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Common Standards Monitoring Guidance

for

Rivers

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Common Standards Monitoring guidance for Rivers

Contents

1 Introduction

This guidance covers condition assessment of representative river SSSIs / ASSIs and SACs. It should be used where a site has been notified as an example of a high quality river and/or as a good representative of one or more River Community Types (RCTs), as defined in the SSSI selection guidelines and subsequent modifications. It may also be used to provide an assessment of condition for river SACs designated as examples of the Annex I habitat H3260 ***Water courses of plain to montane levels with Ranunculion fluitantis and Callitricho-Batrachion vegetation***. Further information on *Ranunculus* communities is given in the LIFE in UK Rivers Project (Hughes, 2003a, 2003b). More detailed environmental requirements of any particular species or habitat features (SSSI / ASSI or SAC) may be superimposed on this guidance, as required.

Part of this guidance relies on River Habitat Survey (RHS) to provide information for assessing condition. Its inclusion here reflects its status as the only standard UK-wide field method for assessing the physical features of rivers. However, the interpretation of RHS data, as well as data on water quality, water quantity and biota, will inevitably depend substantially on expert judgement.

2 Definitions

2.1 Explanation of terms

The following terms are used in this guidance:

'Designated site' – the whole of an SSSI / ASSI / SAC.

'Survey site' – a 500 m river length within which RHS and macrophyte data are collected and/or other observations are made.

'Assessment unit' – a length of river for which an assessment of condition is made (usually equivalent to an Evaluated Corridor Section (ECS) in SERCON (Boon *et al.*, 1996)).

2.2 River Community Types

This guidance covers all RCTs in the UK designated as SSSI, ASSI or SAC. Designated sites may comprise the whole length of a river, from source to the limit of tidal influence, or may consist of only part of the river system.

The nine RCTs represented in the SSSI / ASSI series are:

Type I	naturally eutrophic lowland rivers with a high base flow
Type II	slow-flowing, naturally eutrophic lowland rivers, dominated by clays
Type III	base-rich, low-energy lowland rivers and streams, generally with a stable flow regime. Includes chalk streams
[Type IV	a degraded lowland river type that does not qualify for designation]
Type V	principally a lowland type, widespread over resistant rocks in England and Wales but very rare in Scotland
Type VI	generally rather base-rich, mesotrophic rivers in western and northern Britain, with a moderate to fast current.

Type VII	mainly small, low-gradient streams at a relatively high altitude or latitude, flowing over a moderately basic geology, often through fens or other wetlands
Type VIII	rivers common throughout western Britain over hard rocks
Type IX	oligotrophic, low altitude, generally slow-flowing rivers
Type X	fast-flowing, oligotrophic, base-poor rivers.

3 Basic approach to condition assessment

The approach taken to monitoring rivers involves a combination of field survey and collation / interpretation of existing information.

3.1 Field survey component

Field survey provides a basic assessment of physical habitat structure and RCTs, and may also contribute to the assessment of river flow and water quality. Some aspects of field survey may be waived if suitable data have already been collected by others, provided that the data relate to the relevant 6-year period of the current reporting cycle.

In order to gain an overall impression of the condition of the river and to assess the plant community, this guidance relies on a series of detailed assessments undertaken at 500 m survey sites. The location and frequency of these sites is discussed in section 9.2.1. Where possible, supplementary information should be obtained from aerial photographs.

3.2 Collation/interpretation of existing information

Basic assessments of river flow and water quality are derived from existing information, often held by the environment agencies. Other information (e.g. on river planform, alien species) may also be extracted from existing sources and used in condition assessment (see Section 9.1). The collation and interpretation of existing information will require assistance from the relevant environment agency.

3.3 Fluvial audit

Fluvial audits, which can only be undertaken by experienced geomorphologists, are extremely useful for assessing habitat condition and sedimentation processes, and for the strategic targeting of river restoration. They are particularly recommended where monitoring work indicates that an SSSI may be experiencing problems caused by unnaturally high inputs of sediment to the river. Further details of the fluvial audit procedure can be obtained from specialist freshwater staff in the conservation agencies.

4 Dividing the river into assessment units

Dividing a river into a number of assessment units (river reaches) provides a more accurate assessment of condition along its length than treating it as a single unit. It also allows individual, localised problems to be identified and managed.

River-reach boundaries are most sensibly focused on significant natural features, the most obvious of which are major confluences. Other considerations, such as geological changes or major changes in slope, may also be used. Unless reach boundaries have already been determined for other purposes it is recommended that the river is divided into reaches (Evaluated Corridor Sections – ECSs) using the protocol in SERCON (Appendix 1). Each ECS comprises an assessment unit.

River reaches are tentatively classified according to geology and size, as follows:

Dominant catchment geology		River Size		
		1	2	3
A	Hard upland geologies (all land over 330 metres) - impermeable poor geologies.	Headwater	River	Large river
B	Other Cambrian-Devonian geologies - hard mudstones and sandstones	Headwater	River	Large river
C	Jurassic and Cretaceous limestones - soft limestone and chalk.	Headwater	River	Large river
D	Triassic sandstones and mudstones - soft sandstones and mudstones in lowland areas.	Headwater	River	Large river
E	Mesozoic clay vales and Tertiary clays - impermeable rich geologies	Headwater	River	Large river

River size is determined from Environment Agency flow categories.

5 Information sources

The assessment should be made from a combination of four data sources, as follows:

Source 1: Physical, chemical, and biological data collated from non-field survey sources

(a) Water quality – from Environment Agency (EA) / Scottish Environment Protection Agency (SEPA) / Environment and Heritage Service Northern Ireland (EHS)
(b) Hydrology – from EA / SEPA / EHS
(c) River planform – from maps, historical records, local specialist information
(d) Non-native animal species (from EA, SEPA, EHS, fishery trusts and boards, etc.)

Source 2: Physical data collected from field survey

The preferred option is to carry out a full RHS survey at each site, comprising both the standard 10 transects and the 500 m 'sweep-up' assessment (i.e. summary data for the whole survey site without the use of transects). This approach maximises the value of the survey by allowing the data to be added to the UK RHS database and used for other purposes. Where full RHS is not possible, a simplified procedure may be used by assessing condition only from the 'sweep-up' data. (Note that an assessment of the riparian zone using RHS data is only possible where transects have been surveyed.)

Source 3: Macrophyte community data collected from field survey

These data are collected using the standard JNCC macrophyte survey method (Appendix 2).

Source 4: Additional information gathered by field observation and/or local specialist knowledge

Observations by the surveyor or gathered by others (e.g. conservation agency staff, environment agency staff) may be interpreted using expert judgement and the results applied to the condition assessment. These observations may also trigger further detailed investigations and/or remedial action.

6 Attributes and targets

6.1 Attributes

The guidance for assessing SSSI / ASSI /SAC rivers (Table 1a) covers five basic attributes, some of which have more than one measure associated with them:

- Habitat functioning
  - water flow
  - water quality
- Habitat structure
  - substrate
  - channel and banks: planform, profile, bank and riparian vegetation, instream structures
- Plant community
  - species composition and abundance
  - reproduction of *Ranunculus*
- Negative indicators: non-native/introduced species
- Indicators of local distinctiveness

The first four of these attributes are mandatory, the last discretionary.

Plant community is the only biological component that is addressed in detail, owing to its importance in establishing representative RCTs and its subsequent inclusion as a feature in all representative river designations.

6.2 Making judgements and recording results

Sections 7, 8 and 9 provide guidance on how to make judgements in relation to each data source. Table 1a summarises the targets for all attributes. The assessment of physical habitat and the plant community are described in further detail in the text of this guidance. The overall judgement in relation to each attribute for each assessment unit should be recorded in the proforma in Appendix 3. Information on which the judgement is based, and the interpretation of that information, should be kept locally for reference. Guidance on recording field information is given in Section 9.2 and associated appendices.

7 Recommended visiting period and frequency of visits

Owing to the need to assess the plant community, both in terms of its contribution to habitat structure and its species composition, field survey work should be undertaken between mid-June and late August. Monitoring should be carried out at least once in every six-yearly reporting cycle.

8 Skills requirements for monitoring

The field components of assessment require expertise in aquatic macrophyte survey and identification, as well as experience in River Habitat Survey (RHS) 2003 (Environment Agency, 2003) and Phase 1 habitat survey. Operational staff in the conservation agencies will be able to undertake some or all aspects of the field work, depending on the training and expertise of individual staff members. It is recommended that training is provided where necessary so that operational staff understand and ‘own’ the information. However, where this is not possible, they should be involved in any work contracted out, to help set the local context for specialist surveys and to aid in interpretation of the data. RHS surveyors must have first received training and

accreditation by the Environment Agency in the use of the 2003 field survey manual. (RHS data collected by non-accredited surveyors are not eligible for inclusion in the UK RHS database.)

9 Methods of assessment

9.1 Collating and interpreting existing information

9.1.1 River flows

Flow is an important factor affecting the distribution and ecology of plants and animals in rivers. Macrophyte communities, for example, are often characterised by bryophytes in upland, eroding headwaters where flows are fast and spates are frequent. This is in contrast with the deepest and slowest reaches downstream, where emergent and floating-leaved species may occur.

The availability of data on river flows varies considerably around the UK, particularly with respect to human impacts on natural flow regimes. Conservation agency staff may require considerable assistance with handling and interpreting such information. Where available, data on mean daily naturalised flow should be used. Such an analysis requires that flow naturalisation procedures are applied to the river, with the subsequent application of flow accretion procedures, to assess spatial patterns in naturalised flows and human pressures on those flows (abstraction/impoundment). This practice is becoming routine with the Environment Agency in England and Wales, where local staff may be in a position to provide the necessary data, but the scope for such an analysis is very limited in Scotland and Northern Ireland.

Other sources of information, such as specific hydrological studies or strong circumstantial evidence of flow problems on particular river stretches, may also be used to inform the assessment of condition.

9.1.2 Water quality

Data for each water quality indicator from the past 3 years (or for the whole reporting period, if available) should be requested from the appropriate environment agency, for all routine water quality survey points within each monitoring unit. Compliance with each numerical target should be judged on face value (i.e. is the observed value numerically greater than the target value?). Phosphorus assessments are made with reference to Table 1c. This provides an approximate indication of expected levels of soluble reactive phosphorus in the absence of human impact, based on dominant catchment geology and on river size. The unit is judged unfavourable for a water quality indicator if any of the routine sampling points within the monitoring unit fails to comply with the target.

9.1.3 River planform

An assessment of river planform (i.e. the shape of the river when viewed from above) is important in determining whether the natural course of the river has been artificially straightened or moved from its natural course. In many circumstances, a natural channel may move in response to extreme floods - this is a positive conservation attribute, as opposed to re-alignments for flood defence, which aim to keep the river in its modified channel permanently.

The method for assessing river planform is given in **Appendix 4**.

9.1.4 Negative indicators (biological disturbance)

Whilst the field survey should provide sufficient information for assessing problems caused by invasive or alien plant species, similar assessments for animal species require information from external sources, such as:

- reports indicating the presence of established populations of non-native/introduced species (e.g. mink, non-native crayfish, non-native fish) and consequent decline of characteristic flora/fauna

- reports indicating that the density of stocked native fish is adversely affecting characteristic flora and fauna.

Reports such as this should be investigated, in consultation (where appropriate) with other bodies (e.g. EA, SEPA, EHS, fishery trusts/boards, angling societies, etc.). Expert judgement will be needed to determine whether there is sufficient evidence to generate an unfavourable condition assessment. (See also Section 9.2.5.)

9.2 Undertaking field survey

9.2.1 Location of survey sites

Survey sites must be chosen for both assessment of River Community Types (macrophyte survey) and for River Habitat Survey.

Determine the distribution of each RCT for which the site is notified within each assessment unit, as described in section 9.2.4(a). Normally, individual assessment units will contain no more than two RCTs. For SACs, the macrophyte community is assessed in the same way, using the appropriate SSSI / ASSI RCTs rather than the SAC (CB) categories.

Each assessment unit should contain at least one 0.5 km macrophyte survey site representative of the dominant RCT within it. Where an assessment unit exceeds 10 km or where two different RCTs occur within the assessment unit, more than one survey site should be selected. In general, macrophyte survey sites should be positioned approximately 5 km apart.

The frequency of RHS sites along a river is likely to be a compromise between a complete coverage of the whole river and the limitations of resources for carrying out survey work. In some cases (e.g. some of the very short stretches of river SSSI in Scotland that are only a few kilometres in length) it may be feasible to carry out contiguous RHS for the entire designated site. The minimum frequency should be a 10% coverage (i.e. 1 site every 5 km), coincident with macrophyte monitoring sites. A frequency of 25% (1 site every 2 km), if affordable, is a good compromise as it has been found to provide a reasonably reliable characterisation of the physical features of a river (Wilkinson *et al*., 1998).

The location of each RHS and macrophyte monitoring site should be marked on a map of the site. It is recommended that GPS and site photographs are used to facilitate accurate relocation of sites on future visits; where RHS transects are surveyed, each should include a photograph and GPS location record.

9.2.2 Recording information in the field

The most recent (at the time of writing, 2003) version of the RHS manual (Environment Agency, 2003) must be used for all River Habitat Surveys, recording the results on the standard field survey sheets. Macrophyte surveying and recording should be undertaken according to the JNCC macrophyte survey methodology (Appendix 2). All other observations made at RHS/macrophyte survey sites should be recorded on a separate form. This should include notes on the following features, described in Sections 9.4.2 and 9.4.3:

- River flow
- Turbidity
- Siltation
- Abundance of filamentous and epiphytic algae

Additional information that could prove useful for subsequent assessment of condition should also be gathered, including evidence of point source pollution, recent management of channel vegetation, and any signs of obvious changes since the previous visit. Points where specific observations are made should be marked on the site map, as well as being noted on the recording form.

9.2.3 Physical habitat assessment using RHS

Data from RHS and the supplementary bank vegetation module are used to provide assessments of the following attributes:

Habitat structure: channel and bank planform,
channel and bank profile
bank and riparian vegetation,

These are assessed using protocol for the following (from SERCON):

- The naturalness of river profiles (see Appendix 5)
- The naturalness of river banks (see Appendix 6)
- The naturalness of riparian zones (see Appendix 7)
- The degree and persistence of artificial modifications (Habitat Modification Score, HMS – as revised for the 2003 version of RHS)

Details of RHS methods can be obtained from the environment agencies and from specialist freshwater staff in the conservation agencies. There is also a link from the JNCC website page holding this document.

River profiles and bank vegetation

(i) Assessment of river profiles using RHS transect data

An assessment of the naturalness of the river profile from transect data is made using the protocol in **Appendix 5**.

(ii) Assessment of river profiles from RHS sweep-up data

Assessment should focus on the eight categories of artificial / modified bank profiles given in section I of the RHS sweep-up sheet (e.g. resectioned, reinforced, embanked, etc.). Records are made separately for the right and left banks.

(iii) Assessment of river bank vegetation

A broad assessment of the naturalness of the river banks can be made using the approach outlined in **Appendix 6**. This method consists of a simplified Phase 1 habitat survey, carried out at the 10 RHS transect locations or as part of the sweep-up survey. Note: these data are not recorded in the standard RHS survey. However, the simplified Phase 1 vegetation survey should be undertaken while carrying out the RHS survey work, using a separate sheet to note down bank vegetation categories.

Riparian zones (option for use with full RHS survey)

A broad assessment of the naturalness of the riparian zone immediately adjacent to the river can be obtained from RHS transect data, assessed using the protocol in **Appendix 7.**

The degree and persistence of artificial modifications (Habitat Modification Score, HMS)

The new version of HMS for 2003 (being developed by the Environment Agency) enables a more sophisticated assessment of HMS to be made, based on the nature of modifications to a river and their estimated persistence.

9.2.4 Assessment of River Community Types (macrophyte survey)

The locations of all the macrophyte survey sites should be marked on a map of the site (see section 9.2.1), so that they can be revisited. All survey sites should be photographed on each monitoring visit. Photographs are useful for relocating survey sites and provide an invaluable record of changes in the vegetation.

The following procedure should be followed for all designated sites.

(a) Set a target vegetation community for the survey site. This will normally be the vegetation community previously recorded at the initial baseline survey of the site. Only use a data set as baseline once it has been approved as credible. If this is not available, the first survey undertaken by a reliable surveyor should become the baseline, against which all further surveys should be assessed. The vegetation community recorded at the initial baseline survey should be one of the vegetation communities I-X as described in Holmes *et. al*. (1999). The exception to this will be sites where the vegetation is not viewed as being the natural target community due to degradation. In this case a different target community should be set in consultation with conservation agency specialists. Comparison of JNCC types against *Callitricho-Batrachion* communities (see Section 2) is used to extend this guidance to analogous CB types.

Note: For river SSSIs notified before 1999, references in citations will list the old style RCTs (Holmes, 1983). However, all sites on the JNCC Rivers Database have had their RCTs amended (where necessary) in line with the revised RCT classification (Holmes *et al*., 1999). Where there is any doubt, before setting target vegetation communities existing survey data should be reinterpreted in consultation with conservation agency specialists.

(b) Adjust the target community, taking account of site-specific characteristics of the reach. Individual RCTs often show considerable variation around the country, and may be associated with various less common species. For example, species such as *Allium schoenoprasum, Potamogeton alpinus, Groenlandia densa,* and *Cryphaea lamyana* all occur within specific RCTs, but are not indicators nationally. However, on certain rivers they may be important indicators of favourable condition. Constancy tables that can be

used for assigning appropriate target communities to individual reaches can be found in Appendix 8 – reference to Holmes *et al*. (1999) is also recommended.

(c) Undertake a macrophyte survey based on the method of Holmes (1983) using a standard check-list of macrophyte species (see Appendix 2). Input the data to the standard JNCC data capture template for uploading to the JNCC River Macrophytes Database. This template should be obtained from specialist freshwater staff in the conservation agencies prior to fieldwork, and one spreadsheet must be completed per site. Return completed spreadsheets to the relevant conservation agency freshwater specialist.

(d) Evaluate the community against the target community in the constancy tables (Appendix 8) using the assessment form in Appendix 9. Specific targets are given in Table 1. Freshwater specialists in the conservation agencies can provide further guidance.

(e) The opportunity for reproduction of *Ranunculus* and other aquatic macrophytes should also be recorded by assessing the percentage of beds left uncut during river maintenance procedures.

The detailed analysis of macrophyte communities given above in (a) to (e) is intended to determine, for example, whether changes in taxonomic composition or vegetation cover are sufficient to consider the feature no longer to be in favourable condition. These analyses are designed to indicate broad trends over time, and require expert judgement when interpreting condition, rather than a rigid adherence to every threshold in the FCT. They will also be subject to further refinement as the level of monitoring data gathered by the conservation agencies increases.

Where recent information on the macrophyte community at a specific site throws doubt on the accuracy of previous species identifications, condition assessments should be made with caution.

9.2.5 Negative indicators (biological disturbance)

The presence of non-native species listed in Appendix 10 should be noted during the macrophyte survey, and the scoring system for naturalness of the plant community given in Appendix 10 can then be applied. This protocol applies to negative indicator species of the channel and channel margins. Negative indicator species found on banks and the riparian zone are assessed as part of the naturalness of banks and naturalness of riparian zone protocols and form part of the CSM structure attribute (section 9.2.3.).

9.3 Indicators of local distinctiveness

This attribute is intended to cover any site-specific aspects of this habitat feature (forming part of the reason for notification) which are not covered adequately by the previous attributes, or by separate guidance (e.g. for notified species features). These indicators of distinctiveness may be notable species (e.g. Red List and Nationally scarce vascular plants – Appendix 11) or physical characteristics. It is not intended to set a target for detailed species monitoring, rather to provide a rapid indication of presence/absence and/or approximate extent, allowing for natural fluctuations in population size. Targets are set as appropriate, on a site-by-site basis, to maintain distinctive elements at current extent/levels and/or in current locations.

9.4 Additional observations from field survey and/or local specialist knowledge

9.4.1 General procedure for recording information

Whilst the assessment of condition is mainly derived from data sources 1-3, data source 4 provides an opportunity to take account of additional information gathered during field survey. For some features, these observations may help to confirm an assessment made from external data (e.g. on river flows). For other features (e.g. siltation), field observation may provide the only practical means of assessment where detailed investigations would be too costly. It is important to note that assessing the condition of these elements relies heavily on expert judgement.

9.4.2 Observations on river flow

The field survey can be used only to highlight obvious problems with water availability within the river at the time of survey. Indicators of problems may be a very shallow water depth, a reduction in the wetted area, or reduced water movement relative to what might be expected. It can often be very difficult to determine whether low water availability is a consequence of natural processes or human impact, and whether observed impacts result from changes in flow (due to abstractions or upstream impoundment) or from channel engineering (due to over-sizing of the channel or water backing up behind weirs). It is important that any problems that lead to a judgement of 'unfavourable' are artificially induced. Where only a short stretch of river is affected (e.g. a few tens of metres between an abstraction and a discharge point) this should not lead to an unfavourable assessment unless: (a) there is more than one such problem within the section under review; or (b) the problem is so extreme as to inhibit free movement of biota within the river.

9.4.3 Observations on water quality

The field survey can be used only to highlight obvious problems with water quality within the river at the time of survey. A more considered assessment can be made on the basis of existing water quality data in consultation with contacts in the appropriate environment agency (see Section 5).

Indicators of problems are excessive turbidity (due either to elevated levels of suspended solids or – occasionally in slow, deep rivers – very dense phytoplankton blooms), excessive siltation, or large amounts of filamentous algae.

It should be noted that the targets listed below cannot be defined with numerical precision. This is largely due to the inappropriateness of assessing the condition of a naturally variable feature against a numerical threshold based on one or a few observations over the 6-year reporting cycle. In addition, many river surveyors often find it difficult to make reliable and repeatable assessments of percentage cover.

Turbidity

Note that this should not be assessed immediately after heavy rain, when rivers can become naturally turbid.

Siltation

Excessive siltation (here defined as large amounts of fine sediments coating coarser bed sediments) often results from inappropriate catchment management, and may lead to a range of problems: some relate to surface siltation, some to the in-filling of substrate interstices, and some specifically to the organic fraction of fine sediments. The field survey can only provide a broad indication that excessive siltation may be occurring. Where this appears to be the case, a fluvial audit of the catchment is recommended.

Abundance of filamentous and epiphytic algae

Excessive cover of filamentous and epiphytic algae is often indicative of nutrient enrichment, exacerbated by low flow and high summer water temperatures, and may have an adverse effect on river habitats and biota.

9.4.4 Aspects of environmental disturbance

Aspects of environmental disturbance, such as artificial barriers, fish introductions and exploitation should be noted as an accompaniment to assessing condition (Table 1b). These activities do not comprise condition targets but are intended to help set the context for condition assessment.

10. Derivation of overall condition categories

This guidance deals principally with the major division between 'favourable' and 'unfavourable' site condition categories. For the condition of a representative river SSSI/ ASSI or SAC to be regarded as favourable, the targets on habitat functioning (flow, water quality), habitat structure (substrate, planform, profile, bank and riparian vegetation, instream structures), plant community (species composition and abundance), and negative indicators (non-native/introduced species) must all be met. For SACs, the targets on extent of vegetation and reproduction of *Ranunculus* must also be met. The attribute *Indicators of local distinctiveness* is discretionary, and targets are set to maintain distinctive elements at current extent/levels and/or in current locations.

In general, for the whole site to be in favourable condition, all assessment units (ECSs) should be judged as favourable. However, expert judgement should be used to decide whether the failure of one ECS in a larger SSSI is sufficient to warrant the whole site being classed as unfavourable.

It is not possible to distinguish between the categories of 'favourable maintained' and 'favourable recovered' until at least the second monitoring cycle, because previous records would be unavailable for comparison. Similarly, if a site or assessment unit fails to reach the specified targets on the first monitoring visit, it is not possible to distinguish between the categories of 'unfavourable – no change', 'unfavourable recovering' or 'unfavourable declining'.

10 Favourable Condition Tables

Table 1a. UK GUIDANCE ON CONSERVATION OBJECTIVES FOR MONITORING DESIGNATED SITES: SSSI / ASSI / SAC RIVERS

Interest feature: Rivers
Equivalent Phase 1 type: G2 running water (part)
Annex I habitats included: H3260 Water courses of plain to montane levels with *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation
Reporting category: Rivers and streams

NB All attributes listed are mandatory unless indicated as discretionary or site specific (e.g. for SACs only) by *.

Attribute	Targets	Method of assessment	Comments
Habitat functioning: water flow	Flow regime should be characteristic of the river. As a guideline, flow should be ± 10% of the naturalised daily flow throughout the year (see 'comments').	Gauging station data and expert opinion from relevant environment agency	River flow affects a range of habitat factors of critical importance to characteristic flora and fauna, including current velocity, water depth, wetted area, substrate quality, dissolved oxygen levels and water temperature. The maintenance of both flushing flows and seasonal base flows, based on natural hydrological processes, is vital. Detailed investigations of habitat-flow relationships may indicate that a more or less stringent threshold may be appropriate for a specified reach; however, a precautionary approach would need to be taken to the use of less stringent values.
	Ecological flow criteria already laid down for the river (e.g. for passage of migrating salmon) should also be complied with.	Gauging station data and expert opinion from relevant environment agency	Naturalised flow is defined as the flow in the absence of abstractions and discharges. The target may be modified according to the specific sensitivity of the reach type, with regulated rivers having somewhat lower sensitivity than unregulated ones. However, any relaxation of the guideline figure should relate to the desirability and ecological sustainability of regulating structures.
	There should be no obvious problems with water availability within the monitoring unit.	Field observations	The availability and reliability of data is patchy – long-term gauged data can be used until adequate naturalised data become available, although the impact of abstractions on historical flow records should be considered.
	Springs in aquifer-fed rivers should be maintained.	Field observations	Headwater sections are particularly vulnerable to abstraction, and downstream migration of perennial heads, other than in drought conditions, is a sign of unfavourable condition.

Attribute	Targets	Method of assessment	Comments
Habitat functioning: water quality (General assessments)	England, Wales and NI: (1) Biological GQA Class: a/A or b/B depending on reach type. In addition, no drop in class from existing situation AND (2) Chemical GQA Class: a/A or b/B depending on reach type. In addition, no drop in class from existing situation. Scotland: Water Quality Class: A1 or A2 depending on reach type. In addition, no drop in class from existing situation.	EA and EP standard monitoring protocols EA and EP standard monitoring protocols SEPA standard monitoring protocol	A wide range of water quality parameters can affect the status of interest features, but standard biological monitoring techniques provide a reasonably integrated picture in relation to many parameters. The Biological Module of the Environment Agency's General Quality Assessment scheme is based on assessment of the macroinvertebrate community. All classified reaches within the site should comply with the targets given. The chemical module of the GQA scheme sets standards for dissolved oxygen, biochemical oxygen demand and total ammonia. It therefore covers a number of water quality parameters that commonly cause problems within river systems. The system in Scotland differs from that used elsewhere in the UK. A scale of five Water Quality Classes is used (A1, A2, B, C, D) for assessing water chemistry, biology, nutrients, aesthetic condition, and toxic substances. The overall classification of a water is given by the lowest class derived from these values. All classified reaches should comply with the targets.
Habitat functioning: water quality	**Un-ionised ammonia** (95-percentile) As a guide, a target of <0.025 mg L^{-1} should be used.	Chemical analysis (EA/ SEPA/ EHS data)	The un-ionised form of ammonia is highly toxic to freshwater fauna. A precautionary target should be set, based on the EC Freshwater Fish Directive.

Attribute	Targets	Method of assessment	Comments
	Suspended solids No unnaturally high loads.	Water analysis (EA /SEPA/ EHS data)	Many characteristic species of different river types are susceptible to elevated solids levels, through reduced light availability (for photosynthesis), the clogging of respiratory structures, impaired visibility or siltation of coarse substrates. Lowland clay and alluvial river sections are more depositional in character and resident biota are generally more tolerant. Suspended solids measurements are essential to the estimation of particulate loads within the river network (in combination with gauged flow data), to provide an indication of the risk of siltation. As an approximate guide, a target of 25 mg L^{-1} (annual mean) can be used, based on the EC Freshwater Fish Directive. A more precautionary target of 10mg L^{-1} is proposed for most river reaches. A yet more stringent target than 10 mg L^{-1} may be appropriate for some river sections where solids levels are currently very low (such as chalk streams through the growing season) – an analysis of available data is suggested to verify target selection.
	Soluble Reactive Phosphorus Annual mean: ≤ 0.02, 0.04, 0.06 or 0.1 mg L^{-1} depending on reach (ECS) type (see Table 1c).	Chemical analysis (EA /SEPA/ EHS data)	Elevated phosphorus levels interfere with competitive interactions between higher plant species and between higher plants and algae, leading to dominance by attached forms of algae and a loss of characteristic plant species (which may include lower plants such as mosses and liverworts). The respiration of artificially large growths of benthic or floating algae may generate large diurnal sags in dissolved oxygen and poor substrate conditions (increased siltation) for fish and invertebrate species.

Attribute	Targets	Method of assessment	Comments

Attribute	Targets	Method of assessment	Comments
Habitat structure: substrate	**Siltation** No excessive siltation. Channels should contain characteristic ranges of substrate types for unmodified rivers.	Field observations	Siltation levels vary naturally, depending upon the reach type and hydrodynamic regime. Most sites should have a variety of channel substrates. Localised accumulations of silt on the inside of bends or in back channels do not necessarily indicate a problem. However, widespread siltation of riverine sediments, caused by high particulate loads and / or reduced scour within the channel, is a major threat to interest features. For river types characterised by extensive *Ranunculus* beds, there should be a predominance of 'clean' gravels, pebbles and cobbles, with relatively low cover by silt-dominated substrates. Maximum fines content should not be too great to prevent establishment of new plants. Fines are defined as particles <0.83 mm. Most river SSSIs / ASSIs / SACs do not extend to the entire catchment. Some species or life-cycle stages (e.g. juvenile pearl mussels, salmon eggs and fry) are susceptible to siltation, the source of which may lie outside the site boundary. Sources of silt include run-off from agricultural land, sewage and industrial discharges. A fluvial audit is recommended where specific problems have been identified, e.g. where there is a perceived risk of damage occurring or where a feature of interest is already believed to be in decline. Fluvial audit is not a monitoring tool but can deliver an understanding of geomorphological problems unattainable by any other method, such as the causes or sources of siltation. Further guidance on fluvial audits should be sought from the appropriate freshwater specialists in the country conservation agencies.

Attribute	Targets	Method of assessment	Comments
Habitat structure: channel and banks	**Channel form** Channel form should be generally characteristic of river type, with predominantly unmodified planform and profile. For planform the target is a score for the assessment unit of at least 3 (see **Appendix 4**). For naturalness of the profile using transect data the target is a score for the assessment unit of 4 or 5 (see **Appendix 5**). No RHS site to have any of the eight categories of bank profile modification (Section I in RHS 2003 form) recorded as 'extensive'.	Assess river morphology using RHS (**see text and Appendices 4 and 5 for details**). In addition, for planform: map data, aerial survey data, historical records and local knowledge.	The river should support all of the habitat features necessary for designated interest features to thrive, in characteristic proportions. Widening or deepening of channels, and extensive artificial reinforcement of banks, are indicators of unfavourable condition. Headwater sections are particularly vulnerable to reprofiling. Watercourses with a high degree of naturalness will be governed by dynamic processes which result in a variety of physical habitat features, including a range of substrate types, variations in flow, channel width and depth, in-channel and side-channel sedimentation features, erosion features and both in-channel and bankside vegetation cover. The new version of Habitat Modification Score (HMS) enables a more sophisticated assessment to be made, based on the nature of modifications to a river and their estimated persistence. Details are being finalised by the Environment Agency. A suggested target: 90% or more of condition monitoring sites should fall within the *semi-natural* HMS class 1, with the remainder *predominantly unmodified* (class 2). Targets would have to be reviewed following baseline assessment.
	Bank and riparian zone vegetation Bank and riparian zone vegetation structure should be near-natural. For bank vegetation the target is a mean score for the assessment unit of 4 or 5. For riparian zone vegetation the target is a mean score for the assessment unit of 4 or 5.	For bank vegetation: a simplified Phase I habitat survey, carried out at 10 RHS transect locations or as part of the sweep-up survey (see **Appendix 6**). For the riparian zone: RHS transect data, assessed using the protocol in **Appendix 7**.	**Note**: The protocol in **Appendices 6 and 7** used to assess bank and riparian zone naturalness incorporates a modification due to negative indicator species.

Attribute	Targets	Method of assessment	Comments
Plant community: species composition and abundance	(i) Species Composition The following should all occur: for the relevant river type; at least 60% of species with abundance V or IV in the constancy table should be present, AND at least 25% of species with abundance III should be present. (ii) Loss of Species 60% of species with cover >1 in the initial baseline survey should be at least present and all species recorded as dominant in the initial baseline survey should still be present. (iii) Abundant Species At least 25-35% of species recorded as dominant in the initial baseline survey should still recorded as dominant.	Survey the macrophytes of representative stretches at intervals of *ca*. 5 km , using the method of Holmes (1983) and a standard check-list of macrophyte species (see **Appendix 2**). Evaluate the community against the target community in the constancy tables (**Appendix 8**). Record measures of species composition and abundance on the form in **Appendix 9**. Alien species, filamentous green algae (including *Cladophora*, *Vaucheria*, and *Enteromorpha*) and other species indicative of eutrophication should be excluded from the assessment.	In-channel vegetation of SSSI / ASSI / SAC rivers should be dominated by characteristic species. Species composition and abundance should be assessed using data from two 500 m stretches in each ECS where possible. Each ECS should be assessed separately to allow specific problematic river stretches to be highlighted. This will help to target resources more specifically to improve any unfavourable ECSs. When assessing targets (ii) and (iii), the data from all macrophyte survey sites in the ECS should be pooled and compared against pooled baseline data. Cover values are expressed using a simplified DAFOR 3-point scale. Where necessary, 5-point scale data converts into the 3-point scale as follows: 5/4 = **3,** 3 = **2,** 2/1 = **1**. Any sections classified as Type IV are considered to be in unfavourable condition. Comparisons in (ii) and (iii) should be made with the initial baseline survey, not with survey data from the previous monitoring cycle. An exception occurs if the baseline survey data reveals unfavourable condition. In this case, a subsequent 'favourable' survey should be used as the baseline against which future data can be compared. The text under *Targets* summarises the suggested specific targets for each of the criteria. These should be used to guide those undertaking the condition assessment, but because of local variation it cannot be expected that all elements will 'pass'. This is especially likely where sites are on the edge of their 'type' – e.g. upper reaches of chalk streams that may be occasionally dry, or upstream sites where downstream seeding of species may be limited. Loss or gain of species can be indicative of either deterioration or improvement, so assessment needs to take account of the reasons for change. Non-native species are not considered under this attribute, but are covered under *Negative indicators***.** Rare species are not considered under this attribute, but are taken account of under *Indicators of local distinctiveness.*

Attribute	Targets	Method of assessment	Comments
Plant community: reproduction	A sufficient proportion of all aquatic macrophytes should be allowed to reproduce in suitable habitat, unaffected by river management practices.	Field observations during macrophyte survey.	This only applies where control measures such as weed cutting are implemented (usually in *Ranunculus* rivers, but can apply in other vegetation types). Flowering outside the normal period and weed cutting or other activities that do not leave patches of plants to flower and set seed are indicators of unfavourable condition. 25% of the total habitat / macrophyte population should be left uncut for the full duration of the growing season.

Attribute	Targets	Method of assessment	Comments
Negative indicators: native species	Targets should be set to register high or increasing cover as unfavourable. **For blanketweed, epiphytic or other algae, *Potamogeton pectinatus* or *Zannichellia palustris*:** Cover values over 25% should be considered unfavourable, but should trigger further investigation. Cover values should not increase significantly from an established baseline. **ii) For taxa with STRs as follows:** River Types I, II, III – STR 1 or 2 River Types V, VI, VII – STR 1-3 River Types VIII, IX, X – STR 1-4 Cover values over 25% should be considered unfavourable, but should trigger further investigation. Cover values should not increase significantly from an established baseline.	Survey the macrophytes of representative stretches at intervals of *ca*. 5 km, using the method of Holmes (1983) and a standard check-list of macrophyte species (see Appendix 2).	Care should be taken with the setting of these targets as thresholds may vary considerably by site and conservation goals. Taxa typically associated with enrichment are considered negative indicators of favourable condition. The species will vary depending on the River Community Type. Species that are characteristic of enrichment, or have atypically low Species Trophic Ranks (STRs) in the Mean Trophic Rank (MTR) system (Holmes *et al.*, 1999) and that are recorded as dominant (3), are used as indicators. Note: in using MTR, each species is allocated a score dependent on its tolerance to eutrophication; this system cannot be used to assess acidification. Expert judgement will be important in assessing the ecological significance of cover values of these species. At some sites, it may be appropriate to set more stringent targets. Occasionally thresholds may need to be raised, according to wider conservation objectives. *Alien species are assessed within the Negative indicators: alien/ introduced species attribute instead.*

Attribute	Targets	Method of assessment	Comments
Negative indicators: alien/ introduced species	No impact on native biota from alien or introduced species **Aquatic and marginal macrophytes** The mean SERCON score for naturalness (derived from individual survey sites) should be 4 or 5 (see **Appendix 10**). **Other organisms** No alien/introduced species present at levels likely to be detrimental to the characteristic biological community.	For aquatic and marginal macrophytes the presence of alien species listed in Appendix 10 should be noted during the macrophyte survey and the scoring system for naturalness applied. For other organisms contact external organisations (e.g. EA, SEPA, EHS, fisheries trusts and boards) for local reports on alien or introduced species.	Non-native species constitute a major threat to many river systems. For example, species such as signal crayfish have been responsible for much of the decline of native crayfish through competition, habitat damage and the introduction of crayfish plague. Note: 'Introduced species' include species that are native to the UK but outside of their natural range. The SERCON scoring system for naturalness of aquatic and marginal macrophytes is used to assess alien plant species. **Note**: This protocol applies to negative indicator species of the channel and channel margins. Negative indicator species found on banks and the riparian zone are assessed as part of the naturalness of banks and naturalness of riparian zone protocols and form part of the CSM structure attribute Expert judgement will be needed to determine whether there is sufficient evidence to generate an unfavourable condition assessment. For example, for signal crayfish, presence alone would constitute unfavourable condition. Other species, such as barbel, can be tolerated at low levels; higher levels would constitute unfavourable condition.
* Indicators of local distinctiveness	Maintain distinctive elements (e.g. rare species, habitat features) at current extent/levels and/or in current locations	As appropriate. (See appendix 11 for riverine Red List and Nationally scarce plant and invertebrate species.)	This attribute is intended to cover any site-specific aspects of this habitat feature (forming part of the reason for notification) which are not covered adequately by the previous attributes, or by separate guidance (e.g. for notified species features). For 'notable' species (e.g. Red List and Nationally scarce plants or species rare in rivers) it is not intended to set a target for detailed species monitoring, rather to provide a rapid indication of presence/absence and/or approximate extent, allowing for natural fluctuations in population size. For 'notable' features (e.g. shingle bars) the same approach applies.

Table 1b. ASPECTS OF ENVIRONMENTAL DISTURBANCE TO BE NOTED AS AN ACCOMPANIMENT TO ASSESSING CONDITION

Objective	**Specified assessment method (if appropriate)**	**Comment**
No artificial barriers significantly impairing characteristic migratory species from essential life-cycle movements.		Barriers may take the form of weirs, barrages or intakes/off-takes that entrain characteristic species.
Fish introductions should not interfere with the ability of the river to support self-sustaining populations of characteristic species.	Use stocking consents	Many priority species can be affected by fish introductions, through increased predation, competition or genetic introgression, or through disease transfer. Stocking is undesirable within SSSIs/ASSIs unless undertaken as an agreed emergency interim measure for priority species whilst underlying adverse environmental factors are resolved. (See also *Negative indicators: non-native/ introduced species*)
Exploitation should not interfere with the ability of the river to support self-sustaining populations of characteristic species.	Assessed through recorded exploitation and status of target species	Key interest features under threat are Atlantic salmon, brown trout, and sea and river lampreys. Exploitation should be licensed at sustainable levels.

Table 1c. CLASSIFICATION OF RIVER REACHES AND SOLUBLE REACTIVE PHOSPHORUS TARGETS

Dominant catchment geology		Soluble Reactive Phosphorus: annual mean (mg L^{-1})		
		1. Headwater	2. River	3. Large river
A	Hard upland geologies (all land over 330 m) - impermeable poor geologies.	≤ 0.02	≤ 0.04	≤ 0.06
B	Other Cambrian-Devonian geologies - hard mudstones and sandstones	≤ 0.06	≤ 0.06	≤ 0.10
C	Jurassic and Cretaceous limestones - soft limestone and chalk.	≤ 0.04	≤ 0.06	≤ 0.06
D	Triassic sandstones and mudstones - soft sandstones and mudstones in lowland areas.	≤ 0.06	≤ 0.06	≤ 0.10
E	Mesozoic clay vales and Tertiary clays - impermeable rich geologies	≤ 0.06	≤ 0.10	≤ 0.10

River size is determined from Environment Agency flow categories. SRP targets for category A and B rivers are under review and some may be revised downwards.

11 References

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Appendix 1. Procedure for dividing rivers into Evaluated Corridor Sections (ECSs)

Edited extract from SERCON 2 User's Guide

ECS characteristics

(a) Each ECS must be a single river (including subsidiary channels) and will often be the main stem of a river. If associated tributaries are to be evaluated this should be done separately.

(b) Each ECS should have essentially uniform gross physical characteristics of geology, slope, size, etc.

(c) The channel length (not the valley length) of each ECS should be between 10 km and 30 km. Reaches longer than 30 km should be divided into shorter ECSs. Where possible, this should be based on an obvious natural division (such as the entry of a large tributary), but if there is no natural break the ECS should simply be halved. ECSs shorter than 10 km are only permitted when any of the following conditions apply:

(i) The ECS is the whole of a short river or tributary;

(ii) The ECS is a short length of river separated from other ECSs by major physical features such as lakes or large waterfalls;

(iii) A short river needs to be divided into ECSs on the basis of major changes in the natural characteristics of the river, but this results in one or more of the ECSs being shorter than 10 km.

The following exceptions to the rule may be used with caution:

(iv) Within an ECS a continuous reach may be deemed to merit separate evaluation. For example, a high quality ECS may contain a severely degraded lower stretch; or a channelized ECS with bank reinforcement may contain a discrete stretch of near-natural river. For part of an ECS (i.e. one originally identified on the basis of natural divisions) to be considered as a separate ECS in its own right, it must represent a **continuous** length of at least 5 km that contrasts in perceived quality with the majority of the ECS. If this stretch is located in the middle of the original ECS, the stretches upstream and downstream should be considered together as one ECS rather than two.

Procedure for identifying ECSs

The following procedure for identifying ECSs should be followed even if the user wishes to evaluate only part of a river:

(a) Identify the source and lower limit with reference to 1:50,000 OS maps. Where several small headwaters combine to form the main river, the point at highest altitude should normally be selected as the source, unless there is a particular reason for including in the uppermost ECS a headwater reach at lower altitude than the source. The lower limit for the main stem of a river should be set at the tidal limit as marked on a 1:50,000 OS map, or its confluence with another river or with a lake.

(b) Assemble information on the physical characteristics of the river, making use of the following:

(i) 1:50,000 (or larger scale) OS maps, providing information on altitude, river length, stream order, sinuosity, and extent of the floodplain. The location of significant features such

as lakes and waterfalls will also be indicated. It is recommended that data from maps are used to construct a profile of the river. This will show the change in altitude from source to mouth and give a good visual representation of channel gradient and stretches along the river where the profile changes rapidly;

(ii) Geological maps, providing information on likely downstream changes in substrate and water chemistry;

(iii) Local knowledge and field observations.

(c) Collate and interpret the data to assess the nature of the river in terms of altitude, gradient, size, dominant flow type (from altitude/gradient/sinuosity), substrates, and water chemistry.

(d) Determine the number, lengths and boundaries of ECSs. Using the information in (c), commence at the source and divide the river into ECSs, each one with a river channel length between 10 km and 30 km (apart from exceptions described above). Use the presence of natural features, such as the entry of a major tributary or the location of a large waterfall, to determine where the boundaries should be drawn. Where the boundary between two ECSs is located at the junction with a tributary, that tributary (and its associated catchment) is considered to be part of the lower ECS.

(e) Check that each ECS complies with the guidance on 'ECS characteristics' given above.

Appendix 2: Standard method for river macrophyte survey and for determining River Community Type

Edited extract from SERCON 2 User's Guide

Field survey

Ideally, survey sites are located every 5 to 7 km along a river, but this will vary depending upon the size of the river and ease of access. For most rivers it has been found that sites 5 km apart reflect accurately the character of small streams whilst distances greater than 10 km apart may suffice for large rivers.

The macrophytes in each 0.5 km survey site are surveyed using a check-list of species (Table 1). Where possible, recording is done by wading in the channel, but for deep and wide rivers it is necessary to walk the banks using a grapnel for sampling, or to use a boat.

The survey at each site includes the entire channel and immediate banksides, with separate records being made for those macrophytes found in the river and those found on the bank. This is an attempt to distinguish between species which occur more or less permanently submerged (if only their basal parts), and those that are subjected only to periodic submergence. The former are referred to as 'river' records and the latter as 'bank' records.

To make the separation of these records objective, the following guidelines should be observed when defining the limits of the river being surveyed. At the sides of the river all parts of the substratum are included which are likely to be submerged for more than 85% of the year. The 'bank' can be usefully defined as that part of the side of the river (or islands) which are submerged for more than 50% but less than 85% of the time. In general terms, therefore, 'river' records are reserved for those macrophytes occurring in the region of the river which is rarely uncovered, and those shallow sections which have an upper limit that may be exposed for a maximum of 50 days in any year. 'Bank' records are for those plants that occur above the limit of the 'river' plants, and are thus out of the water for more than 50 days in any one year, yet will be submerged, or partially so, during mean flow periods. The upper limit of the 'bank' excludes all the areas which are submerged during the 150 days of each year when river flows are at their highest. Such estimates have to involve guesswork, but estimates of submergence levels do allow better interpretation of the data and clearer insights into the ecology of individual species and communities at different sites.

The macrophyte survey concentrates on recording the presence or absence of species on the check-list and limits itself to the channel and base of the banks. Additional species of interest are noted but not used in the classification.

Survey results are tabulated, with any species present within a 0.5 km site denoted by a double set of numbers, either under 'River' or 'Bank' (Table 2). (Note that in the case of marginal plants it is not uncommon for the species to be recorded in both habitats.)

The two numbers are essentially estimates of abundance. The first number in each column (r), refers to the relative abundance of one species against the other species present, but does not indicate how much of the site it covers. Assessment is made on a scale of 1-3 which roughly accords to a simplified DAFOR scale.

1 = Rare
2 = Occasional or Frequent
3 = Abundant or Dominant

The second number (a) refers to absolute abundance or percentage cover and is a semi-objective assessment based on the percentage of the river bed or bank covered by each macrophyte species. Again assessment is on a scale of 1-3.

1 = <0.1% cover of the channel (river) or at its wetted margins (bank)
2 = 0.1 - 5.0% cover
3 = >5% cover

Visualizing the relative abundance of one species compared with all the others present in a 0.5 km length of river is relatively straightforward but estimating the actual cover value is more difficult. As a general guide it is valuable to envisage a dense stand of vegetation which stretches from bank to bank, and extends for 5 m downstream as covering 1% of the 500 m stretch. Similarly, an unbroken stand of 25 m represents 5%. Bank cover is best recorded from one bank in very wide rivers. In such cases a continuous fringe of a single species stretching 5 m represents 1%. If both banks are clearly visible and being recorded, then a continuous stand of 10 m represents 1% cover. A species with cover value 3 means, for instance, that it completely covers the stream bed for 25 m, or it covers half the bed for 50 m, a quarter of the bed for 100 m or it occurs throughout the whole 500 m, but more sparsely. For a score of 3 to be given, bank taxa must:

i) be similarly abundant along both banks with a continuous fringe of 50 m, or
ii) form a co-dominant fringe of 100 m, or
iii) occur as 50 plants or colonies each covering 1 m

Table 2 gives an example of how data should be recorded. This is interpreted as:

Species A is co-dominant in the river channel with Sp. E; it covers >5% of the river channel but does not occur on the banks.

Species B is rare; it is present in both river and bank habitats but at a cover value of <0.1%.

Species C is present only in the upstream length. It is co-dominant with Species D on the banks by covering >5%, is frequent relative to other species within the river channel but covers <0.1%.

Species D is co-dominant with Sp. C on the banks. In the river channel it is frequent compared with other species and covers 0.1-5%.

Species E is co-dominant in the river channel with Sp. A; it covers >5% of the river channel but does not occur on the banks.

Table 1. Macrophyte species listed on the standard river survey (RMS) field card.

*non-native taxa and 'dumping ground' categories

Scientific Name	**Common Name**
ALGAE	
Batrachospermum sp(p).	Frogspawn alga
Chara sp(p).	Stonewort
Cladophora aegagropila	Carpet blanketweed
**Cladophora / Rhizoclonium* agg.	Blanketweed
**Enteromorpha* sp(p).	Tubeweed
*Filamentous green algae (other)	-
Hildenbrandia rivularis	-
Hydrodictyon reticulatum	Netweed
Lemanea fluviatilis	-
Nitella sp(p).	Stonewort
**Vaucheria* sp.	Mole-pelt alga
LICHENS	
Collema dichotomum	River Jelly-lichen
Encrusting lichen(s)	-
Foliose lichen(s)	-
LIVERWORTS	
Chiloscyphus polyanthos	-
Conocephalum conicum	-
Jungermannia sp(p).	-
Lunularia cruciata	-
Marchantia polymorpha	-
Marsupella sp(p).	-
Nardia sp(p).	-
Pellia endiviifolia	-
Pellia epiphylla	-
Porella sp(p).	-
Riccardia sp(p).	-
Scapania sp(p).	-
MOSSES	
Amblystegium fluviatile	-
Blindia acuta	-

Brachythecium plumosum	-
Brachythecium rivulare	-
Brachythecium rutabulum	-
Bryum pseudotriquetrum	-
Calliergon cuspidatum	-
Cinclidotus fontinaloides	-
Cratoneuron filicinum	-
Dichodontium pellucidum / flavescens	-
Dicranella palustris	-
Fissidens crassipes / curnovii / rufulus	-
Fontinalis antipyretica	-
Fontinalis squamosa	-
Hygrohypnum luridum / ochraceum	-
Hyocomium armoricum	-
Isothecium holtii	-
Leptodictyum riparium	-
Octodiceras fontanum	-
Orthotrichum sp(p).	-
Philonotis fontana	-
Polytrichum commune	-
Racomitrium aciculare	-
Rhynchostegium riparioides	-
Schistidium agassizii	-
Schistidium rivulare	-
Sphagnum sp(p).	-
Thamnobryum alopecurum	-
PTERIDOPHYTES	
**Azolla filiculoides*	Water fern
Equisetum fluviatile	Water horsetail
Equisetum palustre	Marsh horsetail
Hymenophyllum sp(p).	Filmy ferns
Osmunda regalis	Royal fern
Other ferns	-
DICOTYLEDONS	
Achillea ptarmica	Sneezewort
Angelica sylvestris	Wild angelica
Apium inundatum	Lesser marshwort
Apium nodiflorum	Fool's watercress

Berula erecta	Lesser water-parsnip
Bidens cernua	Nodding bur-marigold
Bidens tripartita	Tripartite bur-marigold
Callitriche hamulata / brutia	Intermediate water-starwort
Callitriche hermaphroditica	Autumnal water-starwort
Callitriche obtusangula	Blunt-fruited water-starwort
Callitriche platycarpa	Various-leaved water-starwort
Callitriche sp(p). indeterminate	Water-starwort (species not identifiable)
Callitriche stagnalis	Common water-starwort
Caltha palustris	Kingcup, Marsh marigold
Cardamine amara	Large bitter-cress
Ceratophyllum demersum	Rigid hornwort
**Crassula helmsii*	Australian swamp stonecrop, New Zealand water stonecrop
Dipsacus fullonum	Teasel
Epilobium hirsutum	Great willowherb
Eupatorium cannabinum	Hemp-agrimony
**Fallopia japonica*	Japanese knotweed
Filipendula ulmaria	Meadowsweet
Galium palustre	Marsh bedstraw
**Heracleum mantegazzianum*	Giant hogweed
Hippuris vulgaris	Mare's-tail
**Hydrocotyle ranunculoides*	Floating pennywort
Hydrocotyle vulgaris	Marsh pennywort
**Impatiens capensis*	Orange balsam
**Impatiens glandulifera*	Indian balsam, Himalayan balsam
Littorella uniflora	Shoreweed
Lotus pedunculatus	Greater bird's-foot-trefoil
Lycopus europaeus	Gypsywort
Lysimachia vulgaris	Yellow loosetrife
Lythrum salicaria	Purple loosetrife
Mentha aquatica	Water mint
Menyanthes trifoliata	Bogbean
**Mimulus* sp(p).	Monkeyflowers
Montia fontana	Blinks
**Montia sibirica*	Pink purslane
Myosotis scorpioides	Water forget-me-not
Myosoton aquaticum	Water chickweed
Myrica gale	Bog myrtle
Myriophyllum alterniflorum	Alternate water-milfoil

**Myriophyllum aquaticum*	Parrot's-feather
Myriophyllum spicatum	Spiked water-milfoil
Nuphar lutea	Yellow water-lily, brandy-bottle
Nymphaea alba	White water-lily
Oenanthe crocata	Hemlock water-dropwort
Oenanthe fistulosa	Tubular water-dropwort
Oenanthe fluviatilis	River water-dropwort
Persicaria amphibia	Amphibious bistort
Persicaria hydropiper	Water-pepper
Petasites hybridus	Butterbur
Potentilla erecta	Tormentil
Potentilla palustris	Marsh cinquefoil
Pulicaria dysenterica	Common fleabane
Ranunculus aquatilis	Common water-crowfoot
Ranunculus circinatus	Fan-leaved water-crowfoot
Ranunculus flammula	Lesser spearwort
Ranunculus fluitans	River water-crowfoot
Ranunculus hederaceus	Ivy-leaved crowfoot
Ranunculus omiophyllus	Round-leaved crowfoot
Ranunculus peltatus	Pond water-crowfoot
Ranunculus penicillatus ssp. *penicillatus*	Stream water-crowfoot
Ranunculus penicillatus ssp. *pseudofluitans*	Stream water-crowfoot
Ranunculus penicillatus ssp. *pseudofluitans* var. *vertumnus*	Stream water-crowfoot
Ranunculus sceleratus	Celery-leaved buttercup
Ranunculus subgenus *Batrachium* sp(p). indeterminate	Water-crowfoot (species not identifiable)
Ranunculus trichophyllus	Thread-leaved water-crowfoot
Rorippa amphibia	Great yellow-cress
Rorippa nasturtium-aquaticum / microphylla agg.	Water-cress
Rorippa palustris	Marsh yellow-cress
Rorippa sylvestris	Creeping yellow-cress
Rumex hydrolapathum	Water dock
Sagina procumbens	Pearlwort
Scrophularia auriculata	Water figwort
Scutellaria galericulata	Skullcap
Senecio aquaticus	Marsh ragwort
Solanum dulcamara	Bittersweet, Woody nightshade
Stachys palustris	Marsh woundwort
Stellaria uliginosa	Bog stitchwort

Symphytum sp(p).	Comfrey
Tussilago farfara	Coltsfoot
Utricularia sp(p).	Bladderwort
Valeriana officinalis	Valerian
Veronica anagallis-aquatica	Blue water-speedwell
Veronica anagallis-aquatica / catenata indeterminate	Water-speedwell (species not identifiable)
Veronica beccabunga	Brooklime
Veronica catenata	Pink water-speedwell
Veronica scutellata	Marsh speedwell
Viola palustris	Marsh violet
*Other non-aquatic dicotyledons	
TREES AND SHRUBS	
**Alnus glutinosa*	Alder
**Rhododendron ponticum* agg.	Rhododendron
**Salix* sp(p).	Willow
*Conifererous Trees	-
*Other Deciduous Trees and Shrubs	-
MONOCOTYLEDONS	
**Acorus calamus*	Sweetflag
Alisma lanceolatum	Narrow-leaved water-plantain
Alisma plantago-aquatica	Common water-plantain
Alopecurus geniculatus	Marsh foxtail
Bolboschoenus maritimus	Sea club-rush
Butomus umbellatus	Flowering rush
Carex acuta	Slender tufted-sedge
Carex acutiformis	Lesser pond-sedge
Carex aquatilis	Water sedge
Carex curta	White sedge
Carex disticha	Brown sedge
Carex echinata	Star sedge
Carex elata	Tufted sedge
Carex flacca	Glaucous sedge
Carex hirta	Hairy sedge
Carex nigra	Common sedge
Carex otrubae	False fox-sedge
Carex ovalis	Oval sedge
Carex panicea	Carnation sedge

Carex paniculata	Greater tussock-sedge
Carex pendula	Pendulous sedge
Carex pseudocyperus	Cyperus sedge
Carex pulicaris	Flea sedge
Carex remota	Remote sedge
Carex riparia	Great pond-sedge
Carex rostrata	Bottle sedge
Carex vesicaria	Bladder sedge
Carex viridula	Common yellow-sedge
Catabrosa aquatica	Whorl-grass
**Crocosmia* sp(p).	Montbretia
Deschampsia cespitosa	Tufted hair-grass
Eleocharis palustris	Common spike-rush
Eleogiton fluitans	Floating club-rush
**Elodea canadensis*	Canadian pondweed
**Elodea nuttallii*	Nuttall's waterweed
Glyceria declinata	Small sweet-grass
Glyceria fluitans	Floating sweet-grass
Glyceria maxima	Reed sweet-grass
Glyceria notata	Plicate sweet-grass
Glyceria sp(p). indeterminate	Sweet-grass (species not identifiable)
Groenlandia densa	Opposite-leaved pondweed
Hydrocharis morsus-ranae	Frogbit
Iris pseudacorus	Yellow iris
Juncus acutiflorus	Sharp-flowered rush
Juncus articulatus	Jointed rush
Juncus bulbosus	Bulbous rush
Juncus effusus	Soft rush
Juncus inflexus	Hard rush
Lemna gibba	Fat duckweed
Lemna minor	Common duckweed
**Lemna minuta*	Least duckweed
Lemna trisulca	Ivy-leaved duckweed
Luronium natans	Floating water-plantain
Molinia caerulea	Purple moor-grass
Nardus stricta	Mat-grass
Narthecium ossifragum	Bog asphodel
Phalaris arundinacea	Reed canary-grass
Phragmites australis	Common reed
Potamogeton alpinus	Red pondweed

Potamogeton berchtoldii	Small pondweed
Potamogeton broad-leaved spp. indeterminate	Pondweed (species not identifiable)
Potamogeton crispus	Curled pondweed
Potamogeton fine-leaved spp. indeterminate	Pondweed (species not identifiable)
Potamogeton friesii	Flat-stalked pondweed
Potamogeton gramineus	Various-leaved pondweed
Potamogeton lucens	Shining pondweed
Potamogeton natans	Broad-leaved pondweed
Potamogeton nodosus	Loddon pondweed
Potamogeton pectinatus	Fennel pondweed
Potamogeton perfoliatus	Perfoliate pondweed
Potamogeton polygonifolius	Bog pondweed
Potamogeton praelongus	Long-stalked pondweed
Potamogeton pusillus	Lesser pondweed
Potamogeton trichoides	Hairlike pondweed
Potamogeton x *olivaceus*	Hybrid pondweed
Potamogeton x *salicifolius*	Willow-leaved pondweed
Sagittaria sagittifolia	Arrowhead
Schoenoplectus lacustris	Common club-rush
Schoenoplectus tabernaemontani	Grey club-rush
Scirpus sylvaticus	Wood club-rush
Sparganium angustifolium	Floating bur-reed
Sparganium emersum	Unbranched bur-reed
Sparganium erectum	Branched bur-reed
Spirodela polyrhiza	Greater duckweed
Typha angustifolia	Lesser bulrush
Typha latifolia	Bulrush
Zannichellia palustris	Horned pondweed
*Other monocotyledons	-

Table 2. An example of the way in which macrophyte survey data are tabulated before determination of the River Community Type

	River		**Bank**	
	r	**a**	**r**	**a**
Species A	3	3		
Species B	1	1	1	1
Species C	2	1	3	3
Species D	2	2	3	3
Species E	3	3		

Determining the River Community Type

The RCT for designated sites is given on the JNCC Rivers Database, copies of which are held by each of the conservation agencies. Advice on keying out RCTs from the species recorded during the monitoring process should be sought from the appropriate specialist in SNH, EN, CCW and EHS.

Appendix 3. Overall condition assessment form

(One form required per designated site unless >10 assessment units)

Record - F: favourable, U: unfavourable and ND: no data
**For overall attribute: record condition category based upon assessment of all ECSs.*

Note: Shaded boxes relate to the field survey, unshaded boxes relate to interpretation of existing information

Attribute	**Assessment Unit (ECS)**										***Attribute overall**
	1	2	3	4	5	6	7	8	9	10	
1.1 Habitat function: flow											
Obvious visual problems											
Recorded hydrological problems											
1.2. Habitat function: water quality											
Observed turbidity											
Compliance with biological class											
Compliance with chemical class											
Compliance with ammonia target											
Compliance with suspended solids target											
Compliance with phosphorus target											
2.1. Habitat structure: substrate											
Observed surface siltation											
2.2. Habitat structure: channel and banks											
Compliance with river planform target											
Compliance with river profile target (RHS transect data)											
Compliance with river profile target (RHS sweep-up data)											
Compliance with river bank vegetation target											
Compliance with riparian zone target											

Compliance with HMS target											
3. Plant community											
Compliance with species composition target (i)											
Compliance with loss of species target (ii)											
Compliance with abundant species target (iii)											
Compliance with reproduction target											
4. Negative indicators (biological disturbance)											
Compliance with native macrophyte species target											
Compliance with naturalness of macrophytes target											
Compliance with 'other organisms'											
5. Indicators of local distinctiveness											
Rare species											
Other site-specific aspect(s):											
6. Aspects of environmental disturbance											
Note any											
Overall condition of ECS (Fav. / Non-fav.)											

Appendix 4. Assessment of river planform

The following text is modified from the SERCON 2 technical manual (SERCON attribute NA 1a - Naturalness: Planform and River Profile)

(i) Calculate the score as follows, using map data, historical records, and local specialist information:

Score	Description
0	>50% of ECS river artificial, re-aligned, or constrained
1	>25-50% of ECS river artificial, re-aligned, or constrained
2	>10-25% of ECS river artificial, re-aligned, or constrained.
3	>5-10% of ECS river artificial, re-aligned, or constrained.
4	>0-5% of ECS river artificial, re-aligned, or constrained.
5	No evidence of channel re-alignments or constraint.

Appendix 5. Assessment of river profiles

The following text is modified from the SERCON 2 technical manual (SERCON attribute NA 1b – Naturalness: River profiles)

(i) Scoring uses information from RHS forms, Section 'E'. A maximum of 10 points can be derived for each RHS site, scoring 1 point for each spot-check which indicates some form of river profile modification as listed in Table 1. Ignore entries of 'NV' (not visible).

(ii) Determine the mean score by dividing the total points by the number of entries (normally 10, but fewer if 'NV' has been entered).

(iii) Calculate the score for each RHS site as follows:

Score	Points
0	> 0.8 – 1.0
1	> 0.6 – 0.8
2	> 0.4 – 0.6
3	> 0.2 – 0.4
4	> 0 – 0.2
5	0

(iii) Calculate the score for the ECS (assessment unit) as the mean of scores from all RHS sites.

Table 1: River profile modifications

RHS feature	RHS code	RHS data source
Resectioned (reprofiled) bank	RS	Bank modification(s)
Artificial berm	BM	Bank modification(s)
Embanked	EM	Bank modification(s)
Resectioned	RS	Channel modification(s)
Ford	FO	Channel modification(s)

Appendix 6. Assessment of bank vegetation naturalness

Note: these data are not recorded in the standard RHS survey. The simplified Phase 1 vegetation survey should be undertaken while carrying out the RHS survey work, using a separate sheet to note down bank vegetation categories.

The following text is modified from the SERCON 2 technical manual (SERCON attribute NA 5 – Naturalness: Plant Assemblages on the Banks)

Each RHS site is surveyed with respect to the broad habitat categories listed in **Table 1** and in the descriptive notes beneath the table. When recording a vegetation type as present (✓)**,** it must occur as more than a single out-crop (i.e. it should be ≥5 m^2 or occupy at least 1% of the bank face on a 500 m length). For land use categories or notable nuisance plant species to be recorded as extensive these should "occur" (= presence) along > 33% of the total bank length (but not necessarily cover > 33%).

Method PART A

Option 1: Based on spot-check Phase 1 Habitat Survey information derived from the RHS vegetation recording module

When recording vegetation types on river banks as an added module to standard RHS, spot-check records relate to the bankface and banktop in the 10 m wide transect.

Surveys result in 20 separate records for each RHS site – the left and right bankfaces and banktops of the 10 spot-check transects.

Using points assigned to vegetation types in Table 1:

(i) Calculate the total points for each RHS site within the ECS (maximum score 100 if all 10 transects score (2x) 5 points for the presence of one of the semi-natural vegetation types in Table 1);

(ii) Assign the initial SERCON score for each RHS site as follows:

SERCON score	Points
0	0-15
1	>15-30
2	>30-45
3	>45-60
4	>60-75
5	>75-100

OR

Option 2: Based on Phase 1 Habitat Survey information derived from RHS 'sweep-up' method

Using scores assigned to vegetation types in Table 1, determine the number of points for each RHS site within the assessment unit, as follows:

(i) For all vegetation types recorded only as present ('✓'), add together the number of points for each record for each bank

(ii) For all vegetation types recorded as extensive ('E'), multiply the points score by 3 and add together the number of points for each record for each bank

(iii) Add the points from (i) and (ii) and Assign the initial SERCON score for the survey site as follows:

SERCON score	Points
0	0-12
1	13-18
2	19-24
3	25-30
4	31-36
5	≥37

Method PART B

Take the scores from Options 1 or 2 then;

(a) **Using Section O of the RHS form, modify the score for each RHS site as shown in Table 3:**

Note: this section refers to non-native plant species **(see Table 2)**

Table 3. Score modification

	Bankface	Banktop to 50m
≥2 species present (✓)	Subtract 1	N/A
1 or more species extensive ('E')	Subtract 2	N/A

(b) Calculate the overall score for in the assessment unit as the mean of scores from all RHS sites.

Table 1. Phase 1 vegetation categories together with points assigned for use in assessments of the naturalness of bank plant assemblages

Broad description	Code	Detailed description	Points
A. Woodland and scrub	A1	Semi-natural deciduous/coniferous	5
	A2	Scrub	3
	A1p	Plantation (& planted trees)	0
B. Grassland and marsh	B1-3	Unimproved & good semi-improved	4
	B4	Improved & amenity grassland	0
	B5	Marshy grassland	4

	B6	Poor semi-improved	1
C. Tall herb and fern	C1	Bracken	1
	C2	Upland species-rich	4
	C3.1	Tall ruderal	1
	C3.2	Fern/non-ruderal	4
D. Heathland	D(1-6)	Heath & heathy acid grass	5
E. Mire	E(1-3)	Bog, flush & fen/mire	5
F. Marginal, etc.	F(1-2)	Inundation/swamp/marginal	5
	Fa	Planted reeds/marginals, etc.	2
I. Rock & artificial exposure	I1	Natural shingle/boulders/rocks	5
	I2	Artificial (e.g. revetment bryophytes)	0
J. Miscellaneous	J4a	Bare (natural)	2
	J4b	Bare (artificial)	0
	J5a	Bryophytes	5
	J5b	Other	0

Notes to Table 1

A. Woodland and scrub

A1. Semi-natural Deciduous/Coniferous - standard Phase 1 A1 natural and semi-natural woodland, excluding plantation.

A1p. Plantation and Planted trees (sub-category of A1).

A2. Scrub - standard Phase 1, with standard exclusions such as *Myrica* (E), *Ulex* (D).

B. Grassland and marsh

B1-3. Unimproved and Good Semi-improved Grasslands - record Unimproved Acid (B1), Neutral (B2), Calcareous (B3) according to standard Phase 1 descriptions, and also all good semi-improved grassland.
B4. Standard Phase 1 Improved grassland - also include Amenity grassland (J1.2)
B5. Marshy grassland - standard Phase 1 description - this is the category for bankside communities with a mixed herb/grass flora with abundant rushes, sedges and/or wetland herbs such as meadow-sweet, purple loose-strife, etc. Also include banks with reeds/sedges, etc. that do not have permanently high water table (*cf.* 'F').
B6. Poor semi-improved - record where flora of meadow character, but with poor diversity; exclude 'improved/amenity/tall grass/ruderal' (B4).

C. Tall herb and fern

C1. Bracken - standard Phase 1 description.
C2. Upland species-rich - standard Phase 1 description, primarily devoted to small patches of natural/semi-natural flora with species such as *Angelica*, *Filipendula*, *Solidago*, *Athyrium*, *Trollius* and *Crepis*.
C3.1 Tall ruderal - standard Phase 1 description, primarily for nettle, knotweed, etc.
C3.2 Fern/non-ruderal - standard Phase 1 description, primarily for shaded banks with ferns or *Luzula*.

D. Heathland

Phase 1 has 6 categories (D1-6) for Heath & heathy acid grass - use standard Phase 1 descriptions to code just as 'D' and provide D1-6 information as target notes if desired. Includes heather, gorse, lichen/bryophyte, etc.

E. Mire

Phase 1 has 3 categories - Bog (E1) , Flush (E2) and Fen/Mire (E3) - use standard Phase 1 descriptions to record as 'E' - target notes referring to E1-3 can be provided which will be determined by the adjacent riparian habitat type.

F. Marginal, etc.

F. Swamp/Marginal/Inundation - use standard Phase 1 descriptions to record as 'F' where river margin merges with natural or semi-natural tall reed/sedge/mixed communities with permanently high water-table.
Fa. Planted reeds/marginals, etc. (not standard Phase 1 category - reserved for vegetation restoration areas).

I. Rock & artificial exposure

I1. Natural shingle/boulder/rock - extend standard Phase 1 descriptions to include banks with shingle flora (transient) and banks dominated by natural boulders or other rocks with bryophytes and semi-natural herb communities between and in fissures.
I2. Artificial - extend standard Phase 1 description to include all revetments and artificial structures with bryophytes or higher plants between cracks, etc.

J. Miscellaneous

J4a. Miscellaneous - Naturally Bare - include standard Phase 1 descriptions plus include bare peat category (E4).
J4b. Miscellaneous - Artificially Bare - include all bare man-made banks.
J5a. Bryophytes – banks dominated by mosses and liverworts (common for upland river banks, but not Phase I category).
J5b. Other - use for any other communities not covered above (should be avoided unless essential, and target notes provided).

Table 2. 'Notable Nuisance Plant Species' recorded in RHS

n.b. other non- native nuisance species, such as Rhododendron *Rhododendron ponticum*, can be added to the list if necessary.

Scientific name	Common name
Fallopia japonica	Japanese knotweed
Heracleum mantegazzianum	Giant hogweed
Impatiens glandulifera	Indian balsam (Himalayan balsam)

Appendix 7. Assessment of riparian zone naturalness

The following text is modified from the SERCON 2 technical manual (SERCON attribute NA 6 – Naturalness: Riparian Zones)

Naturalness of the vegetation of the riparian zone is scored using data recorded in section 'F' of the RHS form (land-use within 5 m of bank-top). Twenty land-use values are recorded for each RHS site, 10 on each bank. Eighteen categories can be coded (Table 1), each one of which has been assigned points of 0-4 according to the 'naturalness' of the vegetation. Ignore entries of 'NV' (not visible). For land use categories or notable nuisance plant species to be recorded as extensive these should "occur" (= presence) along > 33% of the total bank length (but not necessarily cover > 33%).

The score is derived in three steps:

(a) Using points assigned to vegetation categories in Table 1:

(i) Calculate the total points for each RHS site within the ECS (maximum score 80 if all 10 transects score (2x) 4 points for the presence of one of the semi-natural land-use types in Table 1)

(ii) Determine the mean score by dividing the total points by the number of entries (normally 20, but will be fewer if 'NV' has been entered).

(iii) Calculate the score for each RHS site as follows:

Score	Points
0	0 – 0.5
1	> 0.5 – 1.25
2	> 1.25 – 2.00
3	> 2.00 – 2.50
4	> 2.50 – 3.00
5	> 3.00

Table 1: RHS land-use categories together with points assigned for use in assessments of riparian zone naturalness

Points	RHS land-use categories	RHS code
4	Broadleaf/mixed woodland	BL
1	Broadleaf/mixed plantation	BP
4	Coniferous woodland	CW
0	Coniferous plantation	CP
3	Scrub and shrubs	SH
1	Orchard	OR
4	Wetland (e.g. bog, marsh, fen)	WL
4	Moorland/heath	MH
1	Artificial open water	AW
3	Natural open water	OW
3	Rough/unimproved grassland/pasture	RP
1	Improved/semi-improved grassland	IG
2	Tall herb/rank vegetation	TH
4	Rock, scree or sand dunes	RD

0	Suburban/urban development	SU
0	Tilled land	TL
0	Irrigated land	IL
0	Parkland or gardens	PG

(b) Using Section H of the RHS form, modify the initial SERCON score for each RHS site as follows:

Add 1 to the SERCON score when one or more of the following is recorded as extensive ('E') on one bank: RP, SH, OW
Add 2 to the SERCON score when one or more of the following is recorded as extensive ('E') on both banks: RP, SH, OW

Add 2 to the SERCON score when one or more of the following is recorded as extensive ('E') on one bank: BL, CW, WL, MH, RD
Add 3 to the SERCON score when one or more of the following is recorded as extensive ('E') on both banks: BL, CW, WL, MH, RD

Subtract 1 from the SERCON score when one or more of the following is recorded as extensive ('E') on one bank: CP, TL, IL, PG
Subtract 2 from the SERCON score when one or more of the following is recorded as extensive ('E') on both banks: CP, TL, IL, PG

Subtract 2 from the SERCON score when SU is recorded as extensive ('E') on one bank
Subtract 3 from the SERCON score when SU is recorded as extensive ('E') on both banks

(c) Using Section O of the RHS form, modify the score for each RHS site as shown in Table 3:

Note: this section refers to non-native plant species **(see Table2)**

Table 3. Score modification

	Bankface	**Banktop to 50m**
≥2 species present (✓)	N/A	Subtract 1
1 or more species extensive ('E')	N/A	Subtract 2

(d) Calculate the overall score in the reporting unit as the mean of scores from all RHS sites.

Table 2. 'Notable Nuisance Plant Species' recorded in RHS

n.b. other non- native nuisance species, such as Rhododendron *Rhododendron ponticum*, can be added to the list if necessary.

Scientific name	Common name
Fallopia japonica	Japanese knotweed
Heracleum mantegazzianum	Giant hogweed
Impatiens glandulifera	Indian balsam (Himalayan balsam)

Appendix 8: River Community Type constancy table

Summary description of River Community Types

River Community Type I

These are naturally eutrophic, lowland rivers with a high base flow. They are species-rich communities dominated by higher plants, and are especially vulnerable to abstraction, agricultural pollution, flood defence works and eutrophication.

River Community Type II

Type II rivers are dominated by clays and like Type I, are slow-flowing, naturally eutrophic, lowland rivers. Due to the fine, soft, poorly oxygenated substrate many species have trouble rooting and sites are consequently less species-rich than Type I. Many sites are impacted by agriculture and siltation.

River Community Type III

Type III are base-rich, low-energy lowland rivers and streams, including the well-known chalk streams. The principal feature common to the great majority of sites is a stable flow regime resulting from substantial base flow. Harder substrates allow a wide range of species to occur, especially in combination with traditional management practices that have restricted shading by trees. Many of the occasional species in this community are characteristic of slow flow and eutrophic conditions. Increases in their frequency along a river are a sign of unfavourable condition.

River Community Type V

Type V is a principally lowland type widespread over resistant rocks in England and Wales but very rare in Scotland. It is the only widespread lowland community to have a significant diversity of bryophytes. *Oenanthe crocata* is often very abundant in this type.

River Community Type VI

Type VI are generally rather base-rich, mesotrophic rivers in western and northern Britain with a moderate to fast current. Individual sites are often not particularly species-rich but are often associated with rivers of high conservation value for their semi-natural geomorphology. Many sites are quite large and have extensive exposed riverine sediment beds.

River Community Type VII

All Type VII sites are arguably of some conservation importance, since none of the subtypes are common. Type VII are mainly smaller, low-gradient streams at a relatively high altitude or latitude flowing over a moderately basic geology, often through fens or other wetlands. These characteristics combine to make the range of species present especially site-specific, and it is therefore important to select target species carefully. Most of the commoner plant species are higher plants, but individual sites can be relatively species-poor. Type VII reaches of river are rarely extensive.

River Community Type VIII

Type VIII rivers are common throughout western Britain over hard rocks. They are frequently (though by no means always) heavily shaded and often contain a diverse bryophyte flora. Most SSSI rivers in the western half of Britain will contain at least some Type VIII, and the Type is likely to be associated with rare or sensitive bryophyte species, especially in Wales.

River Community Type IX

Type IX are a naturally rare river type; both oligotrophic and low altitude. Sites typically have clear water and relatively slow flow, combining to allow the presence of a wide range of species including some more usually associated with standing waters (e.g. *Littorella uniflora*).

River Community Type X

Type X are fast-flowing, oligotrophic, base-poor rivers generally associated with upland areas. Instream communities are dominated by bryophytes tolerant of acidic conditions and swift flows. Many sites are naturally rather species-poor and prone to acidification. None is particularly scarce.

Table 1. River Community Type constancy table

Note: P stands for 'predicted presence' and indicates which river types these species might be expected to occur in. This has been derived from existing knowledge plus a certain amount of expert judgment where necessary. Apart from 'indeterminate' or otherwise lumped taxa, predicted species are likely to be rare. However, if present they are usually good indicators of favourable condition.

Non-native species have been removed from the table (since this is for condition assessment).

	River Community Type								
Taxon	**I**	**II**	**III**	**V**	**VI**	**VII**	**VIII**	**IX**	**X**
Achillea ptarmica					II	IV	III	III	III
Agrostis stolonifera	V	V	V	V	V	V	V	IV	III
Alisma lanceolatum				I					
Alisma plantago-aquatica	II	III	I	II	II	II	I	II	
Alnus glutinosa	P	P	P	P	P	P	P	P	P
Alopecurus geniculatus	II	II		I	III	II	I		
Amblystegium fluviatile			II	IV	IV	I	IV		
Angelica sylvestris	II	II	III	II	II	III	III	III	III
Apium inundatum						II			
Apium nodiflorum	V	III	V	III	I	I		II	
Batrachospermum sp(p).			II						
Berula erecta	III		IV						
Bidens cernua	I								
Bidens tripartita	II								
Blindia acuta								I	III
Bolboschoenus maritimus	P	P							
Brachythecium plumosum						I	III		III
Brachythecium rivulare				II	II	II	III		II
Brachythecium rutabulum	II	II	II	III	III	II	II		III
Bryum pseudotriquetrum						II	IV	II	III
Butomus umbellatus	III	II			I				
Calliergon cuspidatum						II	II	II	IV
Callitriche hamulata / brutia				III	II	IV	III	III	II
Callitriche hermaphroditica	P	P	P	P	P		P		P

Callitriche obtusangula	III	II	V			I			
Callitriche platycarpa	IV	II	III	II		II	I		
Callitriche sp. indeterminate	P	P	P	P	P	P	P	P	P
Callitriche stagnalis	IV	III	IV	II	III	III	II	III	II
Caltha palustris			II	II	IV	IV	IV	IV	IV
Cardamine amara					II	III			I
Carex acuta		I			I				
Carex acutiformis	III	II	V						
Carex aquatilis						II	I		
Carex curta						P	P	P	P
Carex disticha				P	P	P	P		
Carex echinata								I	II
Carex elata	P						P	P	P
Carex flacca						II			
Carex hirta	II			II	II	I			
Carex nigra						II	IV	IV	III
Carex otrubae	P	P	P	P	P	P	P		
Carex ovalis						P	P		P
Carex panicea							P	P	P
Carex paniculata			II						
Carex pendula		P	P	P	P		P		
Carex pseudocyperus		P		P		P		P	
Carex pulicaris								P	P
Carex remota				II			III		
Carex riparia	V	II	IV						
Carex rostrata					II	II	II	III	II
Carex vesicaria						II			
Carex viridula						III	II	II	III
Catabrosa aquatica		P	P		P				
Ceratophyllum demersum	II	I							
Chara sp(p).						III			
Chiloscyphus polyanthos				III	II	III	V		II
Cinclidotus fontinaloides				II	III	IV	II		
Cladophora / Rhizoclonium agg.	IV	V	III	IV	IV	II	II		
Cladophora aegragophila				III	II				
Collema dichotomum					II				
Conocephalum conicum				IV	III	II	IV		II
Cratoneuron filicinum	P	P	P	P	P	P	P		
Deschampsia cespitosa		II	I	II	II	IV	III	III	III
Dichodontium flavescens / pellucidum				II			III		III
Dicranella palustris									II
Dipsacus fullonum	I	II							

Eleocharis palustris				II	III	II	II	IV	
Eleogiton fluitans								II	
Encrusting Lichens				II	II		III		
Enteromorpha sp(p).	IV	IV			II				
Epilobium hirsutum	V	V	V	IV	IV	I			
Equisetum arvense	II	II	II	III	IV	II	III		III
Equisetum fluviatile					II	III	II	IV	II
Equisetum palustre		II	I	II	II	II	II	III	II
Eupatorium cannabinum	IV	I	IV	III			I		
Filamentous green algae (other)	II	II		II	IV	IV	IV	III	IV
Filipendula ulmaria	III	III	V	IV	IV	IV	IV	III	IV
Fissidens sp(p).	P	P		P	P		P		
Foliose lichens		II	II	V	V	II	V		
Fontinalis antipyretica	III	II	III	V	V	IV	V	III	III
Fontinalis squamosa				IV	II	II	IV		II
Galium palustre		II	I	I	I	III	III	IV	II
Glyceria declinata									
Glyceria fluitans	III	II	II	IV	III	IV	IV	IV	II
Glyceria maxima	V	IV	IV		II				
Glyceria notata			II	II	II				
Glyceria sp(p). indeterminate	P	P	P	P	P	P	P	P	P
Groenlandia densa			I			II			
Hildenbrandia rivularis			I	IV	IV		III		
Hippuris vulgaris			II					II	
Hydrocharis morsus-ranae	P	P							
Hydrocotyle vulgaris								II	
Hydrodictyon reticulatum	P	P		P					
Hygrohypnum sp(p).						V	V		IV
Hymenophyllum sp(p).							P	P	P
Hyocomium armoricum							II		III
Iris pseudacorus	III	III	IV	II	II	II	II	II	
Isothecium holtii							P		P
Juncus acutiflorus	II	II	I	IV	IV	III	IV	III	IV
Juncus articulatus	II				II	III		III	II
Juncus bulbosus						II	II	V	IV
Juncus effusus	I	II	III	III	III	V	IV	V	IV
Juncus inflexus	III	III	IV	II	II	I			
Jungermannia sp(p).						II	III		III
Lemanea fluviatilis				III	III	II	IV		II
Lemna gibba	II	II							
Lemna minor	IV	IV	II	II	II				
Lemna trisulca			III						

Leptodictyum riparium	III	IV	III	III	III		I		
Littorella uniflora						I	IV	III	II
Lotus pedunculatus						II	II	II	III
Lunularia cruciata				III	II		II		
Luronium natans						P		P	
Lycopus europaeus	IV	III	III	III	III	I			
Lysimachia vulgaris			I	II	II				
Lythrum salicaria	III	III	III	III	II	II		II	
Marchantia polymorpha				II	II	I	II	II	II
Marsupella sp(p).									III
Mentha aquatica	V	IV	V	IV	V	IV	IV	III	II
Menyanthes trifoliata						I		II	
Molinia caerulea							III	IV	IV
Montia fontana						II	II	II	II
Myosotis scorpioides	V	V	V	IV	V	IV	IV	II	II
Myosoton aquaticum	III	III		II	III				
Myrica gale								P	P
Myriophyllum alterniflorum				IV	III	III	III	III	III
Myriophyllum spicatum	IV	III	III	II	II	II		II	
Nardia sp(p).									II
Nardus stricta							II		III
Narthecium ossifragum									II
Nitella sp(p).						P	P	P	P
Nuphar lutea	IV	III				I		II	
Nymphaea alba	P	P				P		P	P
Octodiceras fontanum				P	P		P		
Oenanthe crocata	V	I	II	V	II	III	III	II	
Oenanthe fistulosa	P	P	P						
Oenanthe fluviatilis	III		I						
Orthotrichum sp(p).				P			P		P
Osmunda regalis				P		P	P	P	
Other ferns				II	II	III	III	III	IV
Other tree species	IV	IV	V	V	IV	IV	V	III	III
Pellia endiviifolia		II	II	III	III		II		
Pellia epiphylla				III	I	III	IV	IV	V
Persicaria amphibia	III	IV	II	II	III			II	
Persicaria hydropiper	P	P	P	P	P	P	P	P	P
Petasites hybridus	II	I	II	II	III		II		
Phalaris arundinacea	V	V	V	V	V	IV	IV	II	
Philonotis fontana							III	II	II
Phragmites australis	III	II	III			I		II	
Polytrichum commune								II	IV

Porella sp(p).				P	P		P		
Potamogeton alpinus					II				
Potamogeton berchtoldii	II			II					
Potamogeton broad-leaved spp. indeterminate	P	P	P	P	P				
Potamogeton crispus	III	III	II	II	III				
Potamogeton fine-leaved spp. indeterminate	P	P	P	P	P				
Potamogeton friesii		I				I			
Potamogeton gramineus					II				
Potamogeton lucens	III	II	I						
Potamogeton natans		II		II	II	II		III	
Potamogeton nodosus	P	P	P						
Potamogeton pectinatus	IV	IV	II		I				
Potamogeton perfoliatus	III	III		I	II				
Potamogeton polygonifolius								III	II
Potamogeton praelongus	P	P				P			
Potamogeton pusillus	P	P				P			
Potamogeton trichoides	P	P							
Potamogeton x *olivaceus*					P				
Potamogeton x *salicifolius*	P	P			P				
Potentilla erecta						II	I	III	IV
Potentilla palustris								III	
Pulicaria dysenterica	II		II	II					
Racomitrium aciculare						II	III	III	IV
Ranunculus aquatilis						II	II		
Ranunculus circinatus	II								
Ranunculus flammula				II		III	III	V	IV
Ranunculus fluitans	II	II		II	III				
Ranunculus hederaceus				P	P	P	P	P	P
Ranunculus omiophyllus				P	P	P	P	P	P
Ranunculus peltatus					II				
Ranunculus penicillatus ssp. *penicillatus*				III	I	II	I	II	
Ranunculus penicillatus ssp. *pseudofluitans*	III	II	V	III	II				
Ranunculus penicillatus ssp. *Pseudofluitans* var. *vertumnus*				P	P				
Ranunculus sceleratus	II	III	II		II				
Ranunculus subgenus *Batrachium* indeterminate	P	P	P	P	P	P	P	P	
Ranunculus trichophyllus	P	P	P	P					
Rhynchostegium riparioides	II	II	III	V	V	III	V		II
Riccardia sp(p).				P			P		
Rorippa amphibia	I	IV			II				
Rorippa nasturtium-aquaticum / microphylla agg.	V	IV	V	III	III	III	I	III	

Rorippa palustris	II	II			II				
Rorippa sylvestris		II		II	III				
Rumex hydrolapathum	II	II	III						
Sagina procumbens				II	II	II	III	II	III
Sagittaria sagittifolia	IV	III							
Salix sp(p).	IV	V	V	V	V	IV	V	III	IV
Scapania undulata						II	IV	II	IV
Schistidium agassizii							II		
Schistidium rivulare				II	II	II	III		III
Schoenoplectus lacustris	IV	III	II					I	
Schoenoplectus tabernaemontani	P	P	P						
Scirpus sylvaticus				II	II				
Scrophularia auriculata	IV	IV	V	II	II				
Scutellaria galericulata		II							
Senecio aquaticus	I				II	III	I	II	I
Solanum dulcamara	V	V	V	IV	III		II		
Sparganium angustifolium								II	
Sparganium emersum	V	IV	II	IV		II	I		
Sparganium erectum	V	V	V	V	IV	III	II	II	
Sphagnum sp(p).								III	IV
Spirodela polyrhiza	P	P		P					
Stachys palustris	II	II	II	II	II	II	II	II	
Stellaria uliginosa				I	I	II	II		II
Symphytum officinale	III	III	III	II	II				
Thamnobryum alopecurum				III	II	I	III		I
Tussilago farfara				II	II	III	II		II
Typha angustifolia	P	P	P						
Typha latifolia	II		II						
Utricularia sp(p).								P	P
Valeriana officinalis				P	P	P	P	P	P
Vaucheria sp(p).	IV	IV	IV	IV	IV		II		
Veronica anagallis-aquatica	III	II	V			II		II	
Veronica anagallis-aquatica / catenata indeterminate									
Veronica beccabunga	V	IV	V	V	IV	III	II	III	
Veronica catenata	III	II							
Veronica scutellata								II	I
Viola palustris						P	P	P	P
Zannichellia palustris	IV	II	III	II	I				

Table 2. Less Common Species on River SSSIs

The following table includes less frequent species (constancy I or II). Some of these are largely restricted to one or a few river types. Others occur in various types but are rare. The following species are rarely recorded everywhere and should be preserved if possible. The type(s) in which they are most likely to occur are shown in brackets.

Alisma lanceolatum (II, V)	*Philonotis fontana* (X)
Apium inundatum (VII, IX)	*Porella* spp.
Chara spp.	*Potamogeton alpinus* (VI)
Groenlandia densa (III)	*Potamogeton berchtoldii*
Hippuris vulgaris (III)	*Potamogeton friesii*
Hymenophyllum spp. (X)	*Potamogeton gramineus* (VI)
Isothecium holtii (VIII, X)	*Potamogeton lucens* (I-III)
Lemna trisulca (III)	*Potamogeton nodosus*
Luronium natans (VII)	*Potamogeton polygonifolius* (IX, X)
Menyanthes trifoliata (IX)	*Potamogeton praelongus*
Myrica gale (IX, X)	*Potamogeton pusillus*
Narthecium ossifragum (X)	*Potamogeton* hybrids
Nitella spp. (IX)	*Ranunculus aquatilis*
Octodiceras fontanum	*Ranunculus circinatus* (I)
Oenanthe fistulosa (I-III)	*Ranunculus trichophyllus*
Oenanthe fluviatilis (I-III)	*Schistidium agassizii* (VIII, X)
Orthotrichum spp (VI, VIII)	*Spirodela polyrhiza* (I, II)
Osmunda regalis	*Utricularia* spp. (IX)

Appendix 9. Assessment form for plant community

(One form required per macrophyte survey site)

SSSI Name		Assessment Unit Name/No.	
NGR		Date	
Surveyor(s)			
Target Community			

Species Recorded					
a. Species with frequency V. 80% or more of those listed on the constancy table should be present					
Name	Cover		Name	Cover	
	channel	bank		channel	bank
Frequency V Species	**PASS**			**FAIL**	
b. Species with frequency IV. 60% or more of those listed on the constancy table should be present					
Frequency IV Species	**PASS**			**FAIL**	
c. Species with frequency III. 25% or more of those listed on the constancy table should be present					
Frequency III Species	**PASS**			**FAIL**	

d. Additional (site-specific) target species (if any).					
OVERALL ASSESSMENT	**PASS**			**FAIL**	
Field Notes					

Appendix 10. Assessment of aquatic and marginal macrophyte naturalness

The following text is modified from the SERCON 2 technical manual (SERCON attribute NA 7 – Naturalness: Aquatic and Marginal Macrophytes). It can be used to assess the impact of non-native plant species (negative indicators)

The degree of naturalness of the macrophyte community is assessed by comparing the proportion of native species to alien species recorded by standard River Macrophyte Survey (see Table 1 for list of alien species on the standard check-list). Only species of the channel and the margins are considered (the area used in the macrophyte classification). Negative modifiers are applied if alien species are dominant within the recorded communities, or it is known that aquatic and marginal alien species not on the standard Check-list are also present within an assessment unit ECS (see Table 2).

(i) Assign the SERCON score for each macrophyte survey site as follows:

SERCON score	Description
0	≤82% of the aquatic and marginal macrophyte species are native.
1	>82-87% of the aquatic and marginal macrophyte species are native.
2	>87-91% of the aquatic and marginal macrophyte species are native.
3	>91-95% of the aquatic and marginal macrophyte species are native.
4	>95-98% of the aquatic and marginal macrophyte species are native.
5	>98% of the aquatic and marginal macrophyte species are native.

Subtract 1 when any alien species in Table 1 is recorded as 'abundant' or 'dominant' (cover value '3').

(ii) Calculate the overall score as the mean of scores from all macrophyte survey sites.

(iii) Modify the overall score as follows:

Subtract 1 when any alien species listed in Table 2 is established within the ECS.
Subtract 2 when 2 or more alien species listed in Table 2 are established within the ECS.

Table 1: List of alien aquatic and marginal macrophytes established in the UK on the standard River Macrophyte Survey check-list.

Scientific Name	Common Name
Acorus calamus	Sweetflag
Azolla filiculoides	Water Fern
Crassula helmsii	Australian Swamp Stonecrop, New Zealand Water Stonecrop
Crocosmia sp(p).	Montbretia
Elodea canadensis	Canadian Pondweed
Elodea nuttallii	Nuttall's Waterweed
Fallopia japonica	Japanese Knotweed
Heracleum mantegazzianum	Giant Hogweed
Hydrocotyle ranunculoides	Floating Pennywort
Impatiens capensis	Orange Balsam
Impatiens glandulifera	Himalayan Balsam, Indian Balsam
Lemna minuta	Least Duckweed
Mimulus sp(p).	Monkeyflowers
Montia sibirica	Pink Purslane
Myriophyllum aquaticum	Parrot's-feather

Table 2: List of other alien aquatic and marginal macrophytes established in the UK, but not on the standard River Macrophyte Survey check-list.

Note: Virtually any alien species can (and often does) occur along river banks. The following is a list of aquatic and marginal aliens which have become naturalised on some rivers and become well established over many years:

Scientific name	Common name
Aponogeton distachyos	Cape Pondweed
Egeria densa	Large-flowered Water-thyme
Lagarosiphon major	Curly Water-thyme
Petasites fragrans	Winter Heliotrope
Petasites japonicus	Giant Butterbur
Vallisneria spiralis	Tapegrass

Appendix 11. Red List and Nationally scarce plant and invertebrate species

Table 1. Riverine Red List plant and invertebrate species

Scientific name	Common name
PLANTS	
Groenlandia densa	Opposite-leaved Pondweed (NI only)
Potamogeton acutifolius	Sharp-leaved Pondweed (GB only)
INVERTEBRATES	
Bidessus minutissimus	Water beetle
Ephemera lineata	Mayfly
Heptagenia longicauda	Mayfly
Hydroptila lotensis	Caddis fly
Hydroptila tigurina	Caddis fly
Isogenus nubecula	Stonefly
Ithytrichia clavata	Caddis fly
Libellula fulva	Dragonfly
Lophopus crystallinus	Moss polyp
Macroplea appendiculata	Water beetle
Marstoniopsis scholtzi	Mollusc
Normandia nitens	Water beetle
Oecetis notata	Caddis fly
Pisidium tenuilineatum	Mollusc
Potamanthus luteus	Mayfly
Rhyacophila septentrionis	Caddis fly
Setodes punctatus	Caddis fly
Sphaerium solidum	Mollusc
Stenelmis canaliculata	Water beetle

Table 2. Nationally scarce riverine plant and invertebrate species

Scientific name	Common name
PLANTS	
Callitriche truncata	Short-leaved Water-starwort
Cicuta virosa	Cowbane
Myriophyllum verticillatum	Whorled Water-milfoil (GB only)
Nymphoides peltata	Fringed Water-lily (GB only)
Persicaria mitis	Tasteless Water-pepper
Potamogeton coloratus	Fen Pondweed (GB only)
Potamogeton compressus	Grass-wrack Pondweed (GB only)
Potamogeton filiformis	Slender-leaved Pondweed (GB only)
Potamogeton trichoides	Hairlike Pondweed (GB only)
Sium latifolium	Greater Water-parsnip (GB only)
Stratiotes aloides	Water Soldier
+ mainly bank:	
Allium schoenoprasum	Wild Chives
Illecebrum verticillatum	Coral-necklace (GB only)
Impatiens noli-tangere	Touch-me-not Balsam (GB only)
Oenanthe silaifolia	Narrow-leaved Water-dropwort (GB only)

INVERTEBRATES	
Boreobdella verrucata	Leech
Brachyptera putata	Stonefly
Brachytron pratense	Dragonfly
Ceraclea senilis	Caddis fly
Coenagrion pulchellum	Dragonfly
Donacia dentata	Water beetle
Donacia sparganii	Water beetle
Gomphus vulgatissimus	Dragonfly
Helichus substriatus	Water beetle
Heptagenia fuscogrisea	Mayfly
Hydraena minutissima	Water beetle
Hydraena pulchella	Water beetle
Hydraena rufipes	Water beetle
Hydroptila cornuta	Caddis fly
Metalype fragilis	Caddis fly
Ochthebius exsculptus	Water beetle
Oulimnius troglodytes	Water beetle
Pisidium moitessierianum	Mollusc
Pseudanodonta complanata	Mollusc
Rhabdiopteryx acuminata	Stonefly
Riolus cupreus	Water beetle
Riolus subviolaceus	Water beetle
Sialis nigripes	Alder fly
Sisyra dalii	Sponge fly
Sisyra terminalis	Sponge fly
Ylodes conspersus	Caddis fly