Annex B Information on fish and fish habitat

1 How to assess habitat suitability for juvenile fish

Table 4 (p13) should be consulted to determine whether a full habitat survey is required. If it is, the survey should be designed to provide detailed information on the location, extent and condition of habitat features along and surrounding the river of interest. This should cover the part of the river which will be subjected to altered river flows and the area above any proposed new impounding works.

Information should be collected by walking the selected survey stretch and collecting general information on the current status of the instream habitats. This information should be provided in the form of a map of the river, which should be drawn to scale.

The wetted width of the river should be recorded at regular intervals along the survey stretch and widths should be indicated on the map.

Table B1: Habitat type classification

Habitat type	Classification
Bedrock channels	Areas where the streambed is predominantly bedrock, ie a continuous rock surface (see photograph 1).
Lamprey habitat	Stable/fairly stable fine sediment, particularly along the edges of watercourses. May be patchy and interspersed among coarser substrates (see photographs 2 and 5).
Productive habitat	All other areas, ie riffles, pools and glides with mixed bed substrates (see photographs 3, 4 and 5).
Obstructions to migration	Potentially impassable waterfalls, weirs, bridge sills, etc. See Part 2 of this annex for more information on identifying obstacles to migration.

Note to Table B1: The survey should be carried out under typical summer flows, to ensure that the bed is fully visible. Supporting photographs should be provided of each habitat stretch. The locations of these should be indicated on the map. It is often difficult to determine whether an obstacle is passable, so photographs should be provided showing any potential obstacles during low, medium and high flows. A vertical scale (such as a person or a metre stick) should be present in all obstacle photos to provide a clear scale.

Photo 1: Bedrock channel. The stream bed is dominated by a continuous bedrock sheet, providing poor habitat for fish.

Photograph 2: An example of juvenile lamprey habitat. Juvenile lamprey can sometimes be found in sand/silt aggregations behind large stones or boulders in midstream areas.

Photographs 3, 4 & 5: Productive habitat for salmonids. The streambed substrate includes a mixture of sizes, and is not dominated by a continuous bedrock sheet or by fine sand or silt.

Habitat units should be drawn directly onto detailed high resolution maps (usually 1:10,000 scale). Boundaries of different habitat features and types should be assessed, drawn on the map to represent their actual position on the river, and labelled. Photographs of individual stretches or specific features should be taken and their position noted on the map.

After completion, survey maps should be used to calculate the area of each habitat type which is found within the different areas of the proposal. This may be done using a geographic information system or by manually measuring from the map.

2 Identifying obstacles to fish migration

It is extremely important to know whether the area affected by each scheme is accessible to migratory fish, because this will determine which species are likely to be present, and hence what type and level of mitigation will be most appropriate. Several migratory species, such as Atlantic salmon, European eels and sea lampreys are also of particular conservation or economic importance.

Different fish species have very different swimming abilities, and it is important to consider the range of species present when considering obstacles to migration. Atlantic salmon, for example, are known for their ability to make vertical leaps. There are, however, several examples of waterfalls which cannot be negotiated by salmon, but which trout are able to ascend, due to their greater willingness to use shallower side channels. Lamprey species are particularly affected by high gradient channels. River lampreys, for example, are often unable to pass any obstacle with a sustained gradient of more than 1:5. However, adult lampreys can use their suckers to attach to smooth surfaces and rest between bursts of swimming however, which can allow them to negotiate larger obstacles than might be expected. Juvenile eels (elvers) migrate upstream, with adults migrating downstream to the sea. Elvers cannot leap, but can climb up obstacles under certain conditions where vegetation or rough surfaces are available.

The individual swimming and jumping abilities of various fish species has been studied, particularly for salmonid species, and is given in Table B2. Vertical barriers which are higher than this could reasonably be considered to be limits to migration for these species. It is therefore critical to provide detailed photographs of any obstacles, and these must include a reference object such as a metre stick, which can be used to accurately judge the height of each obstacle.

Table B2: The leaping ability of key species, with note on their behaviour at obstacles.

Species	Ability to leap	Notes
Adult salmon	Yes (<3.7m)	
Adult trout	Yes (<1.81m)	
Adult lamprey	No	Can attach to smooth surfaces.
Juvenile eel	No	Have the ability to climb vegetation and rough surfaces.
Grayling	Yes (<0.96m)	

Note: This information is summarised from Environment Agency data:
www.sniffer.org.uk/Webcontrol/Secure/ClientSpecific/ResourceManagement/UploadedFiles/SEPA_WFD111_Phase1_FishBarrierPorosity_FinalReport.pdf

Although the swimming abilities of different species may be estimated, it can still be difficult to predict how different fish will react to a particular obstacle. Natural waterfalls can have a complicated structure and may be separated into shorter sections or steep chutes which do not require a vertical leap. Water depth below obstacles is also of critical importance in determining the maximum leaping height. Other important factors include water temperature and the size of the individual fish.

Obstacles are also often seasonal, only being passable at particular flows. Many waterfalls are impassable during low flows because the vertical distance is too high, or the water depth too low to allow efficient leaping or burst swimming. On the other hand, many falls are also impassable during the highest flows, when the current speed is too strong for fish to swim against. It is therefore important to assess barriers at a range of flow conditions, and SEPA will require photographs of obstacles under different conditions to enable the application to be determined. In cases where the significance of obstacles cannot be satisfactorily determined from photographs alone, SEPA may require supporting fish survey information to support the application.

Together with partner agencies from the UK and Ireland, SEPA has commissioned work to produce a detailed survey protocol for assessing the significance of natural and artificial barriers to fish. The first part of the work has been completed and is now available on the internet. The report includes a useful review detailing the swimming abilities of all key species:
www.sniffer.org.uk/Webcontrol/Secure/ClientSpecific/ResourceManagement/UploadedFiles/SEPA_WFD111_Phase1_FishBarrierPorosity_FinalReport.pdf

3 Semi-quantitative and quantitative methods of fish population assessment

Fish population assessments should be made by electro-fishing. All electro-fishing surveys should follow the SFCC protocol and guidelines[1] therein. Fish surveys should take place between the start of July and the end of September.

Semi-quantitative assessments involve determining what species of fish and what age classes are present. The preferred method is a single electrofishing pass of a measured area and this provides a minimum estimate of the densities of each species and age class. Relying on a single electro-fishing pass means that catch efficiency cannot be quantified, so absolute fish densities cannot be calculated. This method allows a larger number of sites to be surveyed for a given manpower input, as the time spent at each site is reduced. There is also a timed electrofishing protocol, when the catch is referenced to the fishing time, rather than to the area fished.

The larger the area covered and the longer the time a site is surveyed, the greater the chance that a species or age class will be found if it is present. The electro-fishing survey should therefore cover representative areas of all of the main habitat types in the area that are likely to be frequented by the target species. A survey at each site should cover an area of at least 100m^2. The number of sites should be appropriate to the length of stream or river in question. Site selection should be guided by the information in the habitat report. Where possible, sites should be chosen to coincide with sites where hydrological data was collected and where reference photographs were taken. Reference control sites above and below the proposed scheme should also be included.

[1] www.sfcc.co.uk/protelf.asp

Quantitative assessments require the enumeration of a stock or stock component within a given site. An estimate of the total population of each species and age class at the site is made through depletion sampling, where fish are removed from a site in a series of successive electro-fishing passes. Three runs will normally be sufficient for this purpose, provided that a minimum efficiency of 50% is achieved in each pass. The population estimate should then be made using a maximum likelihood estimation procedure. The model used should be stated and will usually be either the maximum likelihood estimator described of Zippin (1956) or the weighted maximum likelihood estimator described by Carle and Strub (1978).

For fully-quantitative assessments, efforts should be made to maximise site isolation using both upstream and downstream stop-nets, and to fish appropriately sized sites to ensure significant depletions (normally an area of at least $100m^2$). Both areas should be recorded in the data sheets and included in the final report.

The number and location of electrofishing sites should be appropriate to the length of habitat which is likely to be impacted. Site selection should be guided by the information in the habitat report. Where possible, sites should be chosen to coincide with sites where hydrological data was collected and where reference photographs were taken. Reference control sites above and below the proposed scheme should also be included.