 - 2	smaller than coffee granules, and unlike silt/clay, abrasive to the hands when rubbed
pebbles/gravel	2 - 64	coffee granule to half fist size
boulders/cobbles	>64	half-fist size or larger

Visual estimates of percentage cover are known to vary considerably between individuals. This variation can be reduced by experience. An individual can only gain this experience by comparing their estimates against a benchmark: only then will they know whether they tend make over- or under-estimates, and under what circumstances. Experience has shown that variability within teams can be reduced by all of them estimating percentage cover at the same site and comparing results. The only way to improve the accuracy (as opposed to the precision) of visual estimates of cover is to compare them against the results of measured surveys. Figure 2.7 may be used to test variability and accuracy. To do this, cut-out individual squares for each percentage cover from a photocopy of the diagram. Mix the 36 squares and estimate the cover on each. Compare the estimates with the true value. Multiple copies of the top right hand square of each block can be jointed together an arranged to represent cover at the edge or in the middle of a stream channel. This may indicate whether you are prone to over or underestimation, but is not a substitute for field exercises. Copies of the figure may also be attached to the back of notebooks or clipboards and used as an aid in the field.

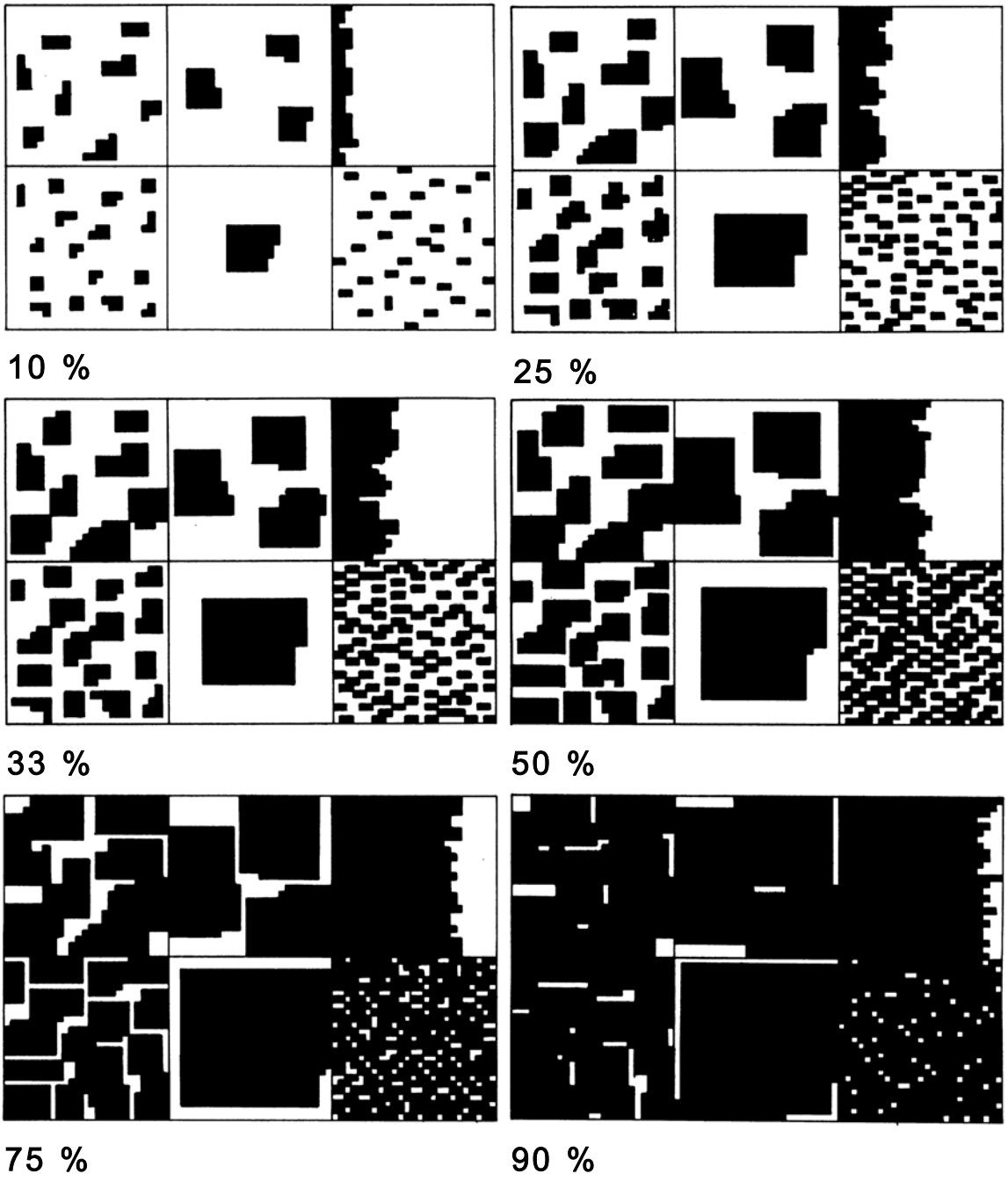


Figure 2.7 **An aid to determining percentage cover**. See text for guidance on using this figure; there is a slight imprecision in these diagrams owing to the thickness of the lines with which it was drawn, this can be gauged by comparing size of black squares in 10% with white squares in 75 or 90%.

Walk along the river bank and make a preliminary note of the substratum after any surface-living animals have been collected. These initial evaluations will be particularly useful at silty sites, and will be necessary for apportioning the sampling effort (see Section 2.7.1). After the rest of the biological sample has been collected, walk over the whole Sampling Area before making the final estimates. It is difficult to judge the composition of the river bed in deep or turbid water. The substratum visible at the water's edge, the feel of the stream-bed under foot, the contents of the sampling net, previously recorded data, and local knowledge may all be used as guides.

2.6.5 Current velocity

Current velocity must be measured only when information on discharge category is unavailable *[i.e Scotland and its offshore islands]*.

The measurements should refer to the surface velocity in the main flow channel. The time that it takes for a floating object (e.g. a leaf of a twig) to travel a known distance can be used to measure the velocity. A current meter is not required.

If the object is thrown into the current, measurements should not be started until initial inertia of the object is overcome. Results should be measured in cm s^{-1}.

For preference, the object should be measured over a 10 metre run with a relatively constant current speed. This may not be possible in small streams or where the character of the river changes rapidly. In this case, the same guiding principles recommending for selecting the position of depth measurements (Section 2.6.2) should also apply to current velocity, and the object can be timed against a metre rule. In practice, except in large uniform rivers, most timings are likely to be made over 1 m rather than 10 m, using a metre rule as shown in the RIVPACS sampling training video (National Rivers Authority, 1990).

It is important that current velocity is measured accurately as possible. Poor runs of the floating object should be discarded and the estimated category should ideally be based on the modal or median value of at least three timed runs on each visit. Wherever possible, sampling under spatey conditions should be avoided when surface velocity measurements need to be taken.Current velocities are recorded using the categories shown in Table 2.4.

Table 2.4 Velocity categories for RIVPACS

Velocity Category	current velocity (cubic metres per second)
1	≤ 10
2	>10 - 25
3	>25 - 50
4	>50 - 100
5	> 100

2.7 Collecting macro-invertebrate samples

2.7.1 General principle

The primary objective is to collect a **comparable** sample (comparable with RIVPACS predictions and with other samples collected by the procedures in this document), rather than examples of every taxon at the sampling site, or any other type of 'representative' sample. Comparability is ensured by strictly controlling the sampling procedure. Each invertebrate habitat in the Sampling Area must be sampled with an effort proportional to its cover. *Within the limitations imposed by this procedure*, as many different taxa in the Sampling Area as possible should be collected. On average, about 60% of families present will be collected in a single three minute kick sample, excluding the manual search (Furse *et al.*, 1981). Although the method is essentially qualitative, the standardisation is sufficient to justify the allocation the abundances of each BMWP taxon collected in a sample to logarithmic categories of abundance as a means of comparing one sample with another.

Wash the collecting net thoroughly before and after taking samples, and check that it is neither damaged nor contaminated with animals from previous samples.

Wherever possible, collect samples by sampling for three minutes with a pond-net and one minute of manual searching. The search is mandatory, although it will not always be fruitful. In deeper water where it is not possible to sample adequately with a pond-net, collect samples by three to five trawls of a medium naturalist's dredge, or a transect across the river with an air-lift, together with a one minute sweep of marginal areas with a pond-net, and a one minute manual search. A combination of kick-sampling and dredging is not permissible. The Sampling Area should not encompass such a wide range of features *along* the river that it includes both deep and shallow areas, see Section 2.3, though there may be this much variation *across* large rivers. A summary of the different sampling strategies and when they should be used is provided in Figure 2.8.

There is no limit to the size of the sample collected: only the sampling time or number of trawls controls the size of the sample.

The same procedure should be used for every sample from the same site whenever possible, to improve the comparability between successive samples and so make any changes easier to interpret.

Whatever sampling method is used, material collected in the net must be removed periodically, to prevent the mesh becoming blocked and the sample being washed-out. As a minimum, this must be done after every minute of sampling with a pond-net, and more frequently if the net is filling rapidly or becoming blocked. Wash fine sediment through the net more frequently than this, to minimise the amount retained in the sample. The dredge must be emptied after every trawl. Large stones and pieces of vegetation can be discarded, but before doing so, agitate them vigorously in the collecting net whilst it is half-submerged, to wash any animals back into it. Check that no animals are still attached before discarding this material.

Retain only enough water to keep the sample damp. This reduces the amount of fixative or preservative that has to be added to it, and reduces damage and the activities of carnivores in samples which are to be transported or sorted live.

Do not retain fish, amphibians, and readily identified rare species in the samples, such as large specimens of the freshwater pearl mussel (*Margaritifera margaritifera*) and crayfish, but return them to the water with care and unharmed. Record their presence in the sample. If removed live for identification, return them only to the site where they were collected.

1st part: MANUAL SEARCH

Seek and collect individual animals from the water surface.
Spend a total of one minute on the manual search, split between parts 1 + 3.

2nd part: MAIN SAMPLE

Collect by *either* A, B, *or* C.

A shallow/wadeable

3 minute pond-net sample collected by a combination of kicking and sweeping, depending on the nature of the substratum, current, and habitats, for benthos and free-swimming animals.
All habitats sampled in proportion to their cover.

B too deep to kick sample whole site, but possible to sample at least some of the main channel with a long-handled pond-net

3 minute pond-net sample collected by a combination of kicking and sweeping for benthos and free-swimming animals.
Attempt to sample all habitats in proportion to their cover, although this may not be possible for habitats in the main channel.

C impossible to sample material from the main channel using a long-handled pond-net

First sample the benthos
3 to 5 trawls with dredge covering all habitats; 1 trawl parallel to bank;
or
air-lift transects over all habitats;

followed by reducing material retained from the dredge

wash-out silt with dredge or pond-net; examine larger material and discard; split the material evenly; put no more than 3 litres into sample container(s); sort remaining material on the bank-side for additional taxa; record its proportion (for abundances) and discard;

followed by sweep
1 minute sweep (*not kick*) with pond-net to collect free swimming animals and those from vegetation, *but not the benthos*. Add the whole of this to the sample.

3rd part: MANUAL SEARCH

Search and collect individual animals from submerged rocks, logs or vegetation.
Spend a total of one minute on the manual search, split between parts 1 + 3.

Figure 2.8 Summary of sampling procedure *[see main text for CS2000 version table = 6.1]*

Retain voucher specimens of these taxa for identification and confirmation only when necessary. Bear in mind that it is particularly important to identify rare taxa correctly, and to differentiate native from introduced crayfish, because of their high conservation value and need for protection, so voucher specimens may be important.

The sample data must relate only to specimens that are actually caught. With the exception of the rare taxa mentioned above, all specimens must be retained in the sample for identification in the laboratory. Other taxa observed at the site but not forming part of the sample may be recorded in a note (this may be useful, for instance for conservation purposes), but they should not be included in the sample data itself.

Pond-net samples must not be collected from a boat, unless it is unsafe to do otherwise (this is the only acceptable caveat).

Avoid sampling during and immediately after spates *[if possible]*. Samples collected in these conditions will not accurately reflect the underlying environmental quality of the site.

2.7.2 Manual searching

The manual search is similar, whatever methods are used to collect the main sample. Unlike the main sample in which animals are collected without seeing them, individual animals seen by the sampler are collected in the search and added to the main sample.

The search is in two parts which together last one minute. The first part is to seek and collect animals living on the water surface, such as whirligig beetles, water crickets and pond skaters. This must be done before any other sampling, because these animals are easily disturbed and will either leave the Sampling Area or be much more difficult to find later. They are best caught with a pond-net. Most surface dwellers are very active and they should be secured in a tied bag or vial immediately after capture. Whilst searching for these animals, note the area occupied by different habitats within the Sampling Area, so that you can apportion the sampling effort amongst them in the main sample.

The second part of the search is for animals from habitats that are not sampled effectively by the methods use to collect the main sample. Pick-off animals attached or clinging to the submerged stems of emergent plants, rocks, logs, or other solid objects, with forceps or a stiff paint brush. Examine rocks at several places across the river to cover the different biotopes and areas covered by different sized substrata. Always search for animals attached to floating-leaved plants. Inspect the under-surfaces of floating leaves as well as the upper surface and stems.

The whole search must last one minute. It is standardised by time alone, and not by searching a certain number of rocks or locations. This period only covers the time spent actually searching, and excludes the time spent moving around the site. A stopwatch or watch with second hand must be used to ensure that the cumulative time spent actively searching is one minute. At some sites, the search will be fruitless, either because no suitable or accessible places to search are found within the minute, or because no animals are found in the places that are searched. Even where the sampler suspects that nothing will be found, the search must be undertaken honestly, to maintain consistency.

2.7.3 Pond-net sampling

The pond-net can be used in different ways depending on the nature of the Survey Area. Different biotopes at the same site may be sampled by a combination of the methods described below. The total sampling time must be three minutes.

If a site comprises discrete habitats, apportion the sampling effort according to their cover in the Sampling Area. If a site appears to be homogeneous in character, continuous diagonal transects will suffice for most of the sample.

Always move upstream and diagonally across the stream a number of times whilst sampling, rather than straight upstream. This will ensure that a greater number of habitats are sampled, even if they are not apparent, and therefore a higher proportion of the taxa present at the site are collected (see Woodiwiss, 1980).

The three minutes covers only the time spent actively sampling, and excludes the time spent emptying the net, or moving around the site. It is recommended that sampling is done in short bursts of 15-20 seconds. There will be 9 to 12 bursts in a three minute sample, which is worth remembering when apportioning the sampling effort to the different habitats. A stopwatch or watch with second hand must be used to ensure that the cumulative time spent actively sampling is precisely three minutes. If two people are on-site, it may be easier for one to time the sampling with the stopwatch so that the other can concentrate on collecting the sample. The sampler should call-out to the timekeeper when to start and stop the watch, and the timekeeper can remind the sampler when each sampling burst should end.

Pond-net samples collected with less effort, in an attempt to prevent denuding sites on very small watercourses, are not compatible with RIVPACS. A longitudinal extension of the site will be required in these streams.

In general, more material will be collected from lowland streams than from stony mountain streams.

2.7.3a *Kick sampling from gravel or cobbles*

When kick sampling, hold the net vertically with the frame at right-angles to the current, downstream from your feet, and resting firmly on the river bed; disturb the stream bed vigorously by kicking or rotating the heel of your boot to dislodge the substratum and the fauna within it to a depth of about 10 cm. Hold the net close enough for the invertebrates to flow into the net with the current, but far enough away for most of the sand and gravel to drop before entering the net. Hold the net further away where the substratum is finer or the current swifter, to prevent it clogging. Move large stones by hand if they cannot be shifted by foot, and sample the finer sediment that collects beneath them.

2.7.3b *Sampling from soft sediments*

Where the stream bed is soft silt or clay, kick sampling is ineffective because the net will become blocked rapidly. Instead, skim the bottom edge of the net gently through the top few centimetres of the substratum, which is where most of the animals will be found. Alternatively, stir-up the surface of the sediment by foot or with the back of the net, and pass the open net through the clouded water. Rinse the silt away through the net frequently, by agitating the net in the current or at the water surface.2.7.3c *Sampling from boulders*

It is not easy, and sometimes impossible, to take a kick sample amongst boulders. Most of the invertebrates will be in the finer deposits that accumulate under the boulders. To reach them, boulders may have to be moved by hand, though small ones may be prised away by foot. Move boulders away at right-angles to the current, or upstream and away from feet, so that the net can be held downstream from the area disturbed. Sample the exposed river bed by kicking in the normal way.

It is impossible to sample effectively where the stream-bed is dominated by large boulders, particularly near waterfalls or where the gradient is steep. Replace these sites by ones that can be sampled effectively.

Figure 2.9 Kick sampling from a shallow, fast-flowing stream. The sampler is facing at right angles to the current and is moving diagonally to the right and towards the photographer, for safety. The sampler is dislodging the substratum using his left foot and is holding the net close-by, in the plume of disturbed sediment, to capture the animals that are dislodged.

2.7.3d *Sampling from vegetation*

Sample from submerged and emergent vegetation and tree roots by pushing the net into them with a variety of forward, upward, and lateral movements. Dislodge animals from dense tangles of tree roots by kicking. Sample the sediment that accumulates beneath plants by kicking or skimming the surface of the sediment. Do not overlook water under overhanging banks, because invertebrates may be hiding there.

2.7.3e *Sampling from still or slow-flowing water over gravel or cobbles*

When sampling from still or slow-flowing water, a different procedure is necessary because there is no current is to carry dislodged animals into the net. Disturb the substratum with your feet and catch the dislodged animals by sweeping the net through the water immediately above the

disturbed area. Use this technique wherever the current is weak, to supplement the methods described above.

2.7.3f *Sampling from deep waters*

In watercourses that are too deep for a conventional kick sample, a sweep sample may be taken from the marginal vegetation and the shoreline with a pond-net, using an extension handle if necessary. This is preferred to using a dredge or air-lift, both of which are less easily controlled, and inefficient on very soft or detrital stream beds.

All habitats must be sampled *[where safe to do so]*. If possible, use a combination of sweeping and kicking. Wherever practicable, collect the sample from both banks. Although each habitat should be sampled in proportion to its cover, this is unlikely to be possible in the main channel. Sample discrete habitats in proportion to their linear predominance along the river.

2.7.6 Removing samples from the collecting net (all types of samplers)

Rinse the sample *[where possible by shaking the pond-net vigorously in the stream without risking loosing any animals]* to remove silt and clay. Discard stones, wood, and large fragments of vegetation before removing the sample from the net *[but take care to remove any clinging animals and drop them back in the pond-net]*.

The easiest way to remove a sample from the collecting net of a pond-net or dredge is to wash the catch into one corner of the net first, by dipping the net into the water and gently shaking it from the opposite corner as it is lifted out of the water. Then, by gradually everting the corner of the net, the bulk of the sample can be dropped into a labelled sample container, or polythene bag. Material clinging to the net can be shaken, or flicked-off from the other side of the net, into the container. Alternatively, it can be removed by dipping the everted net into some water in a tray, bucket, or wide-mouthed sample container, using the surface tension to dislodge any material clinging to the net. A combination of these processes may be used, and they should be repeated until all the animals have been removed. A plastic tea-strainer with a fine mesh is useful for decanting the collection from a tray or bucket into a polythene bag or sample container. Recalcitrant specimens may be picked-off the net by hand or with forceps. **Always wash the collecting net thoroughly to prevent contaminating subsequent samples**

Fill the sample containers to no more than about _ full with collected material. This will leave sufficient room for fixative or preservative, and an air space. Never cram material into a sample container, and never fill it completely: use an additional container instead. Every container must be labelled according to the instructions *[given in the main CS2000 manual]*.

2.9 Transporting and storing samples

Samples should be fixed as soon as possible after capture

If the sample fills more than about 60% of the sample container, transfer some of it to another correctly labelled container.

Not all couriers will carry samples in formalin or from polluted waters. If you intend to despatch samples by courier, you must check that they will accept them.

2.9.1 Sample containers

Usually one sample container will suffice, but two, or a larger container, may be necessary for large samples.

Some find it easier to transfer the sample from the collecting net into a polythene bag rather than directly into a pot *[use this procedure for CS2000]*.

Sample containers should be transported in ... [the] lidded crate [provided], to protect them, and to reduce the movement of air around them.

2.9.2 Labelling samples

Labels should be written on the outside of all sample containers, using a waterproof marker pen. Do this before the container gets wet, and give the ink time to dry to improve the ink's adhesion.

Lids should not be labelled because they can become separated easily from the rest of the sample whilst it is being analysed in the laboratory. Waterproof paper labels marked in soft-leaded pencil or waterproof (alcohol resistant) ink must be added to each sample container as an additional precaution. Few inks are alcohol proof.

2.9.3 Fixing samples

The procedures below have been tested fully and COSHH assessed, however every laboratory adopting these procedures must undertake their own COSHH assessments.

Fix samples in 10% formalin (4% aqueous formaldehyde). It is best to do this immediately after they have been collected, to prevent carnivores, particularly beetles and Gammaridae, from eating other specimens. The fixative hardens insect and oligochaete cuticle, reducing the chances of specimens disintegrating during storage or handling (except for flatworms and the soft bodies of molluscs). It is far better to fix samples when they are fresh than when they have been preserved. The fixative will also kill most pathogens in the sample, which may be useful if it is from polluted water.

Fixative can be added either in concentrated form from small bottles stored in each sample container, or in dilute form (approximately 10% formalin) from a large jerry can, which must comply with the specification in Section 3.2.7.

If concentrated fixative is used, put about 100 ml of neat formalin (40% aqueous formaldehyde) inside a 150 ml Nalgene screw-capped bottle, using a fume cupboard or fume extractor in the laboratory. Place a pre-filled bottle of fixative in each sample pot. In the field, add sufficient fixative to the sample to result in a 10% formalin solution. Cap the bottle containing unused neat formalin securely, and put it back in the sample pot. Do this outside the vehicle in a well ventilated area. This ensures that neat formalin is always double-sealed, prevents large volumes of fixative from being carried in the same container, and limits the total volume carried to that needed for sampling.

If adding dilute formalin to samples from a jerry can, do this outside the vehicle in a well ventilated area.

Distribute the fixative evenly throughout the sample by gently tumbling it in its container after the lid has been firmly secured. You must leave some air in the container (and polythene bag if used) so that the mixing is thorough. You must do this in the open air when in the field (never in a closed vehicle), or in a fume cupboard or extractor in the laboratory. Check that the sample container's lid seals properly and no liquid seeps out. If an adequate seal cannot be made, use another lid or transfer the sample to another container. Live specimens can be found in samples after a few weeks if the fixative has been mixed inadequately. If this happens, you must review your procedures to prevent it reoccurring.

Samples must remain in fixative at least overnight to ensure that it penetrates sufficiently. Samples may be stored in formalin until they are sorted.

Gloves are essential when using concentrated formalin, regardless of whether a barrier cream is used, and the use of barrier cream is recommended. Eye protection and a fume cupboard or fume extractor must be used when concentrated stock solutions are being decanted, and when washing samples containing formalin. Although contact with small quantities is not unduly harmful if rinsed-off immediately with plenty of water, it will sting any breaks in the skin. Individual laboratories should follow the guidelines given in this document, but must also establish their own detailed procedures that are tailored to their particular laboratory conditions and facilities. They must be fully assessed for COSHH.

3.2 Sampling equipment

3.2.1 Mode of transportation

Loads must be secure in vehicles. There must be sufficient load restraints to ensure that the samples, reagents and equipment remain secure in the event of sharp cornering, braking or a collision. The vehicle must be suitable for the job. Passenger seats are generally unsuitable for carrying samples or equipment.

Fire extinguishers must be full and within their expiry date.

3.2.2 The collecting nets

The collecting net is a critical part of the sampling equipment because it determines the size of the animals caught. Collecting nets used for this procedure must be woven from multi-filament polyester with an oval shaped 0.8×1.4 mm $\pm$ 0.2 mm aperture (loosely termed a 1 mm mesh), whatever type of sampler is used. Note that this is larger than the maximum specified in British Standards Institute, 1994 and 1995.

Use only multi-filament polyester nets for this procedure. Do not use monofilament nylon nets. Although multi-filament polyester nets are manufactured to less precise tolerances and are more easily holed, they are easier to repair than monofilament nets. Because they are more flexible, they are much easier to empty.

Damaged nets must not be used. Always carry spare nets when sampling to replace damaged nets, together with tools for changing them (usually a small screwdriver and spanner). Nets are prone to damage, and require care and regular inspection. Repair small holes with rot-proof thread: discard nets with large tears or more than a few repairs. Dry the nets after each day's sampling: this is particularly important for nets bound with cotton thread.

Nets can be protected from accidental damage with stout covers whenever they are not being used.

3.2.3 Long-handled pond-net

A standard FBA-pattern long-handled pond-net should be used. This has a frame with a straight lower edge of 20-25 cm, and straight, vertical sides of 19-22 cm, see Figure 3.6. It should be fitted with a 1 mm mesh collecting net, as specified in Section 3.2.2. The net bag should be square with rounded corners, not conical. Nets and frames from different manufacturers vary in design (see Figure 3.7), but their principal dimensions must not differ from those above.

Polyester nets are available 30 cm deep and 50 cm deep. For this procedure, 50 cm nets should be used. They become blocked less easily because of their greater mesh surface so perform much better on soft sediments, or where there is a large amount of vegetation or detritus, and they are less prone to emptying in eddy currents. Monofilament nylon nets are usually about 25 cm deep or less, and must not be used for this procedure.

Pond-net handles should be about 1.5 m long. Longer handles may be used in deep waters, for example for collecting sweep samples from deep rivers, but they are not recommended for general use.

Check periodically that the bottom-edge of the frame is not bent, because this reduces its sampling efficiency. Thin gauge aluminium frames are particularly prone to this type of damage

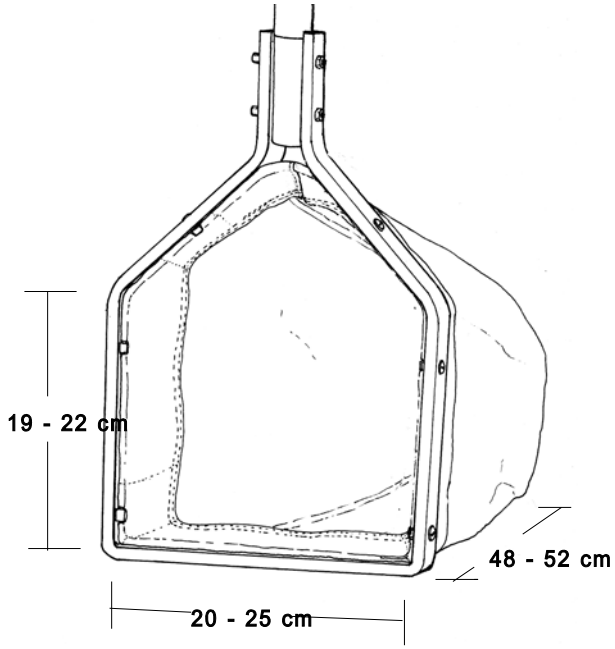


Figure 3.6 Dimensions of the pond-net

3.2.6 Sample containers

Sample storage containers must have air-tight lids to prevent the samples from drying-out, and any sample or preservative from escaping. They should have wide mouths so that samples can be emptied into them easily without damaging delicate specimens. They should be large enough to accommodate most samples: it is better to use one large container than to split samples into two or more smaller ones. Re-usable containers should be easy to clean-out, so that samples are not contaminated by specimens from previous samples. They must be robust, with secure lids that will not break or leak as a result of rough handling during sampling. It is helpful if they can withstand being dropped whilst containing a sample. They should be durable; in particular the lid's seal must retain its integrity when re-used. Containers made of plastic are safer to use and lighter than glass.

1.3 litre polythene pots *[of the type provide]*, 14 cm × 12 cm, with a wide mouth, a urea screw-on lid and a card seal were standardised for the 1990 National Biological River Quality Survey (Figure 3.10), but are no longer manufactured. This design is acceptable, but only if the card seal is in good condition, and in particular the plastic coated side is intact. As an extra precaution against the lids of this type of container unscrewing during carriage by courier (e.g. when used for sending audit samples to the auditor), it is recommended that they are secured with waterproof adhesive tape (electrical tape).

Do not use any containers which have poorly fitting lids, which leak, or which are cracked (even if they do not leak).

Sample containers containing preservative or fixative nust be labelled appropriately.

3.2.7 Fixative bottles

Bottles for transporting fixative in the field must be robust and have water and air-tight caps. If concentrated fixative (40% formaldehyde) is to be used in the field, 100 ml Nalgene bottles with a water and air-tight screw-caps should be used: one to be placed in each sample container. If dilute fixative is to be used in the field (around 4% formaldehyde), a 12 litre high density polyethylene jerry can with fluorinated surfaces and air-tight screw-cap is recommended. These are also produced by Nalgene, and are designed for acids, alkalis and aggressive solvents. Fixative bottles must be labelled appropriately.

3.2.11 Forceps

Either plastic or steel forceps may be used, depending on the user's preference, for examining samples in the field, and for picking individual animals off the collecting net. Plastic forceps are less easily damaged, but are unsuitable for picking-up very small animals.

3.2.12 Waterproof labels

These are essential. They must be non-adhesive. Waterproof paper or drafting film is recommended.

3.2.13 Soft-leaded pencils

Hard leads are too faint and do not photocopy well. Pencils work even when wet. They are recommended for labels and sample data forms. A pencil sharpener and eraser should also be carried.

3.2.14 Waterproof marker pen

This must be alcohol-proof if the sample container is to hold preservative, and able to write on damp plastic, for example the Pentel N50. Marker pens are used to label sample containers.

3.2.16 Other optional equipment

Hooded clipboards, e.g. Weatherwriter, enable notebooks and sample data sheets to be used in wet weather.

Plastic tea-strainers are useful when decanting the sample from the field examination tray into the sample container. They must have a finer mesh than the collecting net, see Section 3.2.2.

Stiff bristle painting brushes are recommended for removing attached animals from stones

3.4 Field measurement equipment

3.4.1 Metre rule

A pond-net handle or river-crossing staff accurately marked in 1 cm intervals may be used instead, but for measuring current velocity, a metre rule is preferable.

3.4.2 Watch or stopwatch

This should be water resistant. Waterproof types are recommended. Stopwatches or watches should be calibrated and serviced periodically.

3.4.3 Camera

This should be capable of adding the date to photographs. Waterproof cameras are recommended. A 35 or 50 mm lens will be appropriate for most purposes. A camera and spare film should be carried when sampling. Photographs are the best aide-memoire to the conditions when sampling. Colour prints are most useful for the site manual.

3.4.6 Polaroid glasses

These are very useful for assessing the nature of the substratum because they reduce reflections from the water surface and enable the stream bed to be seen more clearly. They are also useful for driving.

3.4.7 Optional equipment

Rangefinder. Optical rangefinders must be calibrated regularly. Tests for the River Habitat Survey indicated that many optical rangefinders are inaccurate. Laser rangefinders are accurate, but very expensive. Rangefinders may be used to measure the width of rivers which cannot be crossed.

Tape measure.

Global positioning system (GPS). Relational systems, with fixed base stations may be used to determine site locations (grid references). Hand-held devices, which are less precise, may be used as a supplement to the site manual (Section 3.1.3) to check that you have found sites correctly.

Binoculars, for observing features on the opposite bank, for example finding small discharges.

3.5 Safety equipment

Each organisation's safety advisors may specify particular types of equipment, so the specifications below are only general. It is essential that everyone using these procedures understands when and how to use the equipment that is issued to them.

3.5.1 Life jackets

Life jackets must be self-inflating with a buoyancy of at least 150 N. A re-charging kit containing a spare gas cylinder and fuse should be carried in the vehicle. Life jackets must be inspected periodically: follow the instructions supplied with them.

Never attach a safety line directly onto a life jacket that does not have an integral harness.

It is preferable for life jackets to be issued on a personal basis rather than to be shared, so that the procedures for periodic checking become the responsibility of one person. More importantly, each person can then have a life jacket as part of their personnal field kit so that it is always with them, to ensure that it is available for use when needed.

Buoyancy aids are unsuitable for the work described in this document: life jackets must be worn instead.

3.5.2 River crossing staff

An ordinary wooden broom handle or stout walking stick. A pond-net handle can be used instead.

3.5.3 Throwing line

This is optional. This should be kept in the vehicle for emergencies. It may be taken to the sampling site whenever it is considered prudent to do so.

3.5.4 Personal attack alarm

It is advisable to keep an alarm in the vehicle, and to carry one when it seems prudent, for instance in inner city areas where there is risk of personal attack, or where stray dogs are frequent. Inaudible dog scarers may be useful in some places, however the experiences of some Environment Agency staffs suggest that they are not always effective, but that a good personnal attack alarm is.

3.5.5 Mobile telephone or private mobile radio (PMR)

Different models are supplied by different organisations. Individual organisation's procedures for their use must be followed, including call-back procedures, especially for lone workers.

3.5.6 Antiseptic barrier cream

As a supplement to gloves. Barrier creams should be re-applied as necessary. Those that do not stay greasy are recommended. Unlike gloves, barrier creams will not prevent pathogens entering through cuts and grazes.

3.5.7 Gloves

Gloves for sampling should be elbow-length, preferably with elastic arm bands. They may be either disposable medical gloves or heavy duty PVC. Shorter gloves are not recommended for sampling, because of the ease with which water can enter them. When this happens, water is kept in contact with the skin, and pathogens may be rubbed into cuts.

Normal-length gloves are appropriate when using fixative.

Disposable surgical gloves do not impede the sense of touch.

3.5.8 Bactericidal soap or surgical wipes

Clean water must always be carried for rinsing. Replace it periodically.

3.5.9 Waders

Thigh waders are recommended for kick sampling. Waders with hard soles and metal studs are good on soft rocks such as chalk and limestone, and on gravels. Rubber-soled waders are recommended in areas with hard rocks because they reduce the likelihood of slipping on rocks covered with algae: they are also recommended where it is necessary to walk over metalled surfaces for the same reason. Thigh waders will also keep you dry when using a dredge or air-lift from the river bank.

3.5.10 Waterproof clothing

Waterproof clothing is essential in wet weather. Keeping dry is a prerequisite to keeping warm. Waterproofs will protect you against wind. Waterproofs with thick linings are not reccomended. It is better to wear separate layers of warm clothing that can be removed or added to as necessary: collecting samples is an energetic task. Thick linings take longer to dry-out when they do become wet. Waterproof headwear should be worn, but it is important that it fits well and does not restrict your field of vision: hats are generally more suitable than hoods in this respect. For sampling, waterproofs need to be robust: although effective at keeping you dry and comfortable, not all modern fabrics are sufficiently durable. Waxed clothing must be re-proofed at least once a year, and more frequently when used heavily.

3.5.11 Helmets

A canoeing helmet with chin strap may be worn where there is a risk of head injury from slipping or tripping, for example where the substratum is slippery because of algae, or where there are boulders. They protect the side of the head.

A safety helmet must be worn in designated areas such as quarries and construction sites.

3.5.12 Spare set of clothes

Include a towel. Each sampler should have their own set. In winter this must be a full set, including socks and pullover. In summer, a 'get you home' set will suffice.

3.5.13 First-aid kit

To be kept in the vehicle. The contents must be kept dry, complete, and within the expiry date. Eye wash should also be carried, and must be carried when formalin is used. Remember that eye-wash can be used as a source of sterile water to clean cuts and abrasions. The Health and Safety Commission (1990) recommends that field workers carry three 300 cm^3 bottles of eyewash.

3.5.14 Equipment for rope entry to sites

This is optional. It includes ropes, safety harnesses, karabiners, ascenders, descenders, and loops. This equipment is to be issued only to specially trained personnel. Damaged equipment must not be used. Ropes must be inspected regularly by a competent person and replaced periodically, even if they are undamaged.

3.5.15 Sun protection

In addition to the equipment listed above, samplers are advised to protect themselves from UVA and UVB solar radiation when in the field.

3.5.17 Leptospirosis (Weil's disease) information card

A waterproof card is available from the Environment Agency. Field workers should keep this or a similar card with them all the time.

Appendix 2: Detailed field protocols for conducting River Habitat Surveys, incorporating alder disease surveys.

Abstracted from:

Environment Agency (1997) River Habitat Survey. 1997 field survey guidance manual, incorporating SERCON. Unpublished Environment Agency Manual.

Note: The original section numbering from the source document is retained in this appendix.

PART ONE - INTRODUCTION

1. PREAMBLE

1.1 River Habitat Survey (RHS) is an assessment of the physical structure of freshwater streams and rivers based on a standard 500m length sample unit. It does not require specialist geomorphological or botanical expertise but consistent recognition of features included on the form is essential. To ensure consistency of recording all surveyors must be accredited.

2. PURPOSE OF MANUAL

2.1 The sole purpose of this manual is to provide detailed guidance on the field survey method associated with RHS. The **RHS geomorphology training video** is an essential guidance tool, and should be viewed by all surveyors as an integral part of their training. Other outputs from RHS include (i) a River Habitats report for England and Wales[1], (ii) a 4-monthly newsletter on progress of RHS, (iii) a working classification of river types, and (iv) a scheme for assessing habitat quality. A computer database has been developed to support RHS. Further verification is required, so it is not yet available to external organisations but information can be requested via Marc Naura in North West Region.

2.2 A full review of the rationale and approach for RHS development has been published[2]. The 1997 field survey method is based on the 1996 version with minor refinements, largely based on the incorporation of SERCON-related recording requirements (see paragraph 5.1).

2.3 This guidance is intended for all RHS surveyors. These may include Environment Agency staff, external organisations, consultancies or students.

2.4 A comprehensive compilation of colour photographs illustrating selected features which appear in the RHS field survey form is included as Part Five.

2.5 This manual is not a publication but will form the basis for an Environment Agency handbook.

2.6 This guidance provides the technical basis for undertaking RHS, and where necessary, the extra requirements for a SERCON survey. Precise details of survey work such as permissions, access to data, photographic requirements and extra details to be recorded should be agreed between the commissioning organisation and the contractor.

3. FIELD SURVEY

3.1 The RHS recording form (Part Three) is largely self-explanatory, but training is essential to minimise the chance of incomplete or inaccurate recording.

3.2 Equipment requirements are: RHS recording form; spot-check key and guidance notes (in waterproof document holders); ranging pole; range-finder. Binoculars are useful for additional scrutiny of features on the far bank of larger rivers. It is recommended that the RHS survey forms are completed in the field using a pencil.

4. TRAINING

4.1 All RHS undertaken for the Agency, whether by internal staff, other organisations or external contractors, **must** be carried out by accredited surveyors.

4.2 All RHS coordinators are accredited RHS trainers. They have considerable experience in RHS survey work and have passed a trainer's test. They are responsible for training and accrediting prospective RHS surveyors, including both internal staff and external consultants and contractors.

4.3 Attaining RHS surveyor accreditation involves attending a training course and passing a written test. Accreditation is valid for three years, although depending on the number of surveys carried out, the surveyor may need to attend a refresher course during this period.

5. SERCON (System for Evaluating Rivers for Conservation)

5.1 SERCON was developed by Scottish Natural Heritage, with input from the Environment Agency and other organisations[3]. It uses survey and other data to provide a method of assessing the conservation value of rivers and their corridors.

5.2 The SERCON field survey guide has been incorporated into this manual. RHS provides the data on physical features, whilst the one-page additional SERCON component, when used in addition to RHS, provides the complete SERCON survey. Part Eight of this manual contains the additional SERCON component field survey form with accompanying guidance notes.

5.3 Part Eight also contains SERCON inter-reach survey forms and accompanying guidance notes. These may be used when undertaking a complete river survey, but where RHS/additional SERCON component surveys are not carried out on contiguous 500m reaches.

6. HEALTH AND SAFETY

6.1 ***It is imperative that all field surveyors follow health and safety guidelines provided in Appendix 1.***

6.2 The Agency's Lone Worker Code of Practice (Appendix 2) should be followed at all times and lone workers need to take special care that they never put themselves in a situation in which they are not in control. This guidance extends to external contractors collecting information on behalf of the Environment Agency. In areas considered to be high risk, it is recommended that a team of two undertakes the survey.

7. ACCESS AND PERMISSIONS

7.1 Permission from landowners should be obtained beforehand wherever practicable. All Environment Agency staff should carry full identification with them at all times.

7.2 Surveyors undertaking RHS should be polite and courteous at all times. In all instances, if challenged by landowners, RHS surveyors should offer a full explanation of what they are doing and why and on whose authority. They should also offer to provide information on the site to the occupier if he/she is interested in receiving it. In some instances this may mean returning to a site if the landowner requires further clarification. The RHS newsletter and River Habitats report may be given out to landowners where appropriate.

8. KEY REFERENCES

[1] National Rivers Authority. 1996. River Habitats in England and Wales - A National Overview. Environment Agency, Bristol.

[2] P.J. Raven, P. Fox, M. Everard, N.T.H. Holmes & F.H. Dawson. 1997. River Habitat Survey: a new system for classifying rivers according to their habitat quality. In *Freshwater Quality: Defining the Indefinable?* 215-234. Eds. P.J. Boon & D.L. Howell. HMSO Edinburgh.

[3] P.J. Boon, N.T.H. Holmes, P.S. Maitland, T.A. Rowell & J. Davies. 1997. A system for evaluating rivers for conservation (SERCON): development, structure and function. In *Freshwater Quality: Defining the Indefinable?* 299-326. Eds. P.J. Boon & D.L. Howell. HMSO Edinburgh.

PART TWO - GENERAL GUIDANCE

1997 RIVER HABITAT SURVEY

GUIDANCE NOTES

9. THE FORM

9.1 The RHS form (Part Three) is four pages long and is accompanied by a separate spot-check key. It is recommended that a clip-board or "weather-writer" is used and that a laminated spot-check key is used.

10. BACKGROUND AND OVERVIEW INFORMATION

10.1 Most of page 1 of the form can be completed on arrival at the site, or at the end of the survey as appropriate. The background map-derived information (Section A) needs to be completed for river type and quality assessment purposes.

10.2 The actual number of specific channel features (ie individual riffles, pools, unvegetated and vegetated point bars) are to be recorded in Section D. This can be achieved by keeping a cumulative tally when walking between spot-checks and the total totted up at the end of the survey. In multi-thread channels (ie braided or anastamosing), only those features in the main channel are to be counted.

11. SPOT-CHECKS

11.1 Page 2 of the form comprises the 10 spot-checks. The spot-checks should be located at equal (50m) distances along the 500m. To do this consistently **each surveyor should calibrate their stride length beforehand to identify how many paces represent 50m.**

11.2 Each spot-check comprises an assessment of flow types, physical features, vegetation structure, land-use and vegetation types. Physical features (Section E) are assessed from a 1m wide "transect" across the channel, while vegetation structure, land use (Section F) and channel vegetation types (Section G) are assessed within a 10m wide transect across the river (see Figure 1).

11.3 Spot-check entries on the form include the use of abbreviations. For example, each feature to be recorded in Section E has a unique two letter abbreviation (eg boulder = BO). These abbreviations are listed on the form and in the accompanying spot-check key and most are quickly learnt by experienced surveyors.

11.4 The primary purpose of the spot-checks is to allow greater consistency of recording. They should be completed in sequence on the outward journey. In most instances each

spot-check should take no more than 1-2 minutes to complete, particularly since most boxes will have a single entry. **It is important that all the boxes in Sections E and F and appropriate boxes in Section G are completed at each spot-check before moving to the next one**. With experience, and in uniform sites, the time taken to complete the spot-checks will be reduced significantly.

11.5 Sometimes, there may be two or three possible options for a single spot-check entry, for example, for predominant bank material. Do not spend too long deliberating over which option to enter. Gut reaction is the quickest and usually the best method.

12. SWEEP-UP INFORMATION

12.1 Page 3 of the form comprises a sweep-up to be completed on the return journey. This represents an inventory of features over the whole 500m sample length and will include those features not included in the spot-checks. **NB. Since the sample length is 500m and the ten spot-checks are 50m apart, it is important to include the remaining 50m of the sample length in the sweep-up. This will mean walking an extra 50m from the end of the last spot-check**.

12.2 The presence of features included in the sweep-up is indicated by entering a tick (✓) but those occupying 33% or more of the channel area or total banklength are recorded as "E" (extensive) to reflect their contribution to the overall assessment of structure.

12.3 Trees (Section J) are to be recorded in a tick box format on the basis of distribution pattern along each bank.

12.4 The extent of selected channel features is required in Section K. The list represents features that are readily identified and consequently an assessment of their overall occurrence (absent, present, extensive) will provide a picture of river character. As part of analysis this section will be combined with the specific features (riffles, pools, unvegetated and vegetated point bars) recorded in Section D. It is essential therefore that features in Section D and K are recorded in full.

13. CHANNEL DIMENSIONS, INFLUENCES AND SPECIAL FEATURES

13.1 Page 4 of the form contains a section (L) on channel dimensions. Channel dimensions are to be recorded at **one location** within the 500m, the precise point being selected on the basis of being in a straight or uniform reach with clearly defined banks and a riffle. If no riffles are present within the reach, a uniform location preferably with clearly defined banks should be selected. The location of the point selected to record channel dimensions may or may not coincide with a spot-check.

13.2 The bankfull width, wetted water width and depth should be recorded. Range-finders will be needed for estimating widths of larger rivers and it is recommended that these instruments are calibrated on a daily basis if at all possible.

13.3 Section R contains prompts to describe the overall characteristics of the site, as well as a space for any other significant observations.

13.4 It is imperative that, at the end of sampling, the form is checked for completeness. An extra two minutes for quality control at the end will be invaluable, because incomplete forms may mean having to resurvey the site.

13.5 It is important that completed RHS forms are legible, the pages stapled together and a site reference number clearly marked on both pages 1 and 3.

14. SUITABLE CONDITIONS AND SEASONAL TIMING

14.1 **RHS should not be carried out during spate flows**. If a prolonged period of heavy rain occurs then surveys should be delayed until the water level and clarity revert to suitable levels.

14.2 In lowland rivers where excessive growth of emergent and bankside vegetation interferes with visibility, it is advisable to avoid carrying out RHS during the summer months: May and June are considered a more suitable period. Upland rivers with little or no emergent vegetation can be suitable for survey over a longer period.

14.3 Surveys can be carried out during other times of the year but interpretation of the results will need to take full account of seasonal differences in aquatic and bankside vegetation growth.

PART THREE

THE RIVER HABITAT SURVEY FORM

PART FOUR

DEFINITIONS AND DETAILED GUIDANCE FOR RHS FORMS

(☼14 represents photograph number in Part Five)

A. BACKGROUND MAP-BASED INFORMATION

Altitude (m) To be estimated from 1:50,000 Ordnance Survey (OS) map.

Slope (m/km) To be estimated from 1:25,000 OS map as average channel gradient (metre fall per 1km of river length) over a 1km square or equivalent linear distance.

Flow Category To be a direct read-off from the 1985 Regional River Quality Objective (RQO) maps, or equivalent in Scotland and Northern Ireland, as one of 10 mean annual flow categories: 1 (<0.31 cumecs); 2 (0.31 - 0.62); 3(0.62 - 1.25); 4 (1.25 - 2.5); 5 (2.5 - 5.0); 6 (5.0 - 10.0); 7 (10.0 - 20.0); 8 (20.0 - 40.0); 9 (40.0 - 80.0); 10 (>80.0 cumecs).

Solid Geology Code Category (abbreviated) as assigned by the British Geological Survey (see Appendix 3).

Drift Geology Code As above.

Planform Category to be assessed over 2.5km of river length on 1:50,000 OS map as one of:

'Natural' - straight, sinuous, irregular meanders, regular meanders, anastamosing, braided.

Modified - straightened, navigation, mill channel, water meadow system.

For multi-thread channels, the following guidance should be used in conjunction with the diagrams overleaf:

Anastamosing: multi-thread channel where the flow is deep, and split by rock outcrops or mature islands. A fairly stable system, often with steep banks.

Braided: multi-thread channel where the flow is often shallow, consisting of riffles and rapids, and is split by mid-channel bars. An unstable system, often with eroding banks.

'Natural' Modified

1. *straight*

2. *sinuous*

3. *irregular meanders*

4. *regular meanders*

5. *multi-thread:* *a) anastamosing*

b) braided

6. *straightened/realigned*

7. *navigation*

8. *mill channel*

9. *water meadow*

Distance from source (km)	Distance (km) from source as indicated on 1:50,000 scale OS map. Use a map-wheel to estimate.
Significant tributary?	Indicate ('Yes' or 'No') if significant tributary (ie almost equal size) enters site. Use flow category in RQO map or 1:50,000 scale OS map for guidance.
Navigation?	Indicate ('Yes' or 'No') if channel is a working navigation used by pleasure cruisers, etc. Navigations are as indicated in *"Nicholson's OS Inland Waterways Map of Great Britain"* (ISBN 0-319-00266-7).
Height of Source	To be estimated to nearest 10m from 1:50,000 OS map.
Water Quality Class	To be taken from the 1995 Water Quality (GQA) map.

B. FIELD SURVEY DETAILS

Site number Every site should be given a reference number. Mark clearly in section B and on the top of page 3 of the survey form.

Mid-site grid reference Use 6 figure national OS grid reference for mid-point of site.

River name Name appearing on RQO or equivalent map. Unnamed headwater tributaries should be categorised as such but refer to the named mainstem downstream.

Date/time Note the time of survey as well as the date because this could be invaluable regarding significant observations (eg pollution) and in relation to gauged flow information.

Surveyor name/ accredited surveyor Accredited surveyors will be assigned an individual code. Surveyor name and code must be entered on the form to comply with the RHS accreditation scheme.

Are adverse conditions affecting survey? **Surveys should not be carried out in spate conditions.** NB the water level (high or low) and turbidity will be important factors which will affect recording. *Tick one box only*.

Photograph (general) **A photographic record of the site is essential**. Duplicate photographs showing the overall character of the site should preferably be taken as a pictorial record of the site. Colour transparency and a film speed of ASA 200 or 400 should be used. *Tick one box only.*

C. PREDOMINANT VALLEY FORM

Tick one box only

Use profile diagrams on the form for guidance. Shape refers to **whole valley form**, in the context of the horizon. Symmetrical floodplain ☼2; Asymmetrical floodplain ☼3

"Terraced valley floor" represents the distinctive form produced by old river terraces. The former floodplain, when abandoned, produces a step-like shape. *Tick one box only*. Terraced ☼1

D. NUMBER OF RIFFLES, POOLS AND POINT BARS

For analytical purposes, the actual number of riffles, pools, unvegetated and vegetated point bars needs to be recorded. This is best done as a cumulative tally between spot-checks. Always give the actual number, "greater than" should not be used. The tally can be done at the top of page 2, and at the end of the survey the total transferred to section D. The next version of the form will be redesigned to put this section on the same page as the spot-check information. *NB Sites with a continuous "long riffle" sequence will not be amenable to the counting of discrete riffles. The riffles must be separated by a distinct flow feature to be counted as dicrete features. As a rough guide, riffles rarely occur more frequently than one every 5-10 channel width distance.*

Riffle

Shallow fast-flowing water with a distinctly disturbed surface. **Unbroken standing waves** dominant. ☼ 4

In seasonally-vegetated streams, aquatic macrophytes may create a 'riffle' by constricting or obstructing flow or causing sediment deposition which raises the river bed. **Do not record this as a riffle** ☼ 5

Pool

A distinct natural feature of deeper water. In dry-weather conditions, there is **no perceptible downstream flow**. Back currents may be present. Pools should occupy most of the wetted channel width. ☼ 6

If a pool is longer than 3 times the channel width, check for the presence of artificial ponding (impoundment).

*NB. **Individual** riffles and pools are to be counted in Section D, whilst the extent of riffles and pools throughout the site is to be assessed separately in Section K.*

Unvegetated point bar (PB)

A distinctive depositional feature composed of unconsolidated material derived from the channel; exposed at low flow; shallow slope into the water. Located on **inside** of distinct meander bend. 'Unvegetated' defined as <50% perennial plant cover. ☼ 24,26

Vegetated point bar (VP)

A distinctive depositional feature Composed of bed material from the channel (not the bank); exposed at low flow; shallow slope into the water. Located on **inside** of distinct meander bend. 'Vegetated' defined as ≥50% perennial plant cover, often showing a successional sequence. Include mosses as they indicate stability. ☼ 25

E - G. SPOT-CHECKS

Ten spot-checks should be completed at regular intervals (ca 50m) along the 500m site. It is crucial to indicate on the form whether spot-check 1 is at the upstream or downstream end of the site. At each spot-check, stand on the bank and look across the channel and indicate **in each box** the material, modifications and features present.

All boxes in sections E and F and appropriate boxes in Section G must be completed before moving on to the next spot-check.

Bank Permanent side to river. For banktop, use the bankfull definition, ie the point where the river spills onto the floodplain (see illustration on page 37). Where no distinct breaks in slope occur (eg upland streams in vee-shaped valleys), the bankfull height can be determined by the winter flood level, often marked by a trashline.

Left and Right banks 'Left' and 'right' banks determined by facing **downstream**.

For physical attributes (E), use a transect 1m wide across the channel. *Only one entry per box is allowed for predominant substrate of both banks and channel.* Where more than one channel or bank feature or modification occurs, use a diagonal line to include a further entry in the box.

For banktop land use, vegetation structure and channel vegetation type (F and G) use a 10m wide transect, at the same location (see Figure 1 on page 8).

Each entry should be made clearly using the unique abbreviations shown in the spot-check key and described below.

E. SPOT-CHECKS: PHYSICAL ATTRIBUTES

PREDOMINANT BANK MATERIAL

*Left and right banks are determined by facing **downstream**.*

Not visible (NV) Self-explanatory.

Bedrock (BE) Exposure of underlying solid rock. ☼ 7

Boulder (BO) Loose rocks > 256mm diameter (approx. large head size)

Cobble (CO) Loose material 64 - 256mm diameter (half fist to large head size).

Gravel/Sand (GS) *Combined category*: coarse gravel is 16 - 64mm diameter; fine gravel 2 - 16mm diameter; and sand, < 2mm diameter.

Earth (EA) Crumbly earth (*a generic term*).

Peat (PE) Predominantly or totally peat.

Clay (CL) Solid and cohesive. Sticky when rubbed between finger and thumb. A jab with a ranging pole will distinguish between crumbly earth and sticky clay, the latter producing a coherent smooth conical hole. ☼ 8

Concrete (CC) Concrete revetment - cement which forms a solid face predominantly or totally concrete. ☼ 9

Sheet piling (SP) Vertical steel piles protecting bank face. Includes corrugated iron. ☼ 10,11

Wood piling (WP) Wooden poles inserted to protect the bank face (often toe only). ☼ 12

Gabion (GA) Stones in wire baskets. ☼ 13

Brick/laid stone (BR) Any walls including stone-laid walls. ☼ 14

Rip-rap (RR) Loose boulders imported to protect the bankface (often toe only). Includes blockstone. ☼ 15

Builders' waste (BW) Rubble, metal, wood, etc, dumped on the bank. ☼ 16

BANK MODIFICATIONS

Not known (NK) Self explanatory.

None (NO) No *obvious* modifications visible.

Resectioned (reprofiled) bank (RS) Profile modified **but not reinforced**, often to accommodate flood flow and maintenance machinery. Normally a relatively smooth, uniformly angled slope. ☼ 17,18,19

Reinforced bank (RI) Whole or part of bank artificially strengthened for bank protection purposes. Examples include concrete, sheet piling, corrugated iron, wood piling, gabion, brick/laid stone, rip-rap and builders' waste. ☼ 9,10,11,12,13,14,15

Poached (PC) Bank significantly trampled or puddled by livestock. Include banks trampled as a result of human activity.

Add **(B)** after **PC** (ie **PC(B)**) if the whole bank is predominantly bare, ie <50% vegetation cover. ☼ 20

Berm (BM) Shelf of artificial two-stage channel created by excavating the bank laterally at a level above dry-weather flow but below the banktop level. This modification creates a distinct stepped appearance.☼ 21

Embanked (EM) Embankment created to artificially increase the banktop height. Forms an integral part of the bank. **Do not** include set-back embankments. ☼ 64

BANK FEATURES

Not visible (NV) Self-explanatory.

None (NO) No *obvious* feature visible

Eroding earth cliff (EC) Bankface *predominantly* vertical or near vertical, with a minimum height of 50cm, and showing a clean earth face. Other clues: turf overhanging cliff, turf in channel, recently fallen trees, leaning fence posts. "Earth" defined in the broadest sense. If composed of free-draining soil, sands and gravels ring **EC** (ie **EC)**. ☼ 22

Stable earth cliff (SC) Bankface *predominantly* vertical or near vertical, with a minimum height of 50cm, and **without** obvious signs of recent erosion. Often has mosses and liverworts and odd patches of other vegetation on bankface. If composed of free-draining soil, sands and gravels ring **SC** (ie **SC)**. ☼ 23

Unvegetated point bar (PB) A distinctive depositional feature composed of unconsolidated material derived from the channel; exposed at low flow; shallow slope into the water. Located on **inside** of distinct meander bend. 'Unvegetated' defined as <50% perennial plant cover. ☼ 24,26

Vegetated point bar (VP) A distinctive depositional feature composed of bed material from the channel (not the bank); exposed at low flow; shallow slope into the water. Located on **inside** of distinct meander bend. 'Vegetated' defined as ≥50% perennial plant cover, often showing a successional sequence. Include mosses as they indicate stability. ☼ 25

Unvegetated side bar (SB) A distinctive depositional feature composed of unconsolidated material derived from the channel; exposed at low flow; shallow slope into the water. 'Unvegetated' defined as <50% perennial plant cover. Found in locations other than inside of distinct bends. ☼ 26

Vegetated side bar (VS) A distinctive depositional feature composed of unconsolidated material derived from the channel; exposed at low flow; shallow slope into the water. 'Vegetated' defined as ≥50% perennial plant cover. Include mosses as they indicate stability. Found in locations other than inside of distinct bends. ☼ 27

PREDOMINANT CHANNEL SUBSTRATE (*Wentworth scale shown on spot-check key*)

The ranging pole should be used as a prod on the river-bed to determine channel substrate. In some cases gravel or sand can be covered by a thin layer of silt, especially during low flows. In these instances, the underlying substrate should be recorded, together with a note that silt is present as an overlying deposit.

Bedrock (BE) Exposure of underlying solid rock. Include solid 'clay' acting as an equivalent of bedrock armouring.

Boulder (BO) Loose rocks > 256mm diameter (approx. large head size)

Cobble (CO) Loose material 64-256mm diameter (half-fist to large head size).

Gravel/pebble(GP) *A combined category*. Coarse gravel is 16-64mm diameter; fine gravel is 2-16mm diameter. Pebbles are conker to half-fist size.

Where it is obvious that either pebble or gravel dominates, ring either the **G** or the **P** (ie **G P** or **G P**) depending on which one is predominant. If the proportions are equal or it is not possible to determine which is predominant, leave as normal.

Sand (SA) Particles < 2mm but > 0.06mm in diameter.

Silt/mud (SI) Very fine material as a deposit.

Clay (CL) Solid surface comprising sticky clay material.

Peat (PE) Predominantly or totally peat.

Artificial (AR) eg concrete ☼ 28

Any channel substrates which are considered to be present in >1% of the whole site but NOT recorded in the spot-checks must be entered in the appropriate box in the end column on the form.

PREDOMINANT FLOW TYPE

Recognising flow types in the field

The nine flow types used for RHS are largely based on velocity, flow direction and the influence of the substrate on the flow. Flow type will change with different river levels but the definitions correspond to 'normal' dry-weather conditions.

Relying on photographs (Part Five) for recognition of flow types is inadequate; much of the diagnostic character for flow types comes from other clues such as movement, sound and relative position in relation to channel features. An ***RHS geomorphology training video*** has been produced which describes characteristics of all the flow types. All surveyors should study the video, as part of their overall training.

The flow types are:

Free fall (FF) Where the flow separates clearly from the 'back-wall' of a distinct vertical feature. Generally associated with ***waterfalls***. ☼ 29

Chute (CH) A low, curving fall with substantial flow contact with the substrate. There may be multiple chutes in a short distance often over individual boulders or bedrock outcrops. Associated with ***cascades***. ☼ 30

Broken standing waves (BW) These are the 'stoppers' of canoeists and rafters but may occur on a localised scale where water appears to be trying to flow upstream. A **white water tumbling wave** must be present for the wave to be described as broken. Mostly associated with ***rapids,*** but may occur within a ***riffle***. ☼ 31

Unbroken standing wave (UW) This is water with a disturbed surface which has **upstream facing wavelets** which have not broken: white water may occur as crest waves, not as breaking waves. Associated with ***riffles*** but may also occur within a ***rapid***. ☼ 32

Chaotic flow (CF) A mixture of all the 'rough' flow types (FF,CH,BW,UW) in no organised pattern. **Not to be used as a "catch-all".** Chaotic flow may only be used where there are **three or**

more flow types at a spot-check, and there is no clear predominant type. ☼ 33

Rippled (RP) — No coherent pattern in relation to flow direction, ie no waves. These ripples are symmetrical and **only a centimetre or so high.** General flow direction is downstream but beware windy conditions because these surface undulations are small enough to be wind dragged. ☼ 34

Upwelling (UP) — Where the water surface 'heaves' as upwellings or vertical '***boils***' reach the surface, eg, at tight bends or below falls and cascades. ☼ 35,36

Smooth (SM) — **Laminar (smooth boundary turbulent) flow**. **Moving water without a disturbed surface**. If in doubt, put a rod into the flow (or observe shadows on the bed in clear water) and you will see surface movement either side of the rod. Associated with ***glides.*** ☼ 37

No perceptible flow (NP) — In ponded reaches (above natural bedrock control and weirs), it may be difficult to perceive surface water movement. Use the rod test (as in **SM**), and no surface movement either side of the rod will be seen. Straw or foam may give the only impression of flow. Associated with ***pools, ponded reaches*** and ***marginal deadwater,*** including stagnant pools in prolonged dry conditions. Also associated with ***pools*** where there may be obvious rotational or even upstream surface flow. ☼ 38

No flow (NO) — Completely dry river beds. Includes those in limestone/chalk areas downstream from a sinkhole.

*NB. In all instances, the **predominant** flow type (ie occupying > 50% of the wetted channel) is recorded and only **one entry per spot-check** is allowed.*

Where there are two flow types, both occupying about 50% of the wetted channel, the **faster** flow type should be recorded.

Beware of strong winds giving false impression of flow (eg ripples, movement of light debris).

CHANNEL MODIFICATIONS

Not known (NK) — Self-explanatory

None (NO) — No obvious modification to channel bed

Culvert (CV) — Arched channel or pipeline for carrying water beneath a road, railway, etc. ☼ 39

Resectioned (RS) Obvious regrading/resectioning (reprofiling) of channel bed.

Reinforced (RI) Artificial reinforcement of channel bed; includes concrete aprons. ☼ 28

Dam/weir (DA) In-channel structure controlling river flows/levels. ☼ 40

Ford (man-made) (FO) Permanent artificial fording place: can be rubble infill (farm track) or road crossing.

CHANNEL FEATURES

Not visible (NV)	Self-explanatory
None (NO)	None present
Exposed bedrock/boulders (RO)	Bedrock or boulders outcropping/protruding above water level. Often covered with mosses/liverworts in upland streams. ☼ 41,42
Unvegetated mid-channel Bar (MB)	A distinctive depositional feature composed of unconsolidated material (usually coarse gravels and sands) derived from the channel, exposed at low flow, with a shallow slope into the water. 'Unvegetated' defined as <50% perennial plant cover. Will be covered during periods of high flow. ☼ 26
Vegetated mid-channel Bar (VB)	A distinctive depositional feature composed of bed material from the channel, exposed at low flow with a shallow slope into the water. Perennial vegetation, often reedgrass, occupying ≥50% of area. Include moss-covered substrate as this indicates stability. Will be covered during periods of high flow. ☼ 43,44
Mature island (MI)	Permanent mid-channel feature with surface at or above bankfull height. Invariably vegetated, often with established scrub and trees. If a mature island is surrounded by significant deposits of fresh material, then both mature island and unvegetated mid-channel bar should be recorded. This indicates the presence of a mature feature and unstable, active deposition. ☼ 44
Urban debris (TR)	Bricks, shopping trolleys etc. ☼ 45

Mid-channel bar *Point bar* *Side bar*

F. BANKTOP LAND-USE AND VEGETATION STRUCTURE

To be assessed over 10m length of bank at each spot-check. Refer to spot-check key.

The contribution of land-use and vegetation structure alongside watercourses can be significant to habitat quality. Traditional attempts to measure the "riparian zone" have proved unsuccessful since surveyors have had to make subjective decisions in the field. To overcome the problem, data gathering has been simplified so that decision-making regarding the presence, extent and importance of a riparian zone or buffer strip is left to analysis of the results.

At each spot-check, using the 10m wide transect guidance, surveyors are required to (i) identify land-use within 5m of banktop using abbreviations in the spot-check key; (ii) determine the vegetation structure within 1m of the banktop and (iii) determine the vegetation structure on the bankface, using B (bare), U (uniform), S (simple) or C (complex). *See below for guidance.*

Since floodplain land-use up to 50m from each bank is also recorded (in section H), the combination of structure within 1m, land use within 5m and a general overview of land-use will enable the data to be interrogated in a sophisticated fashion if required.

Banktop The point where the river spills onto the floodplain (ie the definition used for "bankfull" in the channel dimensions section on page 36). Where no distinct breaks in slope occur (eg upland streams in vee-shaped valleys), the bankfull height may be defined by the winter flood level, often marked by a trashline.

An illustrated example of how the land-use and vegetation structure would be recorded in an asymmetrical valley is set out below.

Hedges ☼ 48

NB. A banktop hedgeline should be recorded as complex structure (**C**) in spot-checks and not included as tree distribution (section J). A hedgeline with scattered "standard trees" would be recorded as complex structure in the spot-checks with "isolated" or "regularly spaced" trees in section J as appropriate.

LAND-USE WITHIN 5m OF BANKTOP

To be assessed over 10m length of bank (see Figure 1). Land-use categories are abbreviated as follows:

Broadleaf/mixed woodland (BL)	Woodland containing trees > 6m in height. Includes broadleaf plantation.
Coniferous plantation (CP)	Native conifers can be noted in section R.
Orchard (OR)	Enclosed land with fruit trees.
Moorland/heath (MH)	Upland or lowland heath-dominated communities.
Scrub (SC)	Brambles, woody shrubs, thicket, bracken.
Tall herbs/rank vegetation (TH)	Waist high or taller. Include conservation headlands.
Rough/unimproved pasture (RP)	Herb-rich, unimproved upland and lowland grassland, often with 'coarse' grass or rushes, often in tussocks.
Improved/semi-improved grass (IG)	All grassland other than rough/unimproved. Pasture/meadow/amenity grassland which is reseeded or artificially fertilised.
Tilled land (TL)	Any agricultural land which involves annualploughing. Includes root crops and horticulture.
Wetland (WL)	Includes bog, marsh, fen.
Open water (OW)	Includes natural and artificial waters.
Suburban/urban development (SU)	Buildings, gardens, roads, tracks, rail etc.
Rock and Scree (RS)	Extensive natural rock, mountain scree etc.

VEGETATION STRUCTURE

To be assessed over 10m length of bank (see Figure 1). Category to be determined by the occurrence of different vegetation types.

Vegetation Structure This is based on 3 categories of predominant structure representing vertical layering. *Refer to spot-check key for diagrammatic representation.*

Bare (B) Predominantly bare ground (or buildings, concrete etc). Less than 50% vegetation cover over the 10m banklength. ☼ 22

Uniform (U) Predominantly one vegetation type, but lacking scrub or trees.

☼ 61

Simple (S) Predominantly 2-3 vegetation types, with or without scrub or trees. ☼ 46,47

NB trees with little or short herb understorey (eg coniferous forestry extending to the riverbank) to be included in this category.

Complex (C) Four or more vegetation types, which **must** include scrub or trees. Includes seral succession up the bank, as well as 'random' patterned occurrence of different vegetation types including trees. ☼ 48,49

Vegetation types to be included in assessment:

Bryophytes	Mosses and liverworts
Short/creeping herbs & grasses	Ankle-shin height (includes ivy)
Tall herbs & grasses	Knee height and taller; includes bracken and ferns
Scrub	Brambles, woody shrubs, thickets
Saplings/trees	Trees >6m in height

*NB. Since this exercise is a rapid overview, only the **predominant** structure is to be assessed. Time should not be spent searching for relatively inconspicuous types of vegetation.*

G. CHANNEL VEGETATION TYPES

To be assessed within a 10m wide transect across the channel at each spot-check (see Figure 1). Channel vegetation types are recorded to assess their importance as a habitat structure. Predominant character and leaf-form are important, since species are not distinguished. As a guide, a channel vegetation type must occupy at least 1% of the channel area within the 10m transect in order to be recorded.

None	If no vegetation is present or visible, tick this box.
Mosses/liverworts/lichens	Mosses, liverworts and lichens. These may be exposed or submerged. ☼ 50,51
Emergent broad-leaved herbs	Broad-leaved plants rooted in the river bed or along edges. Leaves and flowers above water level eg *Apium, Rorippa* spp. ☼ 52
Emergent reeds/sedges/ rushes	Narrow leaved monocotyledons (reeds/sedges/rushes) rooted below water or along water's edge. eg *Sparganium erectum, Schoenoplectus, Typha, Phragmites, Glyceria maxima, Juncus* spp, *Carex* spp. ☼ 53
Floating-leaved (rooted)	Rooted in river bed but with floating leaves eg *Nuphar lutea, Potamogeton natans, Sparganium emersum*. ☼ 54
Free-floating	eg *Lemna* spp. *Hydrocharis, Ceratophyllum, Stratiotes.* ☼ 55
Amphibious	Rooted at edge or in bank but shoots or leaves trailing into or across the water eg *Polygonum amphibium, Agrostis stolonifera, Glyceria fluitans, Alopecurus geniculatus, Myosotis scorpioides.* ☼ 56
Submerged broad-leaved	Rooted and completely submerged. Includes submerged *Nuphar*, *Elodea* spp, *Callitriche* spp. ☼ 57
Submerged linear-leaved	Rooted and completely submerged. Includes submerged *Sparganium erectum, Butomus umbellatus, Typha, Sagittaria sagittifolia*.
Submerged fine-leaved	Rooted and completely submerged. Includes submerged *Ranunculus* spp *Myriophyllum* spp, *Ceratophyllum* spp. ☼ 58
Filamentous algae	eg *Cladophora, Enteromorpha*, either occurring alone or coating aquatic plants or stones. ☼ 59

It is important to complete the end "catch-all" column to assess overall presence and character of vegetation types occurring in 500m as a whole including types not recorded at the spot-checks. Use E for ≥ 33% channel area, or ✓ as appropriate in each instance.

H. LAND-USE WITHIN 50m OF RIVER

Use E (≥33% of banklength within site) or ✓(present) for both left and right banks. See guidance for land-use categories in section F.

I. BANK PROFILES

Use E (≥33% of banklength within site) or ✓(present) for both left and right banks

Natural/unmodified profiles

Examples of vertical/undercut, vertical with toe, and composite bank profiles are illustrated by ☼ 22,60,61

Artificial/modified profiles

Resectioned (reprofiled) bank	Profile modified **but not reinforced** often to accommodate flood flow and access for maintenance machinery. Normally a relatively smooth, angled slope. ☼ 17,18,19
Reinforced bank	Whole or part of bank artificially strengthened for bank protection purposes. Differentiated into top only, toe only and whole bank to indicate extent of reinforcement. ☼ 9,10,11,12,13,14,15,62 (Toe only)
Artificial two-stage channel	This is where one or both banks have been excavated laterally into the floodplain to create a shallow shelf above dry-weather flow. Water spills into the second stage channel during flood flows. ☼ 63
Poached	Bank significantly trampled or puddled by livestock. Include banks trampled as a result of human activity. ☼ 20
Embanked	Embankment created to artificially increase the banktop height. Forms an integral part of the bank. ☼ 64
Set-back embankment	Artificial embankment/bund to increase flood capacity but set back from the river channel and forming a distinct landscape feature. ☼ 65

J. EXTENT OF TREES AND ASSOCIATED FEATURES

Due to the importance of trees and associated features, these warrant individual attention.

Trees are defined as woody plants >6m tall.

Trees *Tick one box only for each bank.*

Isolated/scattered

Regularly spaced, single

Occasional clumps

Semi-continuous

Continuous

Associated features *Tick appropriate box for occurrence within the whole 500m ie "none"; ✓present; or E ≥33% either as channel area or total banklength.*

Shading of channel Extent of direct canopy shade on channel surface area.

Overhanging boughs Larger (forearm-size) tree boughs which dip very close to the water surface. ☼ 66

Exposed bankside roots Extensive network of large (≥forearm-sized) exposed roots and associated cavities. Good otter holt structure.

☼ 67

Underwater tree roots Exposed underwater fine/matted tree/shrub roots. Alder roots are distinctive. ☼ 68

Fallen tree(s) Tree(s) uprooted or collapsed *in situ* still attached to bank, either alive or dead. ☼ 69

Coarse woody debris Trees, large branches, etc, swept downstream and temporarily occupying part of channel. ☼ 70

K EXTENT OF CHANNEL FEATURES

The extent of all these features should be recorded on the sweep-up as 'none', present (✓), or E (≥33% of total channel area).

Channel features

RHS uses flow types as a guide to habitats in the channel: 'spotting' them is appropriately done at spot-checks (section E). However, for RHS it is necessary to translate groupings of flow types as larger features in the context of the site as a whole. For example, a 'rapid' may be longer than 50m (the distance between two spot-checks). A 'cascade' has two flow types (chute and broken standing waves). No perceptible flow is associated with a 'pool' or a 'ponded reach' if the feature is central but this is known as 'marginal deadwater' - a different habitat - if at the channel margins.

Table 1 (overleaf) shows the relationship between channel features and flow types.

Flow/substrate-related channel features change with increasing river discharge hence the need to carry out RHS at normal (dry-weather) flows.

The channel features in section K are:

Waterfall — A feature of bedrock channels. **Free fall** flow which separates from rock. ☼ 80

Cascade — **Chute flow** occurring over boulder substrates or bedrock outcrops. Often associated with broken standing waves downstream. ☼ 71

Rapid — Best identified from the whitewater **broken standing waves**, normally over a cobble, boulder or bedrock substrate, with a steep gradient. ☼ 73

Riffle — Shallow, fast-flowing water with a *distinctly disturbed surface*. **Unbroken standing waves** dominant. ☼ 4

NB riffles often become rapids at high discharges.

In seasonally-vegetated streams, aquatic macrophytes may create a 'riffle' by constricting or obstructing flow or by causing sediment deposition which raises the river bed. ***Do not record this as a riffle.*** ☼ 5

Run — Generally fast-moving water with **rippled** surface but no other major features of turbulence. Often associated with a high-velocity feature (eg rapid or riffle) just upstream or where the channel narrows and therefore speeds up the flow. Also, where relatively narrow channel has a moderate, even gradient. ☼ 74

Boil — An **upwelling flow** feature found below falls, some chutes, in meander bends (in the scour pool) and around fallen debris (trees). ☼ 35,36

Glide — Water can move quite fast in glides but 'effortlessly' as **smooth** flow; only careful inspection reveals the turbulence. Also

	common on smooth bedrock surfaces but may be quite a short feature in those cases. In gently-sloping clay rivers, a glide can extend to hundreds of metres in length. ☼ 75
Pool	A distinct natural feature of deeper water. In dry-weather conditions, there is **no perceptible downstream flow**. Back currents may be present. Pools should occupy most of the wetted channel width. ☼ 6 *If a pool is longer than 3 times the channel width, check for the presence of artificial ponding (impoundment).*
Ponded Reach	**No perceptible flow** created by natural bedrock control or artificial obstructions (such as weirs) downstream.
Marginal deadwater	Marginal areas with **no perceptible flow** - perhaps where the bank has eroded into an embayment. Also in remnants of old abandoned channels. ☼ 76,77
Exposed bedrock/boulders	Bedrock or boulders outcropping/protruding above water level. Often covered with mosses/liverworts in upland streams. ☼ 41,42
Unvegetated mid-channel bar	A distinctive depositional feature composed of unconsolidated material (usually coarse gravels and sands), derived from the channel, exposed at low flow, with a shallow slope into the water. 'Unvegetated' defined as <50% perennial plant cover. Will be covered during periods of high flow. ☼ 26
Vegetated mid-channel bar	A distinctive depositional feature composed of bed material derived from the channel, exposed at low flow with a shallow slope into the water. Perennial vegetation, often reedgrass, occupying ≥ 50% of area. Include moss-covered substrate as this indicates stability. Will be covered during periods of high flow. ☼ 43,44
Mature island	Permanent mid-channel feature with surface at or above bankfull height. Invariably vegetated, often with established scrub and trees. If a mature island is surrounded by significant deposits of fresh material, then both mature island and unvegetated mid-channel bar should be recorded. This indicates the presence of a mature feature and unstable, active deposition. ☼ 44
Unvegetated side bar	A distinctive depositional feature composed of bed material derived from the channel; exposed at low flow; shallow slope into the water. 'Unvegetated' defined as <50% perennial plant cover. Found in locations other than inside of distinct bends. ☼ 26

Vegetated side bar A distinctive depositional feature composed of bed material derived from the channel; exposed at low flow; shallow slope into the water. 'Vegetated' defined as ≥ 50% perennial plant cover. Include mosses as they indicate stability. Found in locations other than inside of distinct bends. ☼ 27

Discrete silt deposits A discrete silt deposit either underwater or on the margins with a minimum size of $5m^2$. Only use E when more than a third of the river has frequent occurrence of such features.

Discrete sand deposits A discrete sand deposit either underwater or on the margins with a minimum size of $5m^2$. Only use E when more than a third of the river has frequent occurrence of such features.

Table 1: Channel Features and associated Flow Types

Channel Features	**Flow Type(s)**
Waterfall	**Free fall**
Cascade	**Chute**, broken standing waves
Rapid	**Broken standing waves**, unbroken standing waves
Riffle	**Unbroken standing waves**, broken standing waves
Run	**Rippled**
Boil	**Upwelling**
Glide	**Smooth**
Pool	**No perceptible flow**
Ponded reach	**No perceptible flow**
Marginal deadwater	**No perceptible flow**

L. CHANNEL DIMENSIONS

Make sure that Health & Safety guidance (Appendix 3) is strictly followed when entering the channel to take measurements. For large rivers in which depth cannot be safely measured, enter "unknown" in appropriate box.

Measurements of Choose a straight section preferably with well-defined banks

width, depth and height

and a riffle and measure channel and bank dimensions there. In some instances the channel dimensions will need to be taken at a location other than at one of the spot-checks.

NB Not all sites will have a riffle. Where there is not a riffle, indicate what flow type is present at the location where channel dimensions are taken. In some instances, the river bed will be inaccessible and consequently water depth and bed consolidation unknown. If so, indicate accordingly.

Rangefinders and ranging poles will improve the degree of accuracy. When a rangefinder is used, indicate with (R) in width measurement entry.

Banktop height (m)

Banktop height is the vertical distance from water level on the day, to the first major break in slope above which cultivation or development is possible.

Bankfull height (m)

Bankfull height is the vertical distance from water level on the day, to the point where the river first spills on to the floodplain. Indicate using 'yes' or 'no' whether the bankfull height is equivalent to the banktop height.

Bankfull width (m)	Bankfull width is the horizontal distance across the channel to be measured at a level where the river first spills on to the floodplain.
Water width (m)	Water width is the distance across the wetted perimeter of the channel.
Water depth (m)	Water depth is the maximum depth measured in mid-channel. Do not use "greater than", always try to estimate depth where possible, otherwise use "not visible".
Embanked height (m)	The extra height represented by artificial addition of material for embankment. Include set-back embankments where practicable.
Trashline	The height of the trashline is to be recorded if lower than the banktop. This gives an indication in overdeepened channels of the 'natural' bankfull height, where the trashline marks the winter flood level.
Bed consolidation	**Consolidated bed** will normally be characterised by algal or macrophyte growth on gravel and a stable 'feel' when kicked. **Unconsolidated bed** will comprise clean fresh gravel which is easily dislodged or moved when kicked.

An illustrated example of how channel dimensions would be recorded is shown below.

M. NUMBER OF ARTIFICIAL FEATURES

Indicate the number of each feature in each category (major, intermediate, minor) within site or "none" as appropriate. Use tally system and add up total at the end of the survey.

Weirs

Major = weir across entire width of channel (but not rubble/loose stone); side weir ≥25m long. ☼ 40

Intermediate = rubble/loose stone weir; overspill weir; side weir 10 - 25m long.

Minor = side weir <10m long.

See diagram below

Sluices **Major =** structure across the whole channel for controlling the volume or flow of water. *(only category)*

Culverts **Major** = arched channel or pipeline for carrying water beneath a road, railway etc. *(only category)* ☼ 39

Bridges **Major** = road or rail bridges with abutments ≥ 25m long and/or with in-channel supports.

Intermediate = road or rail bridges with abutments 10 - 25m long and without in-channel supports.

Minor = road, rail or foot bridges (include only those with permanent footings, ie not just planks laid across the channel), with or without abutments (< 10m long) and without in-channel supports.

Revetments Artificial bank structures (could be integral part of a building).

Major = ≥ 25m long.

Intermediate = 10 - 25m long.

Minor = < 10m long.

Outfalls **Major** = permanent outfalls. Exclude land drains. *(only category)* ☼ 78

Fords **Major** = permanent *artificial* fording place: can be rubble infill (farm track) or road crossing. *(only category)*

Deflectors **Minor** = structures built into the riverbank to deflect current, such as groynes, croys, hurdles and blockstone. *(only category)*

Other State other structure(s), such as fishing platforms, jetties, etc. and where appropriate, categorise as follows:

Major = bank structures ≥ 25m long.

Intermediate = bank structures 10 - 25m long

Minor = bank structures < 10m long

Is water impounded by weir/dam? If weir or dam is present, indicate if site is affected partly (<33% of site) or predominantly (>33% of site) by artificial channel impoundment. Include effects of weirs or dams downstream of the site if appropriate. ☼ 79

N. EVIDENCE OF RECENT MANAGEMENT

---

*A brief descriptive checklist of **recent** activities and location (left/right banks, channel). Use following categories: dredging, weed cutting, bank mowing, enhancement. Describe other activities as appropriate.*

Recent activity "Recent" is defined as showing **obvious signs** eg machinery present, excavated bare earth, weed/brash cuttings and mowings, unvegetated dredge spoil on bank etc.

Enhancement works Examples include meander and riffle reinstatement, channel narrowing, reed-planting, tree-planting. Most will only be obvious when recent.

O FEATURES OF SPECIAL INTEREST

This is an opportunity to record features of special interest either in the river or floodplain.

The extent of all these features should be recorded on the sweep-up as 'none', present (✓), or E (≥ 33% of total channel length).

Waterfall >5m high Uninterrupted free-fall flow >5m high. ☼ 80

Braiding channels Naturally divided course of a river, characterised by at least two channels which often change their course regularly. ☼ 81

Side channel Permanent channel running parallel, and connected, to the main channel. Occurs most commonly in chalk rivers.

Debris dams Log jam of woody debris creating an obstruction across the channel and ponding back water. ☼ 82

Leafy debris Significant accumulations of twigs and leaf litter along channel edge. An important transitory habitat for insects.

Floodplain features should normally be recorded within a 50m corridor either side of the channel. However, features of special interest visible from the river, but beyond ca 50m, should also be recorded in this section.

Artificial open water Includes gravel-pits, reservoirs, flooded quarries, inland marinas. ☼ 83

Natural open water Includes abandoned ox-bows, lakes, meres. ☼ 84

Water Meadow Floodplain meadows, often associated with chalk streams, traditionally deliberately flooded (irrigated by water channels): drainage channels shallow and parallel. Consist of wet irrigation channels and dry drainage channels. ☼ 90

Fen Mainly lowland wetlands fed by base-rich groundwater, dominated by sedge vegetation. ☼ 85

Bog Area of rain-fed acid peatland. ☼ 86

Carr Wet woodland composed of trees such as willow and alder, often at the edge of other wetlands. ☼ 87

Marsh Fluvial flooded/impeded drainage habitats often dominated by rushes. Often on floodplains. ☼ 88

Flush Groundwater seepage or springs producing a localised wet area. ☼ 89

Fringing reed-bank Fringing reeds which extend at least half-way to bank top. To be recorded, must extend at least 10m along the banklength. See diagram below.

Floating mat A distinct floating 'ledge', equivalent to a 'quaking' bog which extends into the channel. Usually an extension of adjacent wetland into the channel. Extremely rare. See diagram below.

Other *Record any other features of interest, eg reedbeds, herb-rich wet grassland, etc, if appropriate.* ☼ 91,92

P. CHOKED CHANNEL

If 33% or more of the total channel area is choked with vegetation, causing **significant** impediment to flow, indicate by ticking appropriate box. This will depend to some extent on seasonal influences, and dried up stretches of river with abundant *Phalaris* will be included. ☼ 93,94

Q. NOTABLE NUISANCE PLANT SPECIES

Indicate presence within by ticking appropriate box. *Estimate abundance within site as a whole by ✓(present) or E (≥33% total banklength).*

Giant Hogweed ☼ 95; Himalayan Balsam ☼ 96; Japanese Knotweed ☼ 97

R. OVERALL CHARACTERISTICS

Circle relevant prompt words on the form and add others as appropriate.

Major impacts Any major impacts on the site.

Land management Any existing land management within the site.

Animals Sightings of mammals, birds, insects, etc, of interest (see Appendix 4 for BTO's list of birds).

S. ALDERS

Record the presence of alders by ticking appropriate box *(none,✓(present) or E (≥33% total banklength)).*

Record the presence of diseased (dead or dying) alders in the same fashion.

This information is needed for a national assessment of the incidence of *Phytophthora* root disease. See Part Seven for illustrated guidance.

PART SIX - TECHNICAL APPENDICES

APPENDIX RHS.1: HEALTH & SAFETY GUIDANCE

Being near rivers, streams or any other body of water, either for work or recreation, is potentially dangerous.

The survey supervisor is responsible for making all field staff aware of potential dangers and the procedures in case of accidents.

Safety should be an integral part of any RHS training programme. For example, knowledge about Weil's disease is essential; a waterproof card giving information on Weil's disease is available from Agency Regional Health & Safety Advisors.

Every effort should be made to minimise risks in the field by following common-sense behaviour such as:

- wearing a life jacket where necessary
- avoiding steep or unstable banks
- avoiding rivers during spate conditions
- not entering the water if the river-bed is not visible
- working in pairs if river channels need to be crossed
- watching out for hazards, especially in urban rivers, such as broken glass, sharp metal or decomposing waste
- taking care to avoid contact with the water, soil or low vegetation before eating or drinking during field work
- wearing the right clothes for the job and weather conditions
- carrying a basic first-aid kit
- following reporting-in and signing-off procedures, linked to a home base; this is especially important for surveyors working alone.

Survey supervisors should ensure that the location of individual surveyors undertaking fieldwork is known and should establish an agreed system of emergency action in case a surveyor does not report in or sign off at the end of the day.

APPENDIX RHS.2: LONE WORKER CODE OF PRACTICE

This Appendix contains excerpts from the Environment Agency Lone Worker Code of Practice.

Lone working is a common feature of the Environment Agency's operations. The Agency recognises that lone workers face particular problems due to the nature of their work and will not require employees to work alone where this results in unacceptable risks. Management must therefore assess the risks its lone workers face and wherever possible should strive to remove or reduce the risks to an acceptable level.

The Agency is responsible for the health and safety at work of its employees and those affected by its operations. These responsibilities cannot be transferred to its lone workers. The Agency has a duty to organise and control the working activity of its lone workers in a safe manner.

On-site assessments by individuals forms a vital part of implementing the lone worker code of practice and safe working practices. It must be stressed that where lone workers find themselves in situations, which in their opinion, may be stressful or hazardous, then they are able without fear of prejudice to request assistance. The conditions that give rise for concern should, in future, be re-assessed for suitability for lone worker task.

All Agency employees have a responsibility to act in such a way as not to put themselves or their colleagues at risk and where they work alone the Agency places even greater trust in them to act responsibly and safely, and to co-operate with their employer in the discharge of their legal obligations.

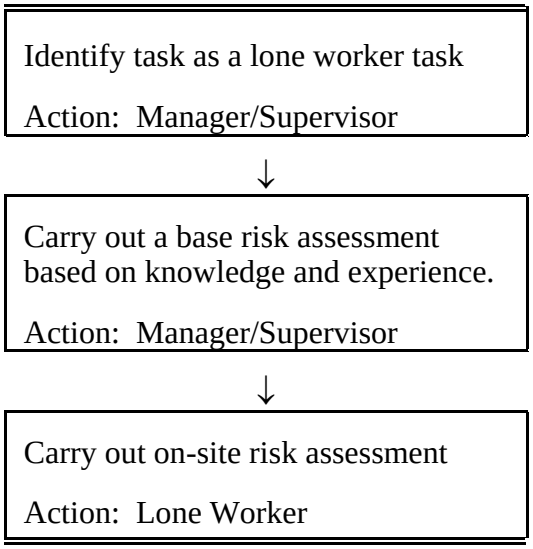
Management are responsible for ensuring that safe systems are designed, in use and that records are kept on lone working activities. Employee representatives should be involved in the design of safe systems.

RISK ASSESSMENT - LONE WORKING ACTIVITIES

The design of a safe system of work for lone working tasks will depend on the quality of the risk assessment carried out.

For a risk assessment to be full and meaningful it requires that all foreseeable hazards are taken into account during the assessment phase and that where the hazard cannot be removed or reduced to an acceptable level then appropriate precautions must be prescribed ie considered unsuitable for lone working.

The risk assessment may be carried out in three phases:



Once the risks have been assessed and the hazards identified then the appropriate safety precautions can be taken to minimise the potential risks to an individual.

The purpose of a safe system for lone workers is to ensure that all such tasks can be carried out in a safe manner with negligible risk of injury to individuals.

Once a task has been identified as a lone worker task then the design of a safe system of work must fully examine the following areas:

(1) The Work Location

(2) The Hazards

(3) Safety Equipment

(4) Personnel

(5) Communications

All tasks identified as lone worker tasks will need to be re-assessed in the light of changing conditions and legislation.

(1) THE WORK LOCATION

Some sites present dangers to the lone worker and full consideration must be given during the risk assessment phase to the potential for risk inherent in each site.

Sites which may be considered as dangerous are as follows:

Waste Disposal Sites

Motorways/Roads

Construction Sites

Active/Disused Lagoons

Marsh/Swamp Areas

Estuary and some Foreshore Sites

Coastal Cliffs, Steep Slopes, Steep River Banks

Industrial Sites

Agricultural Sites

Weirs and Flumes

Military Ranges

Gauging Stations

Remote/Isolated Locations

Some Inner City Areas

NB Culverts and Manholes: these are deemed to be confined spaces and therefore may be unsuitable for lone working tasks.

(2) **THE HAZARDS**

The hazards a lone worker may meet are varied and can include the following:

Drowning	Physical Attack/Abuse
Electrocution	Exhaustion
Major Injury	Poisoning
Hypothermia	Minor Injuries requiring First Aid
Animal Attack	Tides
Access/Egress	Crossing Railway Lines
Weather conditions	Hazardous Chemicals
Getting Lost	Night Working

Slips, Trips, Falls

Infection

Confined Spaces:

- Oxygen Deficiency	}**These hazards preclude**
- Explosive Atmosphere	}**solitary working**
- Toxic Gases	}

In some areas the weather may be fine at the commencement of the task but it can rapidly deteriorate into a "white-out" or a "black-out", giving rise to very unsafe conditions. When considering climatic conditions weather forecasts must be consulted. Lone workers must be aware of changing conditions and never exceed safe limits.

(3) **SAFETY EQUIPMENT**

The risk assessment will determine the level of safety equipment required for a given task which may include some of the following equipment:

- Life Jackets (Standard Issue)
- Protective Clothing to suit conditions
- Footwear to suit conditions
- Eye, Head and Hand Protection
- Safety Harness and Line
- Throw Lines
- High Visibility Jackets
- Air Horn
- Cyalume Flares
- Electronic Anti-Person/Animal Alarm
- Emergency Pack to include:
  - Torch
  - Compass
  - Hypothermia Blanket
  - OS Map
  - Survival Rations
  - First Aid Kit
  - 3 in 1 Gas Detectors

(4) **PERSONNEL**

The selection and training of personnel is crucial to the safe and successful completion of any lone working task.

Personnel should be both physically and mentally fit to carry out the lone working tasks. This requirement will necessitate a periodical medical examination (to an agreed medical protocol) by the Regional Medical Adviser.

Training is a very important factor in the safety of lone workers and should be designed to meet the needs of all Agency functions. All newly appointed staff considered for potential lone working posts should receive comprehensive health and safety induction training which may be function specific and may include general training as follows:

Swimming, Life Saving and Resuscitation Skills
Emergency First Aid
Survival Skills
Fitness Training
Map Reading including use of Compass
Use of Safety Equipment
Communication Skills
Self Awareness/Confrontational skills

There will be a need for managers/supervisors to receive specific training in risk assessment techniques.

(5) COMMUNICATIONS

Good communications enhance the safety of lone workers. The type of equipment provided, ie portable cell phone or radio, will depend on individual regional standards. It should be an objective of all regions to provide adequate means of communications commensurate with the risks involved in lone working. Effective communication systems improve the efficiency of the functions within a region.

Regions should maintain an efficient and disciplined reporting procedure through the 24-hour control centre and should include emergency procedures for all lone worker activities, to include reporting in:

1.	At commencement of task
2.	Periodically during the task as required
3.	On completion of task
4.	Any deviation to planned daily routine

Failure to report in at due time should activate the internal emergency procedure which may include in extreme circumstances contact with the Emergency Services.

NB The possibility of a dedicated Agency lone worker alarm system (personal issue) being made available in the near future will add to the safe operation of lone worker tasks.

PART SEVEN DISEASED ALDERS

PART EIGHT - SERCON

1. DETAILED GUIDANCE FOR ADDITIONAL SERCON COMPONENT

This guidance is only for surveyors required to complete SERCON as part of their river survey.

Refer to the one-page "addional SERCON component" field survey form at the end of this section.

T. SERCON ITEMS I-IX

This section provides an opportunity to record how much of the 500m reach has been affected by engineering works which change its planform, cross-section and longitudinal section, etc (I & II). Some rivers recover from past engineering by restoring in-channel and bankside habitats and features - the extent to which this has occurred is recorded in III & IV. Sections V - IX enable recording of the 'naturalness' of bank and riparian flora to be recorded.

SERCON will use the figure in column T(otal) which is a percentage estimate of the 500m affected - one of 12 figures can be selected from 0 - 95. For example, recording 1% would indicate **some** change, but this would affect <12.5m of river or 25m of bank; 45% indicates just under half the reach is affected whilst 55% indicates just over half is affected, etc. To help surveyors recall information, columns have been provided to record information between each spot-check (SC1-10) - entering information here is not essential, but recording a figure of 0 - 95 or N/A (not applicable) is essential for boxes in column T.

T I: Planform

Assess whether the river within the 500m survey reach flows on a course which has been determined by man's efforts to straighten and move it, or whether river processes have been responsible for its planform. Enter percentage of the 500m realigned.

T II: Longitudinal/cross-sectional channel profile

If a river has been straightened, longitudinal and cross-sectional profiles will have been altered. Similarly, rivers which are deepened and/or widened, but retain their planform, will also have modified profiles. Record the percentage of the reach affected. In some cases minor deepening will not be obvious, whilst in others some affected sections within a reach will be obvious and others not. Signs include uniform side slopes to earth banks, clear cut surfaces at the toe of the bank, no trees at the water's edge, similar structures on opposite banks, etc.

Any river that has a modified planform (I) must have modified profiles (II), but not vice-versa.

T III: Recovery from straightening, deepening and widening

Where a river has been degraded by past works, record the extent to which the 'natural' habitats shaped by fluvial processes have re-established. Variations in longitudinal and cross-sectional depths should be evident usually with appropriate changes in substrate.

Thus riffle/pool sequences should have re-developed, and there will be some erosion and deposition as the river attempts to regain its former length by forming a more sinuous course. *Score the percentage recovery of the AFFECTED stretch, not the whole 500m reach if ALL has not been affected.*

T IV: Recovery from bank re-profiling or revetments

As in TIII score for the extent of recovery within the affected reach where banks have been re-profiled or revetted. Typically the uniform shape created will have been changed to one of great variety by either deposition or erosion (or both). The same also applies to where tipping has occurred, but deposition and establishment of 'natural' vegetation are key points to recovery. Where revetment has broken away, or boulder/blockstone armouring has become covered in deposits and vegetated, indicate the % area of the revetment that has recovered. Note in W the type of recovery taking place.

T V-VI: Naturalness of the vegetation of the riparian zone

Natural or semi-natural communities are dominated by native species where the assemblages reflect little disturbance for many decades. Communities characteristically associated with rivers include ancient wet woodland, alder/willow carr, fen, bog, wet heath, swamp, alluvial wet grassland, tall wet herb, etc. A minimum requirement to be recorded as 'semi-natural' is the presence of some species of ancient grassland in an otherwise semi-improved pasture; herb-rich semi-improved pasture with no such species would **not** qualify.

(V) *Record the percentage of the riparian zone area (5m land-use) covered by natural/semi-natural vegetation, but exclude all communities indicative of disturbance (eg invading ruderals such as nettles, tall grass, aliens, etc). If the understorey of a developing willow scrub is dominated by nettles, also ignore.*

(VI) *Record the percentage of the area noted in (V) that has vegetation typical of river corridors. The presence of several species (or dominance of a single species) indicative of ancient wet woodland, fens, reedbeds, wet heaths and rushy pastures should be used.*

T VII-IX: Naturalness of the plant assemblages on the banks

The truly natural plant assemblages of river banks are usually trees with a ground flora dominated by species associated with woodland and carr. In the western parts of the UK, rivers are of major European significance for bryophytes which require high humidity.

For SERCON purposes, natural or semi-natural communities of river banks are considered to be dominated by native species where the plant assemblages reflect little disturbance for many decades. Typical examples of semi-natural bank communities with no special affinity to rivers include dry woodlands, scrub, dry meadows and dry heaths. When the bank communities are those with special affinity to rivers,eg high humidity woodland, carr, wet heath, bog, fen, swamp, wet grassland, tall wet herb, etc., note their extent relative to other communities which are not particularly characteristic of rivers.

(VII) *Record the percentage of the bank area covered by alien species.*

(VIII) *Record the percentage of the bank area covered by natural/semi-natural vegetation (eg dry woodland, meadow communities) but exclude all communities indicative of disturbance (eg tall grass, nettles, aliens, etc.) and all non-vegetated areas. This is equivalent to V.*

(IX) *Record the percentage of the area noted in VIII that has vegetation typical of river banks or river corridors (see VI).*

U. IMPACTS

Surveyors should tick which impacts are obvious during surveys. In the 'Notes' box cite the number and record your assessment of their nature and severity.

NOTE THE SPECIAL MODIFICATION REQUIRED FOR CS2000 WHERE THE PRESENCE OF ANY IMPACT IN THE SPOT-CHECK 50m INCLUDING THE MACRO-INVERTEBRATE SAMPLING POINT SHOULD BE RECORDED INDEPENDANTLY AS WELL AS RECORDS FOR THE 500m AS A WHOLE

In the majority of cases 'impacts' will be assessed in SERCON through discussions with those responsible for managing the river, and by assessment of available data and literature. However, there are many examples where field survey will highlight impacts (both local and more general) for which adequate data are not available from elsewhere. Good examples include the impact of alien species or the extent to which structures across the river affect flow regimes upstream. Data are gathered to provide context for high and low conservation scores and to help determine appropriate management (if needed) for different systems.

Guidance is given below for those key impacts for which field survey may provide useful information.

U 2/3: Effluents

Only tick the box if you observe a change in vegetation or other biota which can be directly attributed to the effluent.

U 7: Channelization

Assess only the impacts of the *physical changes to river courses:* their depths, widths and bank form. Examples include widening and deepening (resectioning), straightening (re-alignment), embanking, and bank protection works (eg by sheet piling, gabions, blockstone and groyne placements). These activities are considered 'once and for all' channel changes, compared with 'maintenance' (U8). Note if impacts are minor, moderate or severe, and what causes these.

NOTE THE SUB-DIVISION OF THIS CATEGORY WHICH HAS BEEN ADOPTED FOR CS2000 ONLY

U 8: Management for flood defence

River management (maintenance) activities range from major channelization works to minor and irregular mowing of banks. Activities include light dredging, de-silting, selective shoal-removal etc., within the existing channel course, and which do not bring about long term changes in the character of the river. Other examples include selective removal of trees and shrubs, bank mowing and brushing, and mechanical (and other) means of controlling aquatic and marginal vegetation. Note if impacts are minor, moderate or severe and what type of management is undertaken on the reach.

NOTE THE SUB-DIVISION OF THIS CATEGORY WHICH HAS BEEN ADOPTED FOR CS2000 ONLY

U9: Man-made structures

Impact should be assessed according to how structures modify or reduce the wildlife interest of the length. Where man-made structures are installed to redress impacts of channelization (eg deflectors or 'nicospan' vegetation bags in river-narrowing rehabilitation works), these structures should be noted as such. *Pay particular attention to the effect that structures have on flow regime/fluvial processes; for example, note how far upstream any weirs or sluices impound flow into a sluggish slack/ponded water. If the influence extends beyond the 500m reach add notes to upstream survey sheets too.*

NOTE THE SUB-DIVISION OF THIS CATEGORY WHICH HAS BEEN ADOPTED FOR CS2000 ONLY

U10: Recreational pressures

Tick boxes if recreational pressure is evident, and indicate if there is obvious impact. Impact may be very minor (eg local trampling of vegetation by anglers, paddling areas by children) or severe (eg major/intense boating with oily scum on surface and bank eroding through boat wash).

U11: Introduced species

Field observations are likely to be confined to plants, principally those on the bank. Indicate if there is an obvious impact (ie displacement of native species along significant length of bank). Surveyors will record the following as ✓ or 'E' as part of RHS:

Impatients glandulifera (Himalayan balsam)

Heracleum mantagazzianum (Giant Hogweed)

Reynoutra japponica (Japanese knotweed)

Indicate if these species are Rare, Occasional, Frequent, Abundant or Dominant in this 'IMPACT' section. Other typical species may include monkey flower, snowberry or pink purselane. Note if early-season survey suggests they will be having greater cover and impact later in the season.

U12: Others: Specify

THIS BOX HAS BEEN INTRODUCED FOR CS2000 ONLY AND ALLOWS FIELD SURVEYORS TO NOTE ANY POTENTIAL IMPACTS NOT COVERED BY THE PREVIOUS CATEGORIES. ANYTHING MAY BE NOTED.

V. SPECIAL FEATURES/ADDITIONAL FEATURES OF IMPORTANCE

The presence of SFs and AFIs should be ticked and a brief note made in the 'Notes' box regarding their significance. Surveyors should note any other negative or positive features they feel justify highlighting.

SPECIAL FEATURES are attributes which may contribute greatly to the overall conservation value of an ECS but which are not commonly encountered, or are not appropriately assessed

using the classic descriptors of Naturalness, Representativeness, Species Richness, etc. In SERCON many of these are assessed using data from desk studies and consultations. However, in some cases surveys can provide useful additional information. This provides greater opportunities for highlighting key features of interest than is possible by RHS alone.

Within some ECSs there may be river or floodplain features (either physical or biological) which are important regionally or nationally, but which are not adequately reflected in the routine scoring system. These ADDITIONAL FEATURES OF IMPORTANCE are mainly positive attributes which add conservation value, although some are negative features that detract from it. They are not themselves scored, but provide information to complement SERCON scores and indices.

Specific guidance on some SPECIAL and ADDITIONAL features for which information may be gathered in the field are listed:

a) **Plant and animal observations** - Opportunity for surveyor to record any observations of otter spraints, rare plants (river/bank/riparian zone), kingfisher sighting or nest, snipe breeding in adjacent meadows, etc.

b) **Floodplain wetlands** - Presence of significant interest within the 50m corridor OR extensive and highly rated habitats within the floodplain which are more than 50m from the bank (specifically note presence of wetlands associated with redundant/cut-off meanders or historic river channels).

c) **Native pinewood** - would not be scored in RHS and so should be highlighted.

d) **Diseased alder** - indicate the extent to which the whole population is affected.

Since floodplain wetlands are very important considerations in SERCON, guidance on what constitutes 'recreatable' and 'unrecreatable' habitat is given (and an indication of how they should be assessed). *These should be highlighted if present close to, or visible from, the river when surveying (therefore can be >50m away). Note the approximate size and type of habitat present to enable further assessments by others at a later date.*

Recreatable wetland habitats within the floodplain should be highlighted if they are ecosystems that can often be created or re-instated within a timescale of 25 years (but definitely within 50 years). Scrubby carr, secondary wetlands such as many marshes, reed beds and semi-improved wet grasslands fall into this category as do open waters such as most gravel pits, amenity lakes and ponds.

Unrecreatable wetland habitats are those which cannot be re-instated in new locations within a timescale of less than 50 years, if at all. Within floodplains the most important unrecreatable wetlands are ancient and natural/semi-natural examples of habitats such as mature carr, fens, mires, flushes, bogs, wet heaths, historic river channel cut-offs and unimproved wet grasslands. Reed beds and marshes may also be considered if they have been present for a period of at least 50 years and are likely to support continuity of flora and fauna. Also include examples where a river flows through, or affects the drainage/water management regime of, very flat land such as

Washes (eg Ouse), Levels (eg Gwent) or extensive grazing marsh systems (eg North Kent). All are affected directly or indirectly by the river through a combination of periodic inundation at times of flood, through maintenance of high groundwater tables or by lack of freeboard to enable free drainage.

W. NOTES

Write a sentence or two to characterize your opinion of the river reach. Highlight any key positive or negative features. Identify if the character of the reach is governed by upstream or downstream influences.

APPENDIX RHS.3 : BGS SOLID GEOLOGY CODES

METAMORPHIC ROCKS	
	METAMORPHOSED IGENEOUS ROCKS IN MOINE & DALRADIAN

28	Folitated granite, syenite & allied types
27	Epidiorite, hornblende-schist & allied types
26	Serpentine
	DALRADIAN
25	Limestone (Upper Dalradian)
24	Limestone
23	Graphic schist & slate
22	Slack shale with chert (Upper Dalradian)
21	Slate, phyllite & mica-schist (Upper Dalradian)
20	Slate, phyllite & mica-schist
19	Quartz-mica schist, grit, slate & phyllite (Upper Dalradian)
18	Quartzose-mica schist
17	Quartzite, grit, interstratified quartzose-mica schist
16	Boulder bed & conglomerate
15	Epidote-chlorite-schist, commonly hornblendic-Green Beds (Upper Dalradian)
14	Epidote-chlorite-schist, commonly hornblendic-Green Beds
13	Undifferentiated schist & gneiss of Shetland & Central Tyrone
	MOINE
12	Granitic gneiss
11	Mica-schist, semi-pelitic schist & mixed schists
10	Quartz-feldspar-granulite
9	Quartzite
8	Undifferentiated
	LEWISIAN COMPLEX
$v_v v$	Granite migmatite complex
7	Gneissose granite, granite & pegmatite
6	Intermediate & basic rock
5	Ultrabasic rock
4	Anorthosite
3	Marble
2	Metasediments
1	Undifferentiated gneiss

IGNEOUS ROCKS	

IGNEOUS ROCKS	
	EXTRUSIVE
	Tertiary
59	Tuff, undifferentiated
58	Rhyolite, trachyte & allied types
57	Basalt & spilite
	Permian
56	Basalt
	Carboniferous
55	Tuff, undifferentiated, mainly basaltic
54	Rhyolite, trachyte & allied types
53	Basalt & spilite
	Devonian & Old Red Sandstone
52	Tuff (including ignimibrite)
51	Rhyolite, trachyte & allied types
50	Andesitic & basaltic lavas & tuffs, undifferentiated
49	Basalt & spilite
	Silurian & Ordovician
48	Tuff, undifferentiated, mainly andesitic
46	Rhyolitic lava
45	Andesitic tuff
44	Andesitic lava & tuff, undifferentiated
43	Basaltic tuff
42	Basalt, spilite, hyaloclastic & related tuffs
	INTRUSIVE
38	Agglomerate in neck
37	Rhyolite, trachyte, felsite, elvans & allied types
36	Porphyrite, lamprophyre & allied types
35	Basalt, dolerite, camptonite & allied types
34	Granite, syenite, granophyre & allied types
33	Diorite & allied intermediate types

IGNEOUS ROCKS	
32	Gabbro & allied types
31	Ultrabasic rock
v v v	Areas of intense granite veining

SEDIMENTARY FORMATIONS	
	NEOGENE
	Pliocene
112-14	Gravel
	PALAEOGENE
	Oligocene
110	Lough Neagh Clays
	Eocene
107-9	Inter-lava beds
	CRETACEOUS
106	Upper Chalk
105	Greensand
	JURASSIC
	Upper
97-9	Kimmeridge Clay, Corallian, Oxford Clay & Kellaways Beds
	Middle
96	Cornbrash
94-5	Great & Inferior Oolite including Great Estuarine Series of Scotland
	Lower
93	Upper Lias
92	Middle Lias
91	Lower Lias
	PERMIAN & TRIASSIC
	New Red Sandstone
90	Triassic mudstones (including "Keuper Marl", Dolomitic Conglomerate & Rhaetic)

SEDIMENTARY FORMATIONS	
89	Permian & Triassic sandstones, undifferentiated, including "Bunter & Keuper"
87	Permian mudstones (including Middle & Upper Marls, Eden & St Bees shales)
86	Magnesian Limestone (Permian)
85	Permian basal breccias, sandstones & mudstones
	CARBONIFEROUS
	Silesian
84	Westphalian & ?Stephanian, undivided of "Barren Red" lithology (England only)
82-3	Westphalian ("Coal Measures")
81	Namurian ("Millstone Grit Series")
	Dinantian
80	Tournalsian & Videan ("Carboniferous Limestone Series")
79	Basal Conglomerate (including possible Dovonian)
	DEVONIAN
78	Upper Old Red Sandstone
77	Middle Old Red Sandstone
76	Lower Old Red Sandstone, including Downtonian
	SILURIAN
74	Ludlow
73	Wenlock
72	Llandovery
	ORDOVICIAN
70-1	Ashgill & Caradoc (includes small inliers of Arenig-Llandeilo in Scotland)
68	Llanvirn & Arenig
67	Durness Limestone (partly Cambrian)
	CAMBRIAN
63	Serpulite Grit & Fucoid Beds
62	Pipe-Rock & Basal Quartzite
	TORRIDONIAN
61	Sandstone and grit

APPENDIX RHS.4

LIST OF BIRDS RECORDED AS PART OF BRITISH TRUST FOR ORNITHOLOGY'S WATERWAYS BIRD SURVEY

This *list is included for guidance only, but provides a flavour of the most important species associated with inland waterways*.

Black-headed Gull
Black-tailed Godwit
Canada Goose
Cetti's Warbler
Common Gull
Common Tern
Common Sandpiper
Coot
Cormorant
Curlew
Gadwall
Dipper
Dunlin
Egyptian Goose
Garganey
Goosander
Grasshopper Warbler
Mallard
Mandarin
Marsh Warbler
Mute Swan
Osprey
Oystercatcher
Pied Wagtail
Moorhen
Pochard
Red-breasted Merganser
Redshank
Reed Bunting
Reed Warbler
Ringed Plover
Ruff
Sand Martin
Sedge Warbler

Great Crested Grebe

Greenshank

Grey Heron

Grey Wagtail

Greylag Goose

Herring Gull

Kingfisher

Lapwing

Lesser Black-backed Gull

Little Ringed Plover

Little Grebe

Shelduck

Shoveler

Snipe

Teal

Tufted Duck

Water Rail

Whitethroat

Whooper Swan

Wigeon

Yellow Wagtail

APPENDIX RHS.5 GLOSSARY OF ACRONYMS

BGS	British Geological Society
BTO	British Trust for Ornithology
GQA	General Quality Assessment
OS	Ordnance Survey
RHS	River Habitat Survey
RQO	River Quality Objective
SERCON	System for Evaluating Rivers for Conservation

Pages 135-144 have been intentionally removed

HEALTH AND SAFETY AT WORK - CODES OF PRACTICE

SAFETY ON FIELD WORK

1. Before going on field work

a) READ the NERC guidance note 'Safety in Field Work'

b) Follow the procedures laid down in the NERC guidance note where relevant

c) As much information as possible on whereabouts and timing of sampling should be given to lab-based colleagues in advance.

2. Preparing for field work

a) YOU are responsible for ensuring that:

i) you are properly equipped to carry out field work

ii) you are physically fit enough to go on field work.

b) If going out in cold weather or for a long period, staff are advised to take food and drink.

c) It is possible to become incapacitated even a short distance from base. Therefore, you are recommended to carry a whistle, on a lanyard, round your neck, at all time.

d) DO NOT carry the whistle in a rucksack or in the pocket of a jacket it could be lost during a fall.

e) It is especially important to carry a whistle when working:

i) in remote areas,

ii) in wooded areas,

iii) on uneven terrain,

iv) on your own.

f) A first aid kit should be carried at all times.

g) If a mobile phone is available it should be carried even on short sampling trips. Carry it with you to the sampling site; do not leave it in the car.

3. Procedure in the event of an accident in the field

a) Field workers should ascertain the nature and extent of any possible health hazard in the proposed locality. In particular advice should be sought before sampling near sewage outfall or in a sewage works. All staff are advised to be vaccinated against tetanus and keep records so they may have the correct booster injections.

Leptospirosis

b) Read the NERC literature on leptospirosis.

c) Carry tap water and antiseptic soap for washing hands after sampling.

d) Antiseptic barrier cream is available for use in field work.

e) Cover all cuts with waterproof plasters.

f) Wear gloves if necessary.

4. Work on other people's land

Make sure you have permission from the owner of land and the owner of fishing rights (if applicable).

SAMPLING FOR INVERTEBRATES, DIATOMS, PUPAL EXUVIAE AND WATER CHEMISTRY

1. It is recommended that a minimum of 2 people are present on sampling trips.

2. Where there is a foreseeable risk of drowning wear a lifejacket or buoyancy aid.

3. In fast-flowing rocky streams protective headgear is recommended.

4. Any person wading in fast-flowing or deep water should be roped to a stable object on the bank if practicable. Persons throwing a dredge from the bank should also be roped.

5. Carry a leptospirosis warning card with you.

6. Exercise care when wading especially over large particulate substrata which are likely to be covered with a slippery algal film. The use of a net pole or wooden stick to which the metre rule may be attached as an aid to stability is recommended.

7. Place the macro-invertebrate or pupal exuviae sample in a sound, good quality polythene bag, add a small volume of river water followed by 40% formaldehyde to give a final concentration of approximately 10% (1 in 4 by volume).

8. Rinse off any formaldehyde which may drip onto outside of bottle or bag.

9. Seal the bag securely with a knot after removal of as much air as possible. Place the bag in a screw-top plastic container (macro-invertebrate sample only) and store in a lidded box in the vehicle.

10 Formaldehyde should be carried in the vehicle in small screw-topped plastic bottles and in sealed plastic containers to prevent fumes and for security in the event of an accident. All containers should be clearly labelled.

11 All containers and boxes containing formaldehyde in any concentration should be clearly labelled with the appropriate hazard stickers.

12 When driving between sites it is recommended that the vehicle driver should change from waders into conventional shoes.

13 Wash hands and arms with antiseptic soap and water (not river water) or wipe with antiseptic before eating, smoking, drinking or applying cosmetics or contact lenses.

Use of formaldehyde

Health risks

Causes burns

Possible risk of irreversible effects

May cause sensitisation by skin contact

May cause cancer

Toxic by inhalation, in contact with skin and if swallowed

Irritating to respiratory system and skin

First aid

Standard treatment

Eyes	Irrigate thoroughly with water for at least 10 minutes and OBTAIN MEDICAL ATTENTION.
Lungs	Remove from exposure, rest and keep warm. In severe cases, or if exposure has been great OBTAIN MEDICAL ATTENTION.
Skin	Drench the skin with plenty of water. Remove contaminated clothing and wash before re-use. Unless contact has been slight, OBTAINMEDICAL ATTENTION.
Mouth	Wash out mouth thoroughly and give water to drink. OBTAIN MEDICAL ATTENTION. DO NOT INDUCE VOMITING.

Spillage

Dilute with plenty of water.

If spilled in the vehicle wash out with plenty of water. Allow fumes to disperse before getting in.

FIELDWORK AT SITES CONTAMINATED WITH SEWAGE

Fieldwork on, and sample taking from, sites that may be contaminated with sewage (human effluent and/or farm slurry), including contaminated rivers/streams, agricultural land and laboratory analysis.

1. Chemical analysis of sample

Never swallow any sample. ALWAYS use automatic pipette fillers provided.

2. Sampling from/working in rivers/streams

a) Always cover and protect cuts and abraded skin. Ensure that covers are watertight. If cuts are severe, fresh or extensive, avoid all contact with water.

b) Wash hands after sampling, particularly avoiding contact with mouth or eyes before washing hands.

If water is swallowed involuntarily, medical advice should be sought.

3. Working on land applied with farm slurry

Protective clothing, particularly rubberised boots, should be rinsed after use.