

Environmental RTDI Programme 2000–2006

**WATER FRAMEWORK DIRECTIVE –
Water Status: Identification and Ranking of Nature
Conservation Designated Areas
(2002-W-DS-10)**

Final Report

Prepared for the Environmental Protection Agency

by

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and

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ACKNOWLEDGEMENTS

This report has been prepared as part of the Environmental Research Technological Development and Innovation Programme under the Productive Sector Operational Programme 2000–2006. The programme is financed by the Irish Government under the National Development Plan 2000–2006. It is administered on behalf of the Department of Environment and Local Government by the Environmental Protection Agency which has the statutory function of co-ordinating and promoting environmental research.

The authors thank all the project participants and all those we consulted throughout the course of the project. These include Jim Ryan, Julie Fossitt, Neil Lockhart, Paul Johnson, Chris Uttley, Bob Davidson, Peter Cunningham, Liz Sides, Ken Irvine, Gareth Kilroy, John Lucey, Martin McGarrigle, Rob Ovington, Gemma Weir, Oscar Merne, Ferdia Marnell, Mike Wyse-Jackson, Jim Kelly, Sarah Ferris, Giorgio Pineschi, Congella Maguire, Boudwijn Beltman, Donal Daly, Una Leader, Rebecca Jeffrey, Howard Fox, Karen Dubsky, Eoin Dubsky, Brian Madden and the many others who gave their time and energy to this project.

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ENVIRONMENTAL RTDI PROGRAMME 2000–2006

Published by the Environmental Protection Agency, Ireland



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1 Introduction

The purpose of the Water Framework Directive (WFD) (Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000) is to establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater (Box 1.1). A component of this framework is the development of a Register of Protected Areas containing land areas that have been designated as requiring special protection under specific Community legislation for the protection of their surface water and groundwater or for the conservation of habitats and species directly depending on water. For each River Basin District, the Register or Registers of Protected Areas must be kept under review and up to date (Water Framework Directive, Article 6).

The complete Register of Protected Areas therefore has a number of components and these are set out in the Directive within Annex IV. It includes water abstraction sites, designated salmonid and shellfish waters, designated bathing waters and nutrient-sensitive areas (see Appendix 1).

This project, entitled “Identification and Ranking of Nature Conservation Designated Areas, where the Status of Water is an Important Factor”, sought to assist the establishment of that other part of the Register covering areas designated for the protection of habitats or species where the maintenance or improvement of the status of water is an important factor in their protection.

Box 1.1. Project context within EU Water Framework Directive (Directive 2000/60/EC).

Article 6. Register of Protected Areas

1. Member States shall ensure the establishment of a register or registers of all areas lying within each River Basin District which have been designated as requiring special protection under specific Community legislation for the protection of their surface water and groundwater or for the conservation of habitats and species directly depending on water. They shall ensure that the register is completed at the latest four years after the date of entry into force of this Directive.
2. The register or registers shall include.....all protected areas covered by Annex IV.
3. For each river basin district, the register or registers of protected areas shall be kept under review and up to date.

Annex IV. Protected areas

1. (v) areas designated for the protection of habitats or species where the maintenance or improvement of the status of water is an important factor in their protection, including relevant Natura 2000 sites designated under Directive 92/43/EEC and Directive 79/409/EEC.

The project developed a methodology for identifying water-dependent habitats and hence protected areas with such habitats. It recorded these sites in digital form within a combined database and mapping system and recorded the water-dependent habitats and the species that they contain, where such information was available. Additionally, a scheme was designed which can be used to rank (and hence prioritise) habitats (and hence sites)

according to their conservation value. A draft approach towards ranking the sensitivity of habitats to hydrological disturbances and other pressures has also been prepared.

The implementation of the Water Framework Directive is initially being assisted via a number of River Basin Management System projects covering River Basin Districts. It is intended that the project’s digital register

and ranking schemes will be a component tool in the River Basin Management Systems and will assist in the development of the required River Basin Management Plans.

The Environmental Protection Agency (EPA) has outlined a list of research priorities to support the implementation of the Water Framework Directive in Ireland. This research area is supported under the Environmental Research Technological Development and Innovation Programme 2000–2006. The current project is one of ten such projects supported under the call of 2002.

The main research objectives of the project were 1) to develop a methodology for identifying water-dependent habitats; 2) to establish a register/database and GIS of these designated areas for which the maintenance or improvement of the status of water is an important factor in their protection; and 3) to develop a ranking scheme for habitats based on conservation value and habitat sensitivity to hydrological disturbances, other pressures and a provisional ranking of the designated areas included in the Water Framework Directive register.

This report presents the outcome of the project using the following structure:

- **Chapter 2** presents the proposed methodology for identifying water-dependent habitats (WDHs) and includes definitions of these habitats and also of water-dependent species (WDS). Lists of WDHs and

WDS which were compiled based on these definitions are then presented.

- **Chapter 3** describes the proposed approach towards establishing the register of designated areas with WDHs and WDS. The types of protected areas/designations which are included are identified, and issues relating to the inclusion of particular designation types are outlined.
- **Chapter 4** presents the project's thinking regarding development of ranking schemes for habitats and sites. The proposed method of evaluating the conservation value of a habitat is outlined, while a draft method of evaluating the sensitivity of a habitat to hydrological change is also described.
- **Chapter 5** summarises the features of the GIS-based tool for viewing and interrogation of the Register of Protected Areas (WDHs) sites, including an overview of attributes held on each site and the tools for calculation of site ranking.
- **Chapter 6** summarises the results of the project and presents a number of recommendations for further development of the water-dependent sites and information management tools.

Please note that since completion of this report further consideration has been given to the components of the overall Register of Protected Areas. Further details are available directly from the EPA.

2 Developing a Methodology for Identifying Water-Dependent Habitats and Species

2.1 Introduction

In order to allow the identification of protected area sites for inclusion on the Register of Protected Areas, a prerequisite is to identify those habitats and species that are water dependent. This allows a subsequent assessment of sites, and identification of sites that include water-dependent habitats or species. The sites identified as containing water-dependent habitats or species should then be included on the Register. Before this process can be undertaken however, definitions of water-dependent habitats and species must be arrived at – it is these definitions that are the subject of this chapter.

2.2 Definitions of Water-Dependent Habitats and Species

2.2.1 Approaches elsewhere

While the Water Framework Directive has specified that the Register of Protected Areas must list those sites designated under European legislation that contain water-dependent habitats or species, definitions of water-dependent habitats and species are not provided within the Directive. Nor have such definitions been provided within Common Implementation Strategy documents. From reviews conducted by the project, there was little evidence of generally accepted definitions arising at a European level with a number of countries undertaking their own studies (Landesanstalt Für Umweltschutz Baden-Württemberg, 2003; Ministry of Ecology and Sustainable Development, 2003), or awaiting the outcome of studies elsewhere.

It is understood that Austria submitted a request to the EU Environment Directorate-General to provide an interpretation for Article 6, Annex 4, Article 1(v) of the EU-WFD regarding the question “what are the criteria for a Natura 2000 site to be ‘water-relevant’” but it is understood that the EC has not yet given a definite answer. Austria has undertaken some work on possible technical criteria for the assessment, indicating which kind of Natura 2000 areas will have to be included on the Register, but results were not available to this project

before completion of its report (Zinke, A. ICPDR Secretariat, personal communication 2003).

Thus, it fell to this research project to formulate definitions and hence to derive subsets of habitats and species considered to be water dependent.

2.2.2 Water-dependent habitats

The project definition includes the various water types as defined in the Water Framework Directive (see Box 2.1) but is drawn also from other definitions of wetlands as given in Appendix 2, and from project consultations.

The project working definition of a water-dependent habitat is as follows:

“A water-dependent habitat is any habitat (whether natural or artificial) where there are special ecological, biogeochemical and hydrological functions arising from its dependence on water. Water includes precipitation, inland water, coastal water, transitional water and groundwater (see Box 2.1). Water may be standing or flowing, fresh, brackish or fully saline, and may be permanent or temporary. These habitats are characterised by soils, substrata and biota that are adapted to some or all of the following: permanent flooding, waterlogging, periodic inundation and/or spray and mist.”

2.2.3 Water-dependent species

Article 6.1 of the Water Framework Directive requires the conservation of species directly depending on water. A definition of water-dependent species (WDS) is needed in order that designated areas that contain water-dependent species can be identified for inclusion on the Register of Water-Dependent Habitats required under the WFD.

The following is proposed as a definition of water-dependent species:

“A water-dependent species is any species of flora or fauna which (i) is aquatic or (ii) depends on a water-dependent habitat (see accompanying definition) at some

Box 2.1. Definitions of water types (taken from Water Framework Directive).

‘Surface water’ means inland waters, except groundwater, transitional waters and coastal waters, except in respect of chemical status for which it shall also include territorial waters.

‘Inland water’ means all standing or flowing water on the surface of the land, and all groundwater on the landward side of the baseline from which the breadth of territorial waters is measured.

‘Transitional waters’ are bodies of surface water in the vicinity of river mouths which are partly saline in character as a result of their proximity to coastal waters but which are substantially influenced by freshwater flows.

‘Coastal water’ means surface water on the landward side of a line, every point of which is at a distance of one nautical mile on the seaward side from the nearest point of the baseline from which the breadth of territorial waters is measured, extending where appropriate up to the outer limit of transitional waters.

‘Groundwater’ means all water which is below the surface of the ground in the saturation zone and in direct contact with the ground or subsoil.

stage of its life cycle. In the case of fauna species, these criteria also apply to breeding, feeding and migrational stages of the life cycle.”

2.3 Lists of Water-Dependent Habitats and Water-Dependent Species

2.3.1 Water-dependent habitats list

Based on the definition above, the water-dependent habitats (WDHs) occurring in Ireland have been identified from those listed in Annex I of the EU Habitats Directive (Council Directive 92/43/EEC). These are presented in [Appendix 3](#).

Those which were clearly not water dependent as per the project’s working definition, were initially eliminated from the list, e.g. hedgerows, earth banks, dry grasslands. Consultation took place with experts at the National Parks and Wildlife (NPW) unit of the Department of Environment, Heritage and Local Government (DEHLG), Ireland, about those habitats whose water dependency was unclear, e.g. dunes, heaths. It should be noted that some habitats may not initially appear to be water dependent but have been included in the list, examples being sand dunes and shingle banks. While these habitats are often dominated by plants which tolerate very dry conditions, it should be remembered that these habitats depend for their formation and

continued existence on water-related processes and mechanisms. Therefore, they are considered to be water dependent, and have been included in the list of water-dependent habitats.

The importance of correlation between various habitat classifications has been recognised and in this regard the correlation with habitats listed in Fossitt (2000) is also shown in [Appendix 8](#). It is important to note that many Annex I habitats are sub-types (Level 4) of Fossitt (2000) habitats. It is recommended that a table showing Level 4 habitats corresponding to those existing in Levels 1 to 3 be developed. This will allow a greater degree of accuracy when dealing with specific habitats which are variable, e.g. mesotrophic and oligotrophic turloughs.

The primary water source/type has also been identified for each WDH. These are given in [Appendix 3](#) using the following notation:

- s – surface waters (excluding transitional and coastal waters)
- g – groundwater
- t – transitional waters
- c – coastal waters
- p – precipitation

It should be noted that for sand dunes the water source is given as ‘c’ because coastal waters were essential to the creation of the habitat type, although it may not be the main water source of the dune in its current form.

2.3.2 Water-dependent species lists

2.3.2.1 Background

For the purposes of this project, it has been decided to include only those species listed for protection in Ireland. It is recommended that this list be expanded at a later date to include other species which are water dependent.

Under EU Community legislation, species are protected under:

- Annex II or Annex IV of the Habitats Directive, and
- Annex I of the Birds Directive (Council Directive 79/409/EEC).

Under national legislation, species are protected under:

- the Wildlife Act 1976
- the Wildlife (Amendment) Act 2000, and
- the Flora (Protection) Order, 1999.

A list of WDS occurring in Ireland has been drawn up based on the definition of WDS (Section 2.2.3), and provided that they are protected under one of the above pieces of legislation. These lists are presented in Appendices 3, 4 and 5. Species occurring in Ireland were split into three groups due to different protective legislation applying to the different groups: fauna (excluding birds), birds, and plants.

2.3.2.2 Fauna (excluding birds)

All fauna species (excluding birds) which are listed in the Wildlife (Amendment) Act 2000, and all those animals listed in Annex II or Annex IV of the EU Habitats Directive, are listed.

Those clearly not water dependent were deleted from the list. Consultations were held with experts at the NPW unit concerning species whose water dependency was unclear. Following this, a list was compiled of water-dependent fauna species in Ireland (Appendix 4).

It has been recommended by the NPW unit that charr and dragonflies/damselflies would be useful groups to include at a later stage. While they are not protected at present under legislation, they would act as useful indicators for a variety of aquatic habitats. It is recommended that these species be considered for inclusion in any further development of the water-dependent species lists.

2.3.2.3 Birds

Under Irish legislation, all bird species (except for a named number of ‘pest’ species) are protected. It is proposed that to include all bird species occurring in Ireland would be too cumbersome, and would mask the valuable information to be gained from focusing on important or listed species. For this reason, it has been decided to include only a subset of Irish birds in the water-dependent species list. After consultation with experts at the NPW unit, it was decided that the ‘Red’ and ‘Amber’ lists of ‘Birds of Conservation Concern’ (Newton *et al.*, 1999) would be used. This would be augmented with those birds occurring in Ireland which are listed under the EU Birds Directive (those which are regularly occurring, as opposed to infrequent visitors).

Any species clearly not water dependent were deleted from this list. Consultations were again held with experts at the NPW unit about those species whose water dependency was unclear. Finally, a project list was compiled of water-dependent bird species in Ireland (Appendix 5).

2.3.2.4 Flora

A list was compiled of all plant species occurring in Ireland which are listed in Annex II of the Habitats Directive and in the Flora (Protection) Order 1999. Those species which were clearly not water dependent were eliminated from the list. Consultations were held with experts at the NPW unit and at the National Botanic Gardens about those species whose water dependency was unclear. A project list of water-dependent plant species in Ireland was then compiled (Appendix 6).

2.4 Summary

Definitions of water-dependent habitats and water-dependent species were developed. Based on these definitions, lists of habitats and species defined as water

dependent were generated, based on habitat and species lists within relevant EU Directives and national legislation. These are important building blocks in identifying water-dependent sites.

It should be noted that these lists of habitats and species can be modified and the water-dependent sites list automatically updated using the project system tools (Chapter 4).

3 Establishing the Register

3.1 Introduction

In relation to protected areas to be included on the Register of Protected Areas, the Water Framework Directive states that sites to be included are those “which have been designated as requiring special protection under specific Community legislation ... for the conservation of habitats and species directly depending on water” (Article 6.1) and defines this further in Annex IV, Article 1(v), as including “areas designated for the protection of habitats or species where the maintenance or improvement of the status of water is an important factor in their protection, including relevant Natura 2000 sites designated under Directive 92/43/EEC and Directive 79/409/EEC”.

This implies that each country must include, at the very least, Natura 2000 sites and sites protected under “specific Community legislation”. However, it can also be decided to include other sites which may be protected under national legislation. A possible interpretation is that any site designated for the protection of habitats and/or species may be included, regardless of its legal status.

This chapter outlines the relevant designation types and issues associated with their inclusion on the Register. It also outlines the approach towards assessment of individual sites under each designation.

3.2 Protected Area Designations for Inclusion

3.2.1 Sites protected at EU level

In Ireland, the relevant Natura 2000 sites are Special Areas of Conservation (SACs) and Special Protection Areas (SPAs). SAC is a statutory designation that has a legal basis under the EU Habitats Directive (92/43/EEC) as transposed into Irish law through the European Communities (Natural Habitats) Regulations, 1997. At present in Ireland, SACs have not been formally designated, but sites that have been selected and notified to the EU are legally protected. These are known as candidate SACs (cSACs). An SPA is a statutory designation which has legal basis in the EU Wild Birds Directive (79/409/EEC) as transposed into Irish law

through the European Communities (Conservation of Wild Birds) Regulations.

Additionally, Ireland is legally required by the EU Freshwater Fish Directive (Council Directive 78/659/EEC on the quality of fresh waters needing protection or improvement in order to support fish life) to designate surface waters that need protecting or improving in order to support fish populations. These are known as Salmonid Waters. Thirty-four river sections have been designated to date in Ireland (see Section 3.4.5).

3.2.2 Sites protected at national level

Through project discussions, the National Parks and Wildlife (NPW) unit has suggested that areas designated or proposed for designation under national legislation also be included on the Register. Natural Heritage Areas (NHAs) are protected under Irish national legislation (Wildlife (Amendment) Act, 2000), once they have been officially designated. Some NHAs have already been designated (these are all raised bog sites), however most are proposed National Heritage Areas (pNHAs). Also defined under national legislation are Statutory Nature Reserves, Refuges for Fauna and Wildfowl Sanctuaries.

3.2.3 Proposed Natural Heritage Areas

Worthy of specific note are Proposed Natural Heritage Areas (pNHAs). As outlined above, these are sites nominated for formal designation as Natural Heritage Areas. Over the next few years, these pNHAs will be fully assessed and processed and many will be officially designated by the NPW unit.

It is proposed that those pNHAs that include water-dependent habitats and species be included on the Register, but only as site attributes for these sites become available and it is possible to assess them for presence of water-dependent habitats and species.

The pNHA and NHA sites form the majority of national-level designated areas. The long-term omission of NHAs from the Register would significantly decrease the extent of area included under the Register. As an interim measure, prior to designation of sites and identification of

a subset for inclusion on the Register, it is recommended that River Basin Management Systems should include map data for pNHAs so that these can be considered in the formulation of River Basin Management Plans.

3.2.4 Salmonid waters

S.I. No. 293 of 1988 (Quality of Salmonid Waters Regulations) gives effect to the EU Freshwater Fish Directive (No. 78/659/EEC) and aims to protect and ultimately enhance ‘salmonid waters’. Assessment of such waters is the responsibility of local authorities, where monthly sampling and analysis for most of the prescribed parameters is required.

The length of river channels designated under the regulations is not extensive or inclusive of all lotic salmonid waters. For example, electrofishing and other forms of fish population assessment carried out by the Central and Regional Fisheries Boards has established the existence of viable salmonid populations in many other river systems or in other parts of systems which have stretches designated under the regulations.

In the context of the protection of habitats, Dúchas (the Heritage Service of the DEHLG) is undertaking an assessment of riverine habitats in the context of their potential inclusion, as salmonid habitats, on the Register of Special Areas of Conservation (as prescribed under the EU Habitats Directive (92/43/EEC)). Such assessment includes river systems that were not included under S.I. No. 293.

Furthermore, the Central and Regional Fisheries Boards have undertaken a national assessment of the extent of salmonid systems based on analysis of electrofishing and other population assessment data, and their acquired knowledge of the systems. This scheme has identified some 261 salmonid systems (each with its own discrete input to tidal waters) as either ‘salmon and sea trout’ or ‘sea trout only’ types. In these systems, limits on the extent of anadromy (for example impassable barriers) have been recorded on the basis of available knowledge, whereby the length of salmonid reaches and thus salmonid habitat has been estimated. The extent of these systems, which reflects the utilisation of surface waters

by salmonid populations, is significantly greater than the proportion of surface waters designated under S.I. No. 293 or the Register of Special Areas of Conservation. A report in preparation by the Central and Regional Fisheries Boards will provide a summary of these salmonid systems in the form of maps of their extent and tabular summaries of the amount of habitat.

It is recommended that this data set be incorporated into the Register of Protected Areas mapping system as a reference data layer, although the identified salmonid or sea trout rivers would not be incorporated into the Register as they do not have a designation status.

3.2.5 Designations without legal protection

Other designated areas that are afforded no legal protection at present, but which may be included on the Register at a later date are National Parks, Ramsar sites, Biogenetic Reserves and UNESCO Biosphere Reserves. Killarney National Park is an exception, however, as it is protected under the Bourn–Vincent Memorial Park Act, 1936. It is noted that the majority of these sites are also designated as pNHAs, SACs or SPAs.

3.2.6 Other designation types

Other designation types existing in Ireland include local authority-level designation such as Special Amenity Area Orders (SAAOs), Areas of Special Control (ASCs) and Tree Protection Orders (TPOs). For the purposes of this project, these designation types are not proposed for inclusion on the Register, as many of them are established under the planning laws and are not specifically for the purpose of nature conservation.

3.2.7 Summary

In summary, the focus of the project has been on the identification and assessment of the following designated site types for inclusion on the Register of Protected Areas:

- Special Areas of Conservation
- Special Protection Areas
- Natural Heritage Areas
- Salmonid Waters.

3.3 Data Sources

3.3.1 Designated site boundaries

The DEHLG – National Parks and Wildlife unit, generate maps of designated site boundaries. Digital GIS format maps are made available via a data download site at www.heritagedata.ie. These maps are derived from mapping using 1:10,560 scale maps primarily, combined with field assessments. Full metadata are available from the heritagedata.ie website.

Site boundaries are made available for the following designation types:

- Special Areas of Conservation
- Special Protection Areas
- Natural Heritage Areas
- National Parks
- Nature Reserves.

3.3.2 Habitat maps

Habitat maps are held by the NPW unit for those SAC sites for which management plans have been prepared. The project assessed these paper maps and undertook conversion of sample maps to digital GIS format (Fig. 3.1). A number of problematic issues arise with the use of these habitat maps in the context of the Register of Protected Areas and River Basin Management Systems. These issues include their paper format which requires that the maps be converted to digital form in order to be capable of meaningful integration with other data sets within a Geographical Information System. The paper maps also typically do not show background mapping that would facilitate accurate conversion of habitat unit boundaries to digital form. Importantly, the maps do not utilise standardised habitat categories, and so cannot be matched sufficiently with habitat categories used under EU Directives or other habitat classifications such as Fossitt (2000).

Arising from the project’s assessment, it is believed that the paper habitat maps cannot be used for accurate

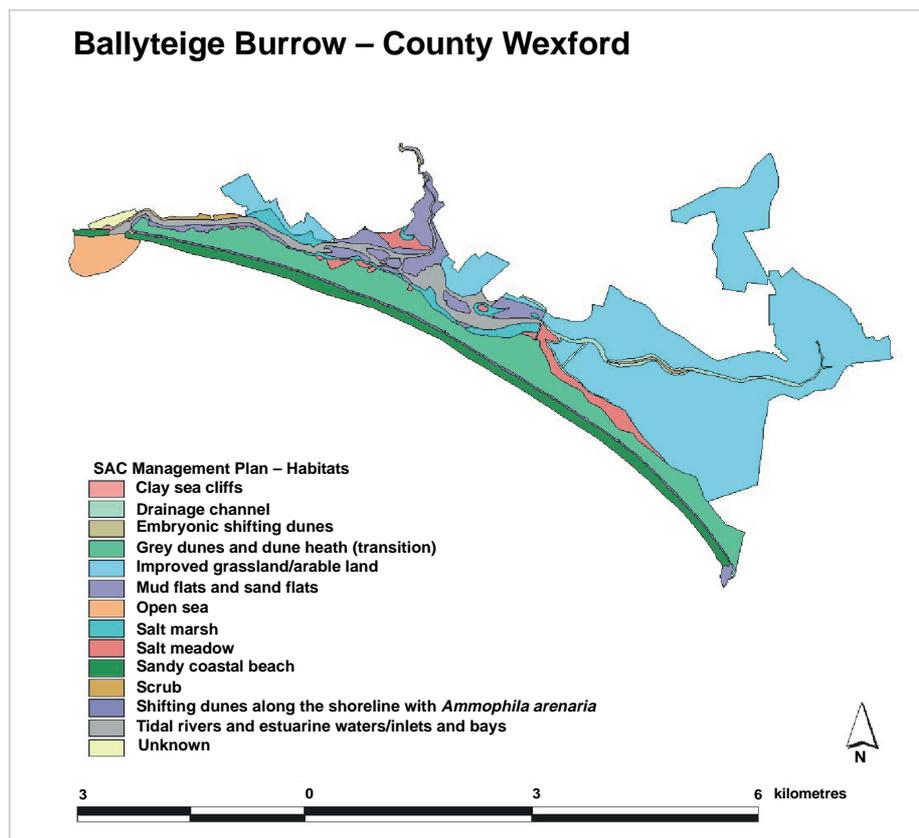


Figure 3.1. Sample habitat map, converted from paper format as held in an SAC management plan file.

mapping and location finding of specific habitats. Rather, the maps can only be used as a reference source for general assessment of habitat types in a site and general identification of the location of those habitats. The maps have not been used for assessment of sites for inclusion on the Register for these reasons.

It is strongly recommended that any future habitat mapping of sites should utilise digital mapping and survey techniques, and standardised habitat mapping approaches and categorisation.

3.3.3 Site attributes

The project assessed a large number of data sources, most of which had been generated through work undertaken or supported by the National Parks and Wildlife unit of the DEHLG, and the precursors of that unit.

3.3.3.1 NHA habitat cards

The NPW unit holds a large collection of hard-copy format data about sites, in particular proposed Natural Heritage Areas. This information holding includes ‘NHA habitat cards’ which consist of a number of pages of site assessment forms. Through the project’s assessments and associated discussions with NPW staff it was decided that this data source should not be used due to the hugely time-consuming task of converting the habitat card information to digital form and the associated work in assessing the data to ensure quality and suitability.

3.3.3.2 EU Natura database

A number of databases holding site attributes and site survey results have been generated by the NPW unit and its precursors. These databases were made available by the NPW unit to the project and were assessed for suitability by the project in close consultation with NPW staff.

Arising from this assessment and initial pilot tests of using the data, it was decided that a single database should be adopted by the project, this being the database developed for reporting purposes to the EU on designated Natura sites. This Natura 2000 database for Ireland is based on data collected using the Natura ‘Standard Data Form’. This form and accompanying Explanatory notes are available on the EUROPA website at [http://](http://europa.eu.int/comm/environment/nature/nature_conservation/natura_2000_network/standard_data_forms/index_en.htm)

europa.eu.int/comm/environment/nature/nature_conservation/natura_2000_network/standard_data_forms/index_en.htm.

This ‘EU Natura database for Ireland’ holds a large amount of data on individual sites with the key data including:

- Site name
- Site code, which facilitates linkage between the boundary mapping and the database
- Habitats within the site for which the site has been designated
- Species within the site for which the site has been designated
- Site quality assessment codes
- Look-up lists of species and habitats for which a site can be designated.

The Explanatory notes provide information on the type of data collected and typically held within the database. The data in the database are deemed to be reliable by the NPW unit.

The EU Natura database structure is being followed to a large degree in the ongoing collation of attributes recorded for SPAs, and, it is hoped, will be extended to NHAs. It is notable however that little digital structured information is available on SPAs and NHAs currently, and this has restricted the assessment that could be undertaken by the project of those categories of designated sites.

It is recommended that an integrated database of site attributes for SACs, SPAs and NHAs be generated and maintained by the NPW unit in order to support the development and maintenance of the Register of Protected Areas.

3.3.4 Other reference data sets

While the project ultimately decided on an approach based primarily on the EU Natura database and the attribution it holds for designated sites, there are a number of other useful reference data sets that River Basin Management Systems should utilise in order to obtain additional information and understanding of

water-dependent habitats, particularly within designated areas. Some of these are noted below.

3.3.4.1 Habitat-specific studies

A number of studies have been carried out for the NPW unit over many years, focussing on specific habitat types. These include studies of the following:

- Shingle banks
- Raised bogs
- Turloughs
- Sand dunes
- Fens.

Through previous EPA RTDI project work undertaken by the project partners (Tubridy and Ó Riain, 2002), the locations and basic attributes of sites referred to in these reports were captured to GIS format (Fig. 3.2).

In addition, the Geological Survey of Ireland hold a number of relevant databases including databases of karst features and springs.

3.3.4.2 Irish Forest Soils Project

Parent soil materials, soil, and land-cover mapping is being undertaken by Teagasc and the EPA. A number of the categories mapped identify water-dependent habitats, e.g. parent materials – fen peat, raised peat, blanket peat

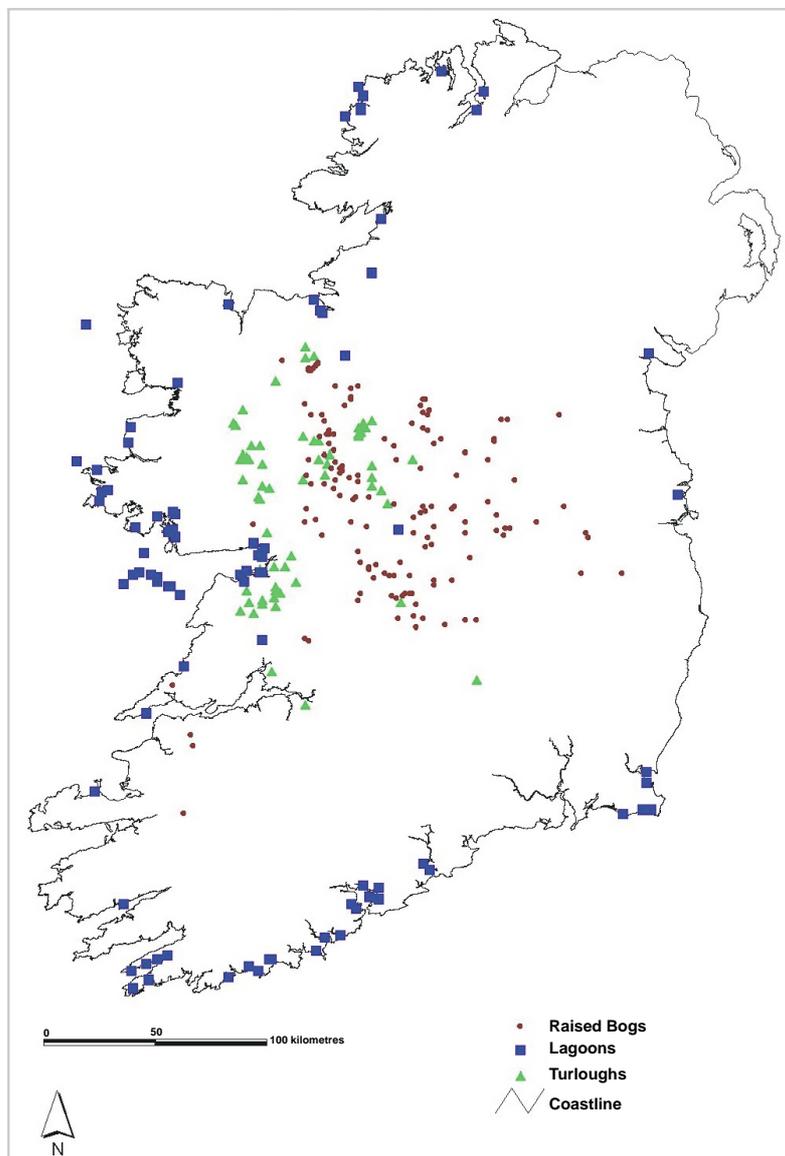


Figure 3.2. View of selected habitat-specific data sets generated from various NPW reports.

and tidal marshes, or the sites of likely water-dependent habitats, e.g. soils – reed swamp/marsh, alluviums and poorly drained mineral soils with peaty topsoil. This suite of data sets is being developed on a county-by-county basis, and will prove valuable in refining information on a site-by-site basis.

3.3.4.3 CORINE land-cover mapping

The CORINE 2000 project as undertaken by the EPA has revised land-cover mapping of Ireland and has provided additional land-cover categories to those used in CORINE 1990. Categories of clear interest include:

Code	Description
4.1.1	Inland marshes
4.1.2	Peat bogs
4.2.1	Salt marshes
4.3.3	Intertidal flats
5.1.1	Stream courses
5.1.2	Water bodies
5.2.1	Coastal lagoons
5.2.2	Estuaries
5.2.3	Sea and ocean
2.3.1.2.2	Unimproved wet grasslands.

As with the Irish Forest Soils data sets, the CORINE land-cover data set should be utilised to gain further site-specific information.

3.3.4.4 Other data sets

A number of other more localised data sets are available that will be of value in managing the Register of Water-Dependent Sites. These include both digital and paper maps held by the Office of Public Works relating to arterial drainage works. Pre-drainage surveys show those lands that were identified as ‘benefiting lands’ from drainage. These are thus typically low lying and may still contain some water-dependent habitats or species. Likewise, the First Edition 1:10,560 scale maps (now held in digital form by the NPW unit) identify areas ‘liable to flooding’. Some local habitat mapping studies are also of interest and would assist in more closely defining the location of water-dependent habitats within designated sites.

3.4 Compilation of the Register

3.4.1 Special Areas of Conservation

The Natura 2000 database, held by the NPW unit, contains information on the SACs, including a list of habitats (those listed in Annex I of the EU Habitats Directive) and species for which the site has been designated. This database can be queried to select those SACs which contain WDHs or WDS (Fig. 3.3).

The remaining sites, i.e. sites which do not have water-dependent Annex I habitats, may nevertheless contain WDHs and/or WDS, but will not have been designated specifically for these. Professional judgement will be required in order to decide if some of these sites should be included in the list. It is proposed that this selection process should be undertaken through the River Basin Management System projects, and that NPW expertise should be made available to these projects in order to ensure consistency across the projects and that optimal use is made of site and process knowledge within the NPW unit.

3.4.2 Special Protection Areas

Information concerning SPAs is held by the NPW unit. It is currently being updated and is not yet available digitally. The paper files held by the NPW unit contain large amounts of data relating to bird species in SPAs; however, data relating to habitat types within SPAs are highly variable. Given the location of SPAs in coastal and transitional water locations in Ireland (Fig. 3.4), they are proposed for inclusion on the Register at this stage, with detailed data relating to these sites to be added as the NPW digital database progresses.

3.4.3 Natural Heritage Areas

Only a limited number of sites have been officially designated as NHAs in Ireland at present (Fig. 3.5). These sites all contain raised bogs, and detailed information is available digitally (although in a different format to that for SACs). Therefore, as all raised bogs are WDHs, they should be considered for inclusion on the Register at this stage.

3.4.4 Proposed Natural Heritage Areas

There are a large number of pNHAs in the country (over 1,100) and information is held in both digital and paper

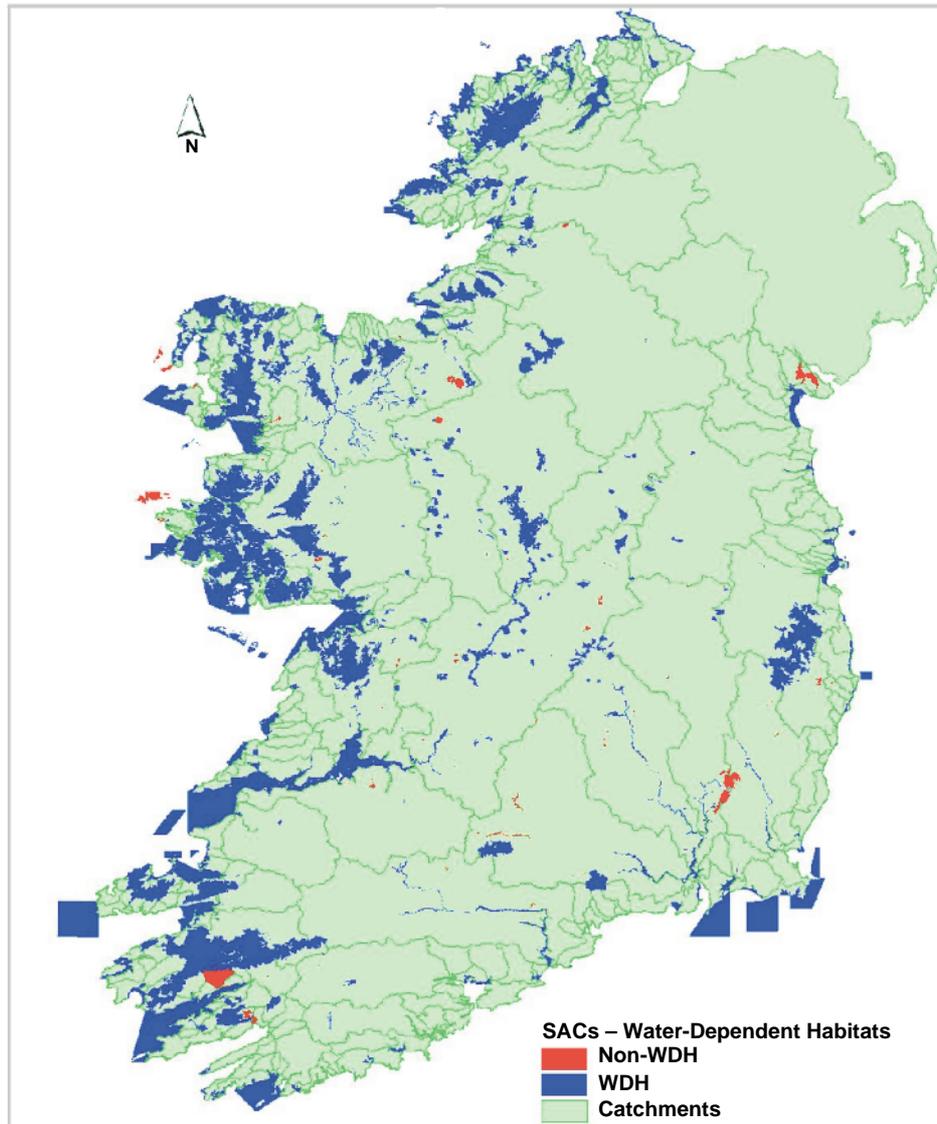


Figure 3.3. Analysis of SACs for water-dependent habitats.

format. Some limitations with these data include the many differing habitat classification systems in use, the varying levels of detail and accuracy involved, and the absence of habitat maps in most cases.

Due to resource constraints, variability of information and the fact that not all pNHAs might be officially designated, they will not be included on the Register at this stage. It is recommended that they are included at a later date, and that the Register be updated regularly to allow for the inclusion of pNHAs which have subsequently been designated as NHAs. It is recommended that a list and maps of pNHAs should be incorporated into every River Basin Management System

to facilitate awareness of these sites within the River Basin District and their inclusion within the River Basin Management Plan.

3.4.5 Salmonid waters

All salmonid waters (Table 3.1) as designated under the European Communities (Quality of Salmonid Waters) Regulations 1988 (S.I. No. 293, 1988) should be included on the Register.

3.4.6 Summary

SACs, SPAs, NHAs and designated salmonid waters are proposed as the focus of the Water-Dependent Sites Register, while other designations and data sets are proposed for recording as part of River Basin

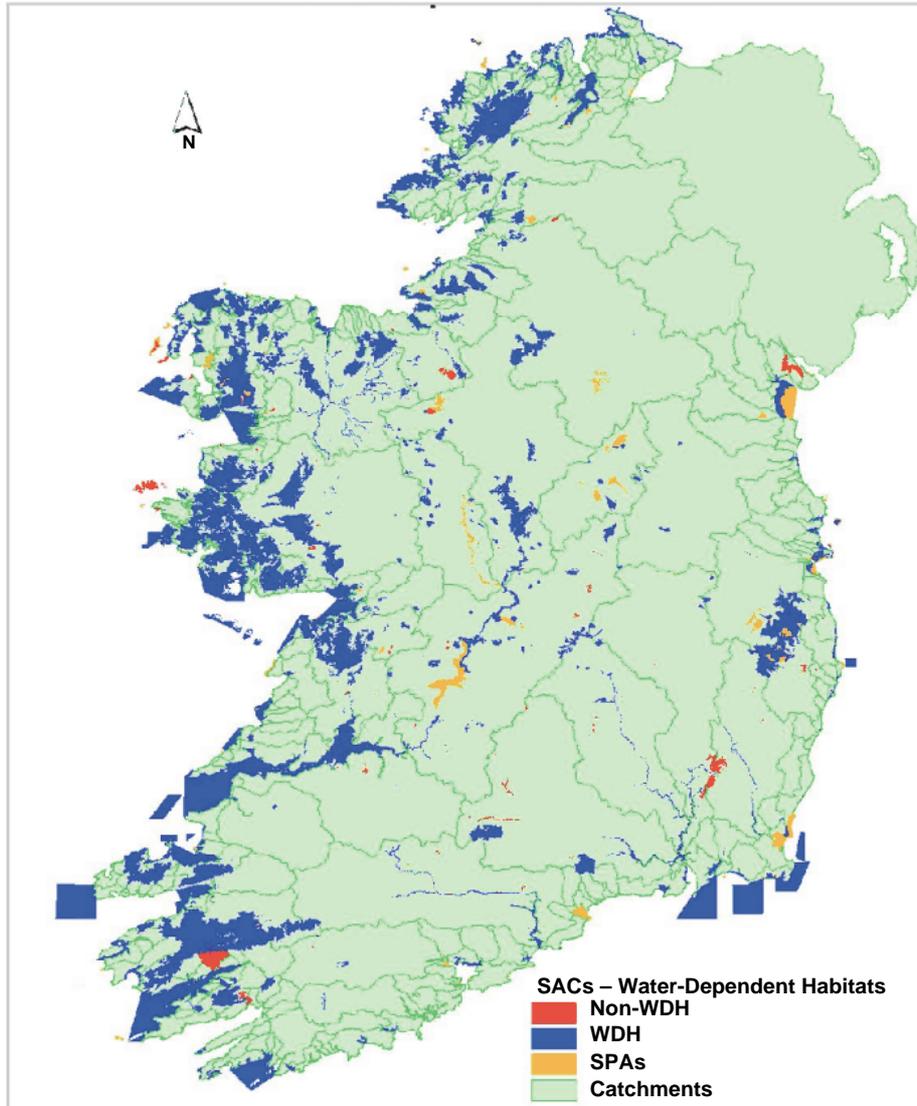


Figure 3.4. Analysis of SACs for water-dependent habitats, also showing SPAs not covered by SACs.

Management Systems (Table 3.2). Other designated sites should be considered for inclusion as additional information becomes available.

Regarding data sources, the EU Natura sites database is the key data source utilised in the assessment of whether SACs have been designated due to the presence of water-dependent habitats or species. Designated NHAs are noted for inclusion as all such designated NHAs contain raised bog habitats which are deemed to be water dependent. SPAs are also included as SPAs in Ireland contain significant river, lake, coastal or transitional waters and consequently contain water-dependent habitats and species. This approach is refined as the EU Natura database is extended to hold similar data on SPAs

and NHAs. Designated salmonid waters are included as these, by definition, contain water-dependent habitats and species.

It is recommended that the knowledge base regarding all designated sites, SACs, SPAs and NHAs in particular, should be improved greatly. An information resource holding digital GIS-format habitat maps following Natura and Fossitt (2000) habitat categories should be generated, while a uniform database should be populated to hold site-related attributes. Other reference data sets should be utilised within the River Basin Management Systems GIS as these become available, including Irish Forest Soils soil and parent soils materials maps, and CORINE land-cover maps for 2000.

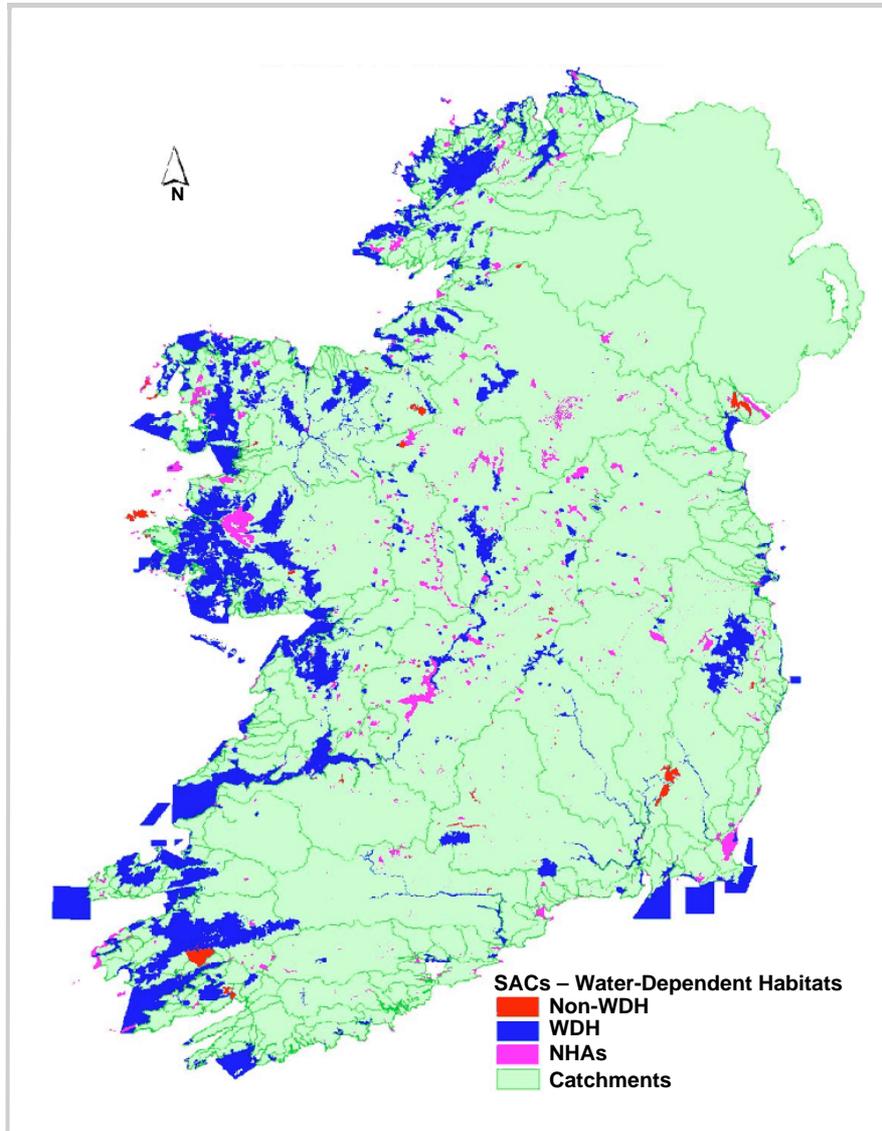


Figure 3.5. Analysis of SACs for water-dependent habitats, also showing all NHAs not covered by SACs.

Table 3.1. Waters designated under Quality of Salmonid Waters Regulations 1988 (S.I. No. 293, 1988) (source: Water Quality in Ireland 1998–2000, EPA).

Water	Hydrometric area	Counties	EPA river code
Aherlow	16	TS	A1
Ardigeen	20	CK	A2
Blackwater (Munster)	18	CK	B2
Boyne	07	MH, OY	B4
Bride (Waterford)	18	WD, CK	B5
Brown Flesk	22	KY	B3
Castlebar	34	MO	C1
Corrib & Lough Corrib	30	GY	C2
Corroy/Corra	25	CE	C9
Dargle	10	WW	D1
Deel (Crossmolina)	34	MO	D1
Feale	23	KY	F1
Fergus	27	CE	F1
Finn (Donegal)	01	DL	F1
Glashagh (lower)	39	DL	G2
Glashagh (upper)	39	DL	G1
Glore (Mayo)	34	MO	G2
Gweestion/Gweestin	22	KY	G6
Lee (Cork)	19	CK	L3
Leannan	39	DL	L1
Lurgy	39	DL	L2
Maggy's Burn	39	DL	–
Maine	22	KY	M1
Manulla	34	MO	M1
Moy	34	MO, SO	M2
Mullaghanoe	34	SO	M3
Nore	15	TN, LS, KK	N1
Owengarve (Sligo)	34	SO	O3
Slaney	12	WX, WW, CW	S2
Spaddagh	34	MO	S3
Swilly	39	DL	S2
Trimoge	34	MO	T1
Vartry	10	WW	V1
Yellow (Foxford)	34	MO	Y1

Table 3.2. Summary of environmental designations considered for inclusion in the water-dependent sites aspect of the Register of Protected Areas.

Designation	Objectives	Considered for Register*
1 Special Area of Conservation (SAC)	Conservation of plants, animals and wildlife habitats of EU importance	Yes
2 Special Protection Area (SPA)	Conservation of rare and threatened European bird species and their habitats	Yes
3 Natural Heritage Area (NHA)	Conservation of plants, animals and wildlife habitats of Irish importance. All other nature designations are sub-sets of NHAs	Yes
4 Salmonid Waters	Maintenance and improvement of water quality for salmon and trout	Yes
5 Statutory Nature Reserve	Strict conservation of plants, animals and wildlife habitats to the exclusion of all other activities	Not currently
6 National Park	Nature conservation and public use and appreciation	Not currently
7 Refuge for Fauna	Conservation of the habitat of a particular animal species	Not currently
8 Wildfowl Sanctuary	Hunting of wild birds prohibited	Not currently
9 Ramsar Site	Conservation of wetlands of international importance listed in the Ramsar Convention	Not currently
10 Biogenetic Reserve	Conservation of biodiversity in sites recognised by the Council of Europe	Not currently
11 UNESCO Biosphere Reserve	Nature conservation and sustainable development in sites recognised by UNESCO	Not currently
12 Areas of Special Planning Control in Development Plans	Maintenance of scenic qualities and amenity value on a county basis	Not currently
13 Special Amenity Area Order (SAAO)	Strict controls over development in areas of high scenic and amenity value	Not currently
14 Tree Preservation Order (TPO)	Protection of trees and woods of special amenity value	Not currently
15 World Heritage Site	Conservation of sites or features of global environmental and/or heritage value recognised by UNESCO	Not currently

*Note that some of the designations not currently considered in generating the water-dependent sites aspect of the Register of Protected Areas may overlap with other designated areas that are being considered.

Source: Based on Hickie (1996) and Tubridy and Ó'Riain (2002).

4 Developing the Ranking Scheme

4.1 Background

A requirement of this project, as outlined in the project brief, is to “develop a ranking scheme for habitats based on conservation value and habitat sensitivity to hydrological disturbances, other pressures and a provisional ranking of the designated areas included in the WFD register”.

A provisional scheme for ranking WDHs is proposed here. It is based on the two main elements given above:

1. Conservation value
2. Habitat sensitivity to hydrological disturbance.

Habitat sensitivity is assessed mainly in relation to hydrological disturbances, but other pressures are also mentioned.

It should be noted that the requirement for ranking relates only to habitats and not to sites. It is recognised however, that the River Basin Management authority may seek to translate the ‘habitat-level’ rankings to ‘site-level’ rankings. It is proposed that this can be best done on a site-by-site basis, with more detailed, site-specific data than are available for this project.

4.2 Conservation Value

4.2.1 Introduction

For the purpose of this project, the conservation value of a habitat is taken to be the ‘Representativity’ value of the habitat, as assigned in the Natura 2000 database following European Commission guidelines (Natura 2000 Network *Standard Data Form*). This value is available for WDHs (listed in Annex I of the EU Habitats Directive) in SACs. It has also been applied in Ireland, in a modified format, to some NHAs and pNHAs.

Representativity values are not available for SPAs and it is proposed that ‘Global’ values be used instead. This ‘Global’ value as recorded on SPA data forms, is “the global assessment of the value of the site for conservation of the species concerned”. It is used to sum up the other criteria used to assess the habitats and the species within

an SPA, and also to assess other features of the site thought to be relevant for a given species.

4.2.2 Representativity

Representativity is the “degree of representativity of the natural habitat type on the site”. The degree of representativity gives a measure of how typical a habitat type is. (Definitions taken from the Natura 2000 Network *Standard Data Form* and associated explanatory notes (European Commission, 1994) and Section A of Annex III of the EU Habitats Directive.) Assessment is made at national (rather than international) level.

When assigning or considering representativity values for a habitat, it is recommended that the interpretation manual (Romao, 1996) on Annex I habitat types be referred to. This manual provides a definition, a list of characteristic species, and accounts of all Annex I habitat types.

Values are assigned as follows in the ranking system:

- A: excellent representativity
- B: good representativity
- C: significant representativity
- D: non-significant presence.

4.2.3 Alternative conservation value assessment scheme

An alternative scheme for rating the conservation value of a WDH is shown in [Appendix 7](#). This alternative scheme is proposed for WDHs which are not listed in Annex I of the EU Habitats Directive, and hence will not be recorded in the EU Natura database, but which are known to be present within a site. While it is not immediately used in this project, its value may come about with the maintenance and development of the Register at the River Basin Management level.

This scheme assigns a 5-point rating to habitats, such that A is the highest and E the lowest, as shown overleaf in [Table 4.1](#). Existing evaluation schemes and criteria

Table 4.1. Approximate correspondence between two proposed schemes to rank habitats for conservation value.

Representativity values		Alternative scheme	
A	Excellent representativity	A	International value
B	Good representativity	B	National value
C	Significant representativity	C	High local/county value
	(no correspondence)	D	Moderate local value
D	Non-significant representativity	E	Low local value

(including Ratcliffe, 1977), and site assessment criteria used in Natura 2000 standard data forms have been incorporated into this scheme. This scheme has been designed so that the ratings correspond approximately to the representativity values.

4.3 Habitat Sensitivity to Hydrological Disturbance

4.3.1 Definition of sensitivity (to hydrological disturbance)

The sensitivity of a habitat to hydrological disturbance is defined as “The degree to which a habitat may be altered (in terms of its plant or animal communities), due to changes in one or any of a number of hydrological variables. These changes are outside the normally

occurring hydrological regime of the habitat, and may be natural or artificial in origin”.

Hydrological variables fall into two broad categories – water quantity and water quality. These are outlined in Box 4.1 below.

For example, a habitat is highly sensitive if a small change in some or any of the above variables results in a major alteration in the habitat. A good example is a petrifying spring with tufa formation: even a slight change in water quality (specifically the amount of CaCO₃ in the water) could result in major alteration of the habitat. An example of a habitat that has a low to moderate sensitivity to hydrological change is a reed swamp: water quality and water quantity may be altered

Box 4.1. Hydrological variables: water quantity and water quality.

Water quantity (which includes):

- flow regime
- water depth/level
- duration and frequency/periodicity of flooding or saturation
- duration and frequency/periodicity of spray (by salt water or fresh water) and/or precipitation
- humidity levels

Water quality (which includes):

- chemical constituents of the water (including pH and conductivity)
- trophic status
- toxic pollutants in the water
- physical parameters such as temperature, among others

to a relatively larger degree without significantly altering the nature of the plant or animal communities.

4.3.2 Assigning a value – Introduction

The amount of alteration caused in a habitat by changing some or any of the above variables must be assessed. This can be done accurately only when there is adequate information available on the structure, function and species composition of the habitat itself, and the source and role of water within the habitat (the ‘hydrological profile’ of the habitat). This is usually very site specific. Unfortunately, such comprehensive data are rarely available.

In the absence of such data, a general hydrological sensitivity rating for a given WDH may be determined by using one or more of the following approaches:

- A simple scale of sensitivity (high, moderate and low), based on ‘best professional judgement’
- Use of Ellenberg indicator values (for moisture and nitrogen)
- Use of Newbold water-level requirement values
- Use of MarLIN – method of assessing the sensitivity of seabed biotopes
- Use of other assessment schemes which have been, and are being, developed.

Some of these approaches are elaborated below. They are designed to take the user through the necessary steps in order to assign a hydrological sensitivity rating. The marine system, MarLIN (www.marlin.ac.uk), is not dealt with further, but is a well-developed and useful tool for marine habitats. It should be noted also that research in all of these areas is ongoing, and the most up-to-date and suitable assessment technique should always be chosen.

4.3.3 Best professional judgement/Initial value

4.3.3.1 Introduction

The hydrological sensitivity ratings of a WDH are:

- High (1)
- Moderate (2)
- Low (3).

Following the guidelines provided below, a rating is assigned to both the water quality and water quantity sensitivities of the habitat in question. It should be noted that a number of variables exist within each of these broad headings. Each should be considered separately, and the relevance to the particular habitat in question should be kept in mind. Using the ‘precautionary principle’, the highest of the ratings is taken. The overall sensitivity rating for a habitat will always be taken as the higher of the two sensitivity ratings for water quality and water quantity variables.

4.3.3.2 Guidelines

In order to accurately assess how sensitive a habitat is, a number of factors should be taken into account. Additionally, it is suggested that literature reviews and research should be conducted in order to become as familiar as possible with the habitats and species in question, and their requirements.

Firstly, the significance and duration of the hydrological change is very important. The predicted change can be minor or major, permanent or temporary, continuous or intermittent. Therefore, these could lead to different ratings being assigned depending on different situations. For example, the abstraction of a certain volume of water may have little or no impact if pumped throughout the year, or may have a significant impact if taken out of a river during only 2 months of the summer when it would impact more severely on low flows. The temporal scale of the impacts is very important, as some pressures may result in impacts many years in the future, and some future impacts will relate to past pressures that no longer exist.

Secondly, hydrological changes are caused by pressures (e.g. agriculture – effluent run-off, which in turn causes impacts, e.g. increased nutrients in water – eutrophication) on the habitats. Box 4.2 gives a list of some of the likely pressures on water-dependent habitats in Ireland. Also shown is whether it is water quality, water quantity, or both, which are likely to be affected. Each of the pressures listed can give rise to its own set of impacts, depending on the habitat type, the location, etc. The nature (size, duration, type, etc.) of the pressures and the impacts should be carefully considered.

Box 4.2. Some examples of impacts on water-dependent habitats in Ireland, and whether water quality, water quantity, or both, are likely to be affected.

Possible pressures	Aspect affected
<p>Point sources of pollution:</p> <ul style="list-style-type: none"> waste water (household and industrial) agriculture (farmyard run-off, etc.) aquaculture (feed material, medication, etc.) old or damaged landfills sites (leachate) etc. 	quality
<p>Diffuse sources of pollution:</p> <ul style="list-style-type: none"> household waste water (rural septic tanks) agriculture (spreading of slurry and fertilisers (mainly N and P), pesticides, insecticides, etc.) forestry run-off etc. 	quality
<p>Morphological alterations:</p> <ul style="list-style-type: none"> flow regulation river management coastal infrastructure development (e.g. harbours, coastal defence, etc.) etc. 	both quantity & quality
<p>Modification of flow regime (surface waters incl. marine):</p> <ul style="list-style-type: none"> abstraction regulation (e.g. dredging, damming, drainage, canalisation, etc.) etc. 	both quantity & quality
<p>Changes in groundwater levels and flow:</p> <ul style="list-style-type: none"> abstraction artificial recharge etc. 	both quantity & quality

Additionally, the importance of the habitat for connectivity should be taken into account. This concerns connectivity to other water-dependent habitats and to areas of groundwater. The relative importance and status of the water-dependent habitats or groundwater body is important in this instance. For example, an area of marsh which may appear to receive a poor rating for conservation value and hydrological sensitivity may be closely linked to a large groundwater body. This groundwater body may feed into or be linked to numerous other sites, some of which may be of high value. Therefore, any damage to the water quality of the marsh could have serious consequences for a number of other, more ‘important’ sites. This implies that although a site may not appear to be of high value in its own right, it may perform valuable buffer or clean-up or barrier

functions, and therefore the sites to which it may be hydrologically linked should be considered also.

It is suggested that the following points should also be kept in mind. These are proposed as some of the ways that, in practical terms, habitat changes may be observed, recorded or predicted.

1. Change in **species composition and abundance** within the habitat (outside normal variation), which may lead to a change in habitat type, e.g. fen to wet grassland. In terrestrial sites, these changes will usually first be noticed in plant communities. However, animal indicators can also be used as they are particularly sensitive to, or are indicators of change, e.g. beetles as indicators of habitat/hydrological conditions. Many aquatic systems are

animal dominated and therefore the use of animal indicators can be more suitable here.

2. Change in **habitat area** – e.g. contraction or expansion of the habitat.
3. Change in **trophic status** of the water itself (which may result in a change in species composition).
4. Obvious change in **water levels**.
5. Changes observed in relation to the **substrate** – may be caused by siltation, other deposition, erosion, etc.
6. Change in **salinity, temperature, turbidity, etc.** of the water.

Once all the above factors have been considered, along with any others that are relevant to the particular situation, a sensitivity value, which at this stage is based on ‘best professional judgement’ alone, can be assigned to a habitat. Table 4.2 gives some examples of how this rating could be applied.

4.3.4 Ellenberg indicator values

4.3.4.1 Introduction

It has been suggested that using indicator values for species could help to form a more objective and quantitative measure for allocating a hydrological sensitivity rating to a habitat. It would also help to further understanding of how particular habitats work.

Ellenberg, in a series of publications (Ellenberg, 1979, 1988; Ellenberg *et al.*, 1991), defined a set of indicator values for the vascular plants of Central Europe. The numerical values are indicative of the range of tolerances by plant species to environmental variables such as moisture, soil pH and soil fertility (expressed as

nitrogen). The Ellenberg values have been adapted for British plants by Hill *et al.* (1999).

4.3.4.2 F and N values

For the purposes of this project, the moisture (F) and fertility (N) values have been used. However, pH values may also provide valuable information. It is worth noting that while F values indicate moisture, they are not actual moisture values, but are on an arbitrary scale reflecting moisture. Similarly, while N values indicate nitrogen (in effect, a general indicator of soil fertility), again, these are on an arbitrary scale reflecting nitrogen and are not directly based on measurements.

It has been decided that for these values to be of use for the purpose of this project, a suite of species characteristic of a particular habitat should be listed, and their F and N values given. A mean value is obtained, and these are taken to be the F and N values of the habitat.

The F values do not directly relate to the sensitivity of a habitat to hydrological change, i.e. a high F value does not necessarily mean that a habitat has a high sensitivity to hydrological changes. It simply gives an indication of how important water is within or to the habitat. In this way, it can be used to provide additional information, but cannot be used as a ‘stand-alone’ means of assigning a hydrological sensitivity rating to a habitat.

However, the N values provide a slightly more direct indication of the sensitivity of a habitat. For example, a habitat with a low N value is more sensitive to change than one with a high N value, i.e. the addition of nutrients will have a much more noticeable effect on a habitat with a low N value (low fertility) because the fertility will be increased more easily.

Table 4.2. Assigning hydrological sensitivity values to habitats.

Habitat type	Possible effect of change in		Overall hydrological sensitivity value
	Water quality	Water quantity	
Freshwater marsh	High to moderate (1–2)	Moderate (2)	High to moderate (1–2)
Reed and large sedge swamp	Moderate to low (2–3)	High to moderate (1–2)	High to moderate (1–2)
Rich fen and flush	Moderate (2)	High (1)	High (1)
Acid oligotrophic lake	High (1)	Moderate (2)	High (1)
Turlough	High to moderate (1–2)	High (1)	High (1)

1, high; 2, moderate; 3, low.

4.3.4.3 Benefits, pitfalls and recommendations

There are a number of potential benefits and pitfalls to this approach. The benefits include the fact that the Ellenberg system is well known and recognised. The use of such a scheme makes the rating system more quantitative and also more objective. On the other hand, a number of disadvantages apply. These include:

1. The suite of species chosen to ‘represent’ a habitat is drawn from the Interpretation Manual of the EU Habitats Directive or Fossitt (2000), and is considered typical for that habitat. However, each individual site will carry a different range and abundance of species, and will, therefore, have slightly different Ellenberg values.
2. The relative dominance of a species in a habitat is not taken into account in this method. For example, in a reed bed, the F and N values of the common reed, *Phragmites australis*, will be much more important than those of other species, as it is likely to be the dominant species. This is likely to affect the overall Ellenberg value for this habitat.
3. The relative importance of the source of the water is not taken into account in this method. For example, an influx of nitrogen to a fen through groundwater can be buffered to a certain extent (nitrification), but an influx through surface water could have more immediate and damaging effects.
4. This scheme does not take into account the duration of inundation. Hydrological sensitivity is determined not only by water level and moisture requirements, but also by the duration and/or frequency of inundation. It is not possible to include this at the moment, as detailed site-specific data would be required.
5. Marine habitats cannot be assessed using this method as Ellenberg values are not available for marine algae or invertebrates.

The Ellenberg system only provides a general indication of the hydrological requirement of a habitat. This should lead to a more detailed study of the hydrological regime of the site based on site-specific data of species and water levels. It has been recommended by staff at the NPW unit

that assessment of a particular site should be done at the level of plant communities, rather than at habitat level. This gives a much greater degree of accuracy, but necessitates large amounts of data. This methodology requires further work and will not be covered in the current project.

4.3.4.4 Results

In order to illustrate how the Ellenberg system might be useful as an indicator of hydrological requirements (and sensitivity), a range of habitats (following Fossitt, 2000) have been assigned Ellenberg values and are presented in [Appendix 8](#). It should be noted that no species are listed for ‘Open Marine Water’, and only a limited number are available for ‘Exposed Rocky Shores’. This illustrates that this system is not suitable for marine and some intertidal habitats.

The results show that the N value for the rich fen is much lower than for the other habitats. This indicates that the fen would be more sensitive to the addition of nutrients (i.e. changes in water quality) than any of the other habitats.

The F values reflect the amount of ‘moisture’ needed by the plants in each of the three habitats. As one would expect, the river plants require the most moisture, and the wet woodland the least (as shown by the average). The salt marsh comes out with a value of 7.5, which is intermediate between the requirements of the wet woodland and the rich fen. This value should be treated with caution as tidal cycles will have a compounding effect on results.

4.3.5 Newbold – water-level requirements

4.3.5.1 Introduction

In 1997, Newbold and Mountford published a document which aimed to provide to water users and managers the known water-level requirements of a range of wetland plants and animals (Newbold and Mountford, 1997). These requirements are the upper and lower limits of tolerance to either soil water tables or depths of water or a mixture of the two. It is proposed that by taking some ‘typical’ species from a water-dependent habitat (similar to the Ellenberg method) and getting the average of their Newbold values, a measure of the range of water-level fluctuations tolerated by certain habitats can be found.

This will provide an indication of one aspect of the hydrological sensitivity of these habitats.

4.3.5.2 Usefulness of Newbold method

It should be noted that Newbold values are available for a very limited number of species only. Thus, only certain habitats such as fens, marshes, etc. can be assessed using this method. It has been decided to include the approach nonetheless, as it illustrates a further way in which existing schemes may be used to assess hydrological sensitivity and make the process more objective. Such schemes can also further our understanding of how particular habitats work.

4.3.5.3 Results

Appendix 9 shows the Newbold values for the habitat examples used in Section 4.3.4. No values are available for the marine and coastal habitats. For the wet oak–ash woodland, only one species has an assigned Newbold value. Therefore, it is impossible to get a useful value for this habitat.

A measure of data variation, i.e. spread, about the mean would be useful in this case, as it is the range, and the variation of the range, which are of most importance. Among the most commonly used measures of data variation is the standard deviation. This allows one to determine where the values of a frequency distribution are located in relation to the mean. However, site-specific and more detailed data (for example, plant community-level data) would be required for these values to be of use.

It can be seen that for the rich fen habitat the average preferred water level is between 1.5 and 20 cm below ground level. In the depositing/lowland river the average preferred water level varies between 75 and 100 cm above ground level. This type of information is valuable

in helping to understand how a habitat works and how important water levels are for the plants in the habitat.

4.3.6 Habitat sensitivity to other pressures

Habitat sensitivity to hydrological disturbance is taken as the main measure of sensitivity for the purpose of this project because WDHs, by definition, are highly dependent on water, and therefore are likely to show responses to any changes in their hydrological regime. However, other pressures will also exert an influence through temperature change, etc. Therefore, the potential sensitivity of habitats to other pressures should also be considered. These pressures are likely to be complex in their type and significance. This project did not aim to deal with these.

4.4 Ranking Scheme

4.4.1 Introduction

As already outlined, the aim of the proposed ranking scheme is to allow prioritisation of sites. The proposed ranking system combines the conservation value rating and the habitat sensitivity rating. By following the guidelines outlined above (Sections 4.2 and 4.3) an overall rank/value can be applied to a site, thus allowing prioritisation between different sites. The highest possible rank is A1 and the lowest possible rank is C3 (see Table 4.3).

4.4.2 Example

To illustrate the application of this scheme, an example is presented. Pollardstown Fen (cSAC 000396) contains three water-dependent habitats listed in Annex I of the EU Habitats Directive, as outlined in Table 4.4 overleaf. All three are highly sensitive to hydrological disturbance, and all three have a high conservation value. Appendix 10 shows the table of results in full. As detailed site-specific data are available for this site, an overall site ranking is possible.

Table 4.3. Final result of provisional ranking system.

Conservation value		Habitat sensitivity		
		1 – High	2 – Moderate	3 – Low
A	Excellent representativity/international value	A1	A2	A3
B	Good representativity/national value	B1	B2	B3
C	Significant representativity/high local value	C1	C2	C3

Table 4.4. Pollardstown Fen – example (see Appendix 10 for table in full).

Habitat	Ellenberg N value	Ellenberg F value	Newbold – preferred (cm)	Conservation value	Hydrological sensitivity	Overall habitat ranking	Overall site ranking
Calcareous fens with <i>Cladium mariscus</i> and species of the <i>Caricion davallianae</i> (7210)	4	9	0 to +5	A	1 high	A1	
Petrifying springs with tufa formation (<i>Cratoneurion</i>) (7220)	2.5	7	–15 to +3	A	1 high	A1	A1
Alkaline fens (7230)	2.5	8.5	–20 to –1	A	1 high	A1	

5 Water-Dependent Sites – GIS and Database System

5.1 Introduction

This chapter summarises the features of the GIS-based tool for viewing and interrogation of the Register of Protected Areas (Water-Dependent Habitats) sites including an overview of attributes held on each site and the tools for calculation of site ranking.

5.2 Overview of System Components

The solution involves the following components – an intermediary database, a stand-alone application and a customised GIS.

5.2.1 Database

A Microsoft Access database was created to link to data held within the existing EU Natura database for Ireland.

This database contains tools that interrogate the information held on a site, assess whether a site contains a water-dependent habitat or species and, if so, note it as being a water-dependent site for inclusion on the Register of Protected Areas. Tools also within the database calculate the conservation ranking of a designated site, and whether it contains a priority species under the EU Habitats Directive. Simple statistics on percentage of a particular designation type within the Register are also available.

5.2.2 Stand-alone application

This software application allows the user to readily view the information held within the database described above. It allows the user to select from a list of designated sites, and displays all relevant site information in a simple to use form.

The stand-alone program is simple to use, and only contain two dialogs. WDS sites can be viewed or updated through this interface. The program is self-explanatory, and requires little or no user training.

5.2.3 Custom GIS

For users wishing to view and interrogate the Register and each site spatially, a GIS interface for viewing and interrogating the Register has been developed. ArcView

8.x (ESRI, www.esri.com) has been used as the platform as it is the platform utilised by the EPA, the DEHLG and other relevant organisations. ArcView GIS is an out-of-the-box solution that provides users with all the basic GIS functionality, plus powerful analysis tools for more advanced users.

A link between this GIS and the stand-alone application outlined above, has been developed. This allows the GIS user to click on a designated site polygon within the GIS, and have the details of the site displayed to them through the stand-alone application. Additional custom functionality has also been added to the GIS to simplify various user tasks (see listing of functions below).

The user interface for ArcMap is based on the standard Windows user interface. Users familiar with Microsoft desktop products should have few problems learning how to access and use the custom functionality. The customised features of the GIS are placed in a new menu.

Users will require basic knowledge about what a GIS is, and how to use the basic GIS tools. The custom functions will help in simplifying this process, but basic training may be required to get the most use out of the system. A designated advanced GIS user should be able to update data sets in the system to ensure it remains up to date.

5.3 Summary of Custom GIS Functions

5.3.1 Search and display of site information

From the stand-alone application, a form allows the user to search for sites using search terms in any of the available fields. It also allows these results to be exported to Excel. Users are able to select sites to be displayed in the Site Details form. When using the GIS, users are able to select sites visually using a custom select tool.

Once a site has been selected a form is displayed showing full details about the site, including information on all related species, habitats, etc. The form also has a password-protected 'update' section, which will allow the user to edit various fields in the database.

It is envisaged that this will be the main use of the GIS, and users will rely on this tool whenever the system is used.

5.3.2 Run GIS analysis from the GIS

This function allows the user to automatically update the database with details of whether a site is within an SAC, an NHA or an SPA.

This function will be run periodically to update the database. It will be necessary either when new sites are added to the database and GIS, or when the underlying geographic data sets (SACs, NHAs, SPAs) are updated.

5.3.3 Custom data loader

A dialog showing all the key data sets required by the GIS is displayed to the user. The user can then select data sets to add to a map document, or to view their associated metadata.

5.3.4 Gazetteer of sites

The gazetteer is a tool that allows the user to select a site from a list, and zoom the map to that site. Other categories of features, such as river basin or catchment boundaries, can be included in the gazetteer to allow more zoom options.

5.3.5 Data-set enhancement

Metadata details about the data sets used in the GIS can be created using the XML editor in ArcCatalog. Either the custom dataloader or ArcCatalog can read these. Layer files containing relevant legends or symbolisation for each of the data sets to be used in the GIS are also designed.

5.3.6 Help documentation

A compiled help file, detailing all of the functions available in both the stand-alone application and within the GIS is available from the interface.

5.4 Technical Notes

The stand-alone application was written in Microsoft Visual Studio using Visual Basic. The custom tools in the GIS are created using ESRI ArcObjects – the COM objects on which ArcGIS is based – and Visual Basic.

The customised GIS coding complies with the conventions and standards set out in the Microsoft Official Guidelines for User Interface Developers and Designers, which is available online at:

<http://msdn.microsoft.com/library/en-us/dnwue/html/welcome.asp>

This includes standards for commenting code, and variable and object naming.

The database consists mainly of read-only tables linked from the EU Natura database for Ireland. These read-only tables that exist in the Natura database are used to create queries alongside other tables in the database. A number of ‘stored procedures’ or queries were created that are used to send information back to the user via the custom dialogs, and through the GIS.

5.5 Hardware Configuration

For ArcGIS 8.3 users, the minimum hardware computer requirements, as recommended by ESRI, are as follows:

- Platform: PC – Intel
- Operating system: Windows NT 4.0 with Service Pack 6a *or* Windows 2000 *or* Windows XP (Home Edition and Professional)
- Memory: 128 MB RAM
- Processor: 450 MHz.

However, the recommended requirements are the same as above except for the items identified below:

- Memory: 256 MB RAM (or higher)
- Processor: 650 MHz (or higher).

5.6 Summary

A user-friendly software toolset has been developed to allow users access, interrogate and visualise the Register of Water-Dependent Sites. This toolset consists of a core database for storage of site attributes, as available, and an interlinked GIS and database interface application. The system is based on technology widely used and is designed with ease of use and data update in mind.

6 Deliverables, Conclusions and Recommendations

6.1 Deliverables

The project has brought forth a number of deliverables from its work. The following can be identified as the main deliverables.

6.1.1 *Assessment of approaches to register development elsewhere*

The project has undertaken an assessment of approaches to the development of the Register of Protected Areas – Water-Dependent Sites – through liaison with a number of organisations across Europe. This has informed the processes undertaken by this project, but provided little direct guidance due to the early-stage status of developments in other countries.

6.1.2 *Definitions of water-dependent habitats and water-dependent species*

Arising from the lack of definitions of water-dependent habitats and water-dependent species, the project developed working definitions, and based its selection of habitats and species on these definitions.

6.1.3 *Data-set assessment*

Various data sets have been assessed, including a number of current and archived NPW databases on site attributes, habitat maps from SAC management plans, various paper records held by the NPW unit, and data sets produced by other national agencies including Teagasc and the EPA. This assessment has yielded decisions as to which data sets are of value in the development and maintenance of the Register of Water-Dependent sites.

6.1.4 *Draft Register of Protected Areas – Water-Dependent Sites*

A draft Register of Protected Areas – Water-Dependent Sites – has been developed for Ireland. This is based on SACs, SPAs and NHAs designated due to the presence of raised bogs, and designated salmonid waters. Proposed extensions to the Register are also outlined.

6.1.5 *Conservation ranking scheme*

Following on assessment of various approaches, a conservation ranking scheme for sites on the Register has

been adopted based on the Representativity value recorded on the EU Natura data form for SAC site assessment.

6.1.6 *System for maintenance of the Register of Water-Dependent Sites*

A GIS and database system has been developed to allow the development and maintenance of the Register of Water-Dependent Sites. The system allows the viewing of site attributes as held within the linked EU Natura database, via a map interface (the GIS) or via a data forms interface. It allows the modification of the selection of water-dependent habitats or species and the consequent re-assessment of sites to include on the Register.

6.2 Conclusions and Recommendations

6.2.1 *Definitions of water-dependent habitats and water-dependent species*

The Water Framework Directive has specified that the Register of Protected Areas must list those sites designated under European legislation that contain water-dependent habitats or species. However, a definition of water-dependent habitats and species has not been provided, nor has a list of habitats or species based on habitat and species listing used in EU Directives. As noted in [Chapter 2](#) of this report, there was little evidence of accepted definitions arising at a European level, therefore it fell to this project to develop working definitions of water-dependent habitats and water-dependent species as a priority.

It is apparent that some uniform guidance would be beneficial in order to facilitate the development of comparable methodologies at national levels, and hence the generation of a comparable register at European level. It is suggested that such guidance should include a common definition of a water-dependent habitat or species, and listing of those habitats and species (based on EU Natura habitat and species lists) likely to be water dependent, with the ability to adjust this listing based on national conditions.

6.2.2 Availability of appropriate data

In order to allow the application of a solid methodology, reliable and accessible data are necessary. A real obstacle to the efficient undertaking of a study such as this and the ability to investigate individual sites to develop a site-level understanding of water–habitat–species processes, is the lack of digital habitat data in accurate digital map or database format.

The availability of suitable data is also an issue as regards development of ranking schemes. While the Representativity value within the EU Natura database was ultimately deemed to be a useful indicator of conservation value, the development of a readily applied and reliable sensitivity indicator proved difficult. This was not helped by the lack of good quality map or attribute data for sites.

In addition to weaknesses in terms of data, the development of indices of sensitivity in particular is also hindered by the limited availability of suitable data on habitat and species requirements or interactions with water processes. Allied to the site-specific nature of such sensitivities, it proved difficult to develop an index that was both readily applicable as a management tool and also scientifically sound.

6.2.3 Data-set management and development within the NPW unit

In undertaking this project, a number of opportunities for enhanced data-set generation and management within the NPW unit became apparent and throughout the course of the project the NPW participants encouraged the presentation of these ideas. A number of these are outlined here.

1. Extend the EU Natura database for Ireland to cover SPAs and NHAs

The EU Natura database is a valuable database that is seen as a reliable source of appropriate data on SACs. This database is at the core of the proposed system for generation and maintenance of the Register of Protected Areas – Water-Dependent Sites. It is therefore important that this database is extended to cover SPAs and NHAs, with information on the sites capable of being extracted from existing site data sheets and ancillary records.

2. Undertake habitat mapping of sites on the Register

The project has tested the conversion of paper-format habitat maps held for SACs with management plans. These paper maps are difficult to convert accurately to a digital format and to an accepted Ordnance Survey map base. Likewise, it is problematic to standardise the habitat categories used across the various sites.

It is recommended that habitat mapping of sites be conducted utilising the Fossitt (2000) and EU Natura categories, using correspondence tables recently devised by this project and by Fossitt (personal communication). In conducting this mapping, optimal use would be made of geographic technologies including GPS and GIS. Use should also be made of remote sensing and other geographic data sets including current orthophotography and the national Digital Terrain Model.

3. Conversion of NPW information holdings to digital spatially enabled format

Recognising the valuable data held in paper formats by the NPW unit, it is recommended that the NPW unit conduct a data capture exercise on the various NPW species and habitat-specific studies. The digital data arising should be held within a structured spatial database and GIS.

4. Wider adoption of geographic technologies

In order to optimise the quality and usability of data generated by field surveys undertaken by the NPW unit and its agents, the use of geographic field and mapping technologies should be adopted within the NPW unit. These technologies include GIS, GPS, Field GIS/GPS, remote sensing and digital notepads.

The project has largely succeeded in meeting all its objectives, with the development of a sensitivity index being an area where additional in-depth work may be required to fully develop and test an approach. The project has also set out a course for improvements that could be made to developing a more information-rich resource for management and development of the Register of Water-Dependent Sites.

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Appendix 1 Components of the Register of Protected Areas

The Water Framework Directive specifies that the following are the components of the Register of Protected Areas:

1. Bodies of Water identified under Article 7(1) as “all bodies of water used for abstraction of water intended for human consumption providing more than 10 m³ per day as an average or serving more than 50 persons” and “those bodies of water intended for such future use”.
2. Areas designated for the protection of economically significant aquatic species, based on:
 - salmonid waters designated under the European Communities (Quality of Salmonid Waters) Regulations 1988 (S.I. No. 293, 1988” and
 - shellfish waters designated under the European Communities (Quality of Shellfish Waters) Regulations 1994 (S.I. No. 200, 1994).
3. Bodies of water designated as recreational water, including areas designated as bathing waters under Directive 76/160/EEC (Bathing Water Directive), based on:
 - bathing waters designated under the European Communities (Quality of Bathing Water) Regulations 1992 (S.I. No. 155, 1992).
4. Nutrient-sensitive areas, including areas designated as Vulnerable Zones under Directive 91/676/EEC (Nitrates Directive) and areas designated as Sensitive Areas under Directive 91/271/EEC (Urban Waste Water Treatment Directive).
5. Areas designated for the protection of habitats or species where the maintenance or improvement of the status of water is an important factor in their protection, including relevant Natura 2000 sites designated under Directive 92/43/EEC (Habitats Directive) and Directive 79/409/EEC (Birds Directive).

Appendix 2 Existing Definitions of Wetlands

Under the Ramsar Convention on Wetlands (Carp, 1972), ‘wetlands’ are defined by Articles 1.1 and 2.1 as shown below. The EU Commission Communication to the Council and the European Parliament entitled “Wise use and conservation of wetlands” also uses the Ramsar definition of wetlands.

Article 1.1:

“For the purpose of this Convention wetlands are areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres.”

Article 2.1 provides that wetlands:

“may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six metres at low tide lying within the wetlands”.

The Working Group of the Common Implementation Strategy (CIS) on ‘The Role of Wetlands in the Water Framework Directive’ states that wetlands are defined as:

“heterogeneous but distinctive ecosystems in which special ecological, biogeochemical and hydrological functions arise from the dominance and particular sources, chemistry and periodicity of inundation or saturation by water. They occur in a wide range of landscapes and may support permanent shallow (<2 m) or temporary standing water. They have soils, substrates and biota adapted to flooding and/or waterlogging and associated conditions of restricted aeration”.

The CIS Working Group on ‘Wetlands Horizontal Guidance’ states that wetlands are defined as:

“diverse, hydrologically complex ecosystems which tend to develop within a hydrological gradient between terrestrial and mainly aquatic habitats. They are heterogenous but distinctive ecosystems which develop naturally or are the product of human activities. Their biogeochemical functions depend notably on a constant or recurrent shallow inundation by fresh, brackish or saline water (<2 m), or saturation at or near the surface of the substrate. They are characterised by standing or slowly moving waters. Common features include hydric soils, micro-organisms, hydro- and hygrophilous vegetation and fauna adapted to chemical and biological processes reflective of recurrent or permanent flooding and/or water-logging”.

Appendix 3 List of Water-Dependent Habitats in Ireland

Water-dependent habitats in Ireland as listed in Annex I habitats from the EU Habitats Directive, and their relationships with Fossitt (2000). (Note that correspondence is approximate in many cases.)

EU code	EU Annex I habitats (Natura 2000 code)	Fossitt code	Fossitt habitat type	Main water source**		
MARINE						
LITTORAL ROCK						
1170	• Reefs	LR1	• Exposed rocky shores	c, (t)		
		LR2	• Moderately exposed rocky shores	c, (t)		
		LR3	• Sheltered rocky shores	c, (t)		
		LR4	• Mixed substrata shores	c, (t)		
8330	• Submerged or partially submerged sea caves	LR5	• Sea caves	c		
LITTORAL SEDIMENTS						
1210	• Annual vegetation of drift lines	LS1	• Shingle and gravel shores	c, (t)		
1140	• Mudflats and sandflats not covered by sea water at low tide	LS2	• Sand shores	c, t		
1210	• Annual vegetation of drift lines					
1140	• Mudflats and sandflats not covered by sea water at low tide	LS3	• Muddy sand shores	c, t		
		LS4	• Mud shores	c, t		
		LS5	• Mixed sediment shores	c, t		
SUBLITTORAL ROCK						
1170	• Reefs	SR1	• Exposed infralittoral rock	c		
8330	• Submerged or partially submerged sea caves	SR2	• Moderately exposed infralittoral rock	c		
		SR3	• Sheltered infralittoral rock	c, (t)		
1170	• Reefs	SR4	• Exposed circalittoral rock	c		
8330	• Submerged or partially submerged sea caves	SR5	• Moderately exposed circalittoral rock	c		
		SR6	• Sheltered circalittoral rock	c, (t)		
SUBLITTORAL SEDIMENTS						
1110	• Sandbanks which are slightly covered by sea water all the time	SS1	• Infralittoral gravels and sands	c, t		
1130	• Estuaries	SS2	• Infralittoral muddy sands	c, t		
1130	• Estuaries	SS3	• Infralittoral muds	c, t		
		SS4	• Infralittoral mixed sediments	c, t		
		SS5	• Circalittoral gravels and sands	c, (t)		
		SS6	• Circalittoral muddy sands	c, (t)		
		SS7	• Circalittoral muds	c, (t)		
		SS8	• Circalittoral mixed sediments	c, (t)		
		MARINE WATER BODY				
				MW1	• Open marine water	c
1160	• Large shallow inlets and bays	MW2	• Sea inlets and bays	c		
		MW3	• Straits and sounds	c, (t)		
1130	• Estuaries	MW4	• Estuaries	t, c, s		

EU code	EU Annex I habitats (Natura 2000 code)	Fossitt code	Fossitt habitat type	Main water source**
NON-MARINE				
FRESHWATER				
3160	• Natural dystrophic lakes and ponds	FL1	• Dystrophic lakes	s, (g)
3110	• Oligotrophic waters containing very few minerals of sandy plains (<i>Littorelletalia uniflorae</i>)	FL2	• Acid oligotrophic lakes	s, g
3130	• Oligotrophic to mesotrophic standing waters with vegetation of the <i>Littorelletea uniflorae</i> and/or of the <i>Isoëto-Nanojuncetea</i>			
3140	• Hard oligo–mesotrophic waters with benthic vegetation of <i>Chara</i> spp.	FL3	• Limestone/marl lakes	g, s
		FL4	• Mesotrophic lakes	s, g
3150	• Natural eutrophic lakes with <i>Magnopotamion</i> or <i>Hydrocharition</i> -type vegetation	FL5	• Eutrophic lakes	s, g
3180	• *Turloughs	FL6	• Turloughs	g, s
		FL7	• Reservoirs	s
		FL8	• Other artificial lakes and ponds	s
3260	• Watercourses of plain to montane levels with the <i>Ranunculion fluitantis</i> and <i>Callitriche–Batrachion</i> vegetation	FW1	• Eroding/upland rivers	s, g
3270	• Rivers with muddy banks with <i>Chenopodion rubri</i> p.p. and <i>Bidention</i> p.p. vegetation	FW2	• Depositing/lowland rivers	s, g
		FW3	• Canals	g, s
		FW4	• Drainage ditches	s, g
7220	• *Petrifying springs with tufa formation (<i>Cratoneurion</i>)	FP1	• Calcareous springs	g
		FP2	• Non-calcareous springs	g
		FS1	• Reed and large sedge swamps	s, g
6430	• Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels	FS2	• Tall-herb swamps	s, g
GRASSLAND AND MARSH				
6410	• <i>Molinia</i> meadows on calcareous, peaty or clayey–silt–laden soils (<i>Molinion caeruleae</i>)	GS4	• Wet grassland	s, g
6430	• Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels	GM1	• Marsh	s, g
HEATH AND DENSE BRACKEN				
4010	• Northern Atlantic wet heaths with <i>Erica tetralix</i>	HH3	• Wet heath	s, p, (g)

EU code	EU Annex I habitats (Natura 2000 code)	Fossitt code	Fossitt habitat type	Main water source**
PEATLANDS				
7110	• *Active raised bogs	PB1	• Raised bog	p, s, (g)
7120	• Degraded raised bogs still capable of natural regeneration			
7150	• Depressions on peat substrates of the <i>Rhynchosporion</i>			
7130	• Blanket bog (*if active bog)	PB2	• Upland blanket bog	p, s, (g)
7150	• Depressions on peat substrates of the <i>Rhynchosporion</i>	PB3	• Lowland blanket bog	p, s, (g)
7150	• Depressions on peat substrates of the <i>Rhynchosporion</i>	PB4	• Cutover bog	p, s, g
		PB5	• Eroding blanket bog	p, s, (g)
7210	• *Calcareous fens with <i>Cladium mariscus</i> and species of the <i>Caricion davallianae</i>	PF1	• Rich fen and flush	g, s
7230	• Alkaline fens			
		PF2	• Poor fen and flush	g, s
7140	• Transition mires and quaking bogs	PF3	• Transition mire and quaking bog	s, p, (g)
WOODLAND AND SCRUB				
91E0	• *Alluvial forests with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i> (<i>Alno-padion</i> , <i>Alnion incanae</i> , <i>Salicion albae</i>)	WN4	• Wet pedunculate oak–ash woodland	s, g
		WN5	• Riparian woodland	s, g
		WN6	• Wet willow–alder–ash woodland	s, g
91D0	• *Bog woodland	WN7	• Bog woodland	s, p, (g)
EXPOSED ROCK/DISTURBED GROUND				
8310	• Caves not open to the public	EU1	• Non-marine caves	g
COASTLAND				
1230	• Vegetated sea cliffs of the Atlantic and Baltic coasts	CS1	• Rocky sea cliffs	c, (t)
		CS2	• Sea stacks and islets	c, (t)
		CS3	• Sedimentary sea cliffs	c, (t)
1150	• *Coastal lagoons	CW1	• Lagoons and saline lakes	t, c, s, g
1130	• Estuaries	CW2	• Tidal rivers	s, t
1310	• <i>Salicornia</i> and other annuals colonising mud and sand	CM1	• Lower salt marsh	c, t
1320	• <i>Spartina</i> swards (<i>Spartinion maritimae</i>)			
1330	• Atlantic salt meadows (<i>Glaucopuccinellietalia maritimae</i>)			
1420	• Mediterranean and thermo-Atlantic halophilous scrubs (<i>Sarcocornetea fruticosi</i>)			
1330	• Atlantic salt meadows (<i>Glaucopuccinellietalia maritimae</i>)	CM2	• Upper salt marsh	c, t, s, g
1410	• Mediterranean salt meadows (<i>Juncetalia maritimi</i>)			
1220	• Perennial vegetation of stony banks	CB1	• Shingle and gravel banks	c, (t)
2110	• Embryonic shifting dunes	CD1	• Embryonic dunes	c, (t)

EU code	EU Annex I habitats (Natura 2000 code)	Fossitt code	Fossitt habitat type	Main water source**
			COASTLAND (contd)	
2120	• Shifting dunes along the shoreline with <i>Ammophila arenaria</i> (“white dunes”)	CD2	• Marram dunes	c, (t)
2130	• *Fixed coastal dunes with herbaceous vegetation (“grey dunes”)	CD3	• Fixed dunes	c, (t)
2140	• *Decalcified fixed dunes with <i>Empetrum nigrum</i>			
2150	• *Atlantic decalcified fixed dunes (<i>Calluno-Ulicetea</i>)			
2170	• Dunes with <i>Salix repens</i> ssp. <i>argentea</i> (<i>Salicion arenariae</i>)			
2160	• Dunes with <i>Hippophae rhamnoides</i>	CD4	• Dune scrub and woodland	c, (t)
2170	• Dunes with <i>Salix repens</i> ssp. <i>argentea</i> (<i>Salicion arenariae</i>)	CD5	• Dune slacks	g, c, (t)
2190	• Humid dune slacks			
21A0	• Machairs (*in Ireland)	CD6	• Machair	c, g, s
	(See Littoral/Sublittoral rock sections)	CC1	• Sea walls, piers and jetties	c, t
*Priority type.				
**Main water source: c, coastal; t, transitional; s, surface water; g, groundwater; p, precipitation. Parentheses indicate that the water source is sometimes a main source.				

Appendix 4 List of Water-Dependent Fauna Species (excluding birds) in Ireland

Fauna species (excluding birds) occurring in Ireland which are protected under Annex II or Annex IV of the Habitats Directive or under the Wildlife Act.

Common name	Latin name	EU HD	WA
MAMMALS			
Daubenton's Bat	<i>Myotis daubentoni</i>	IV	P
Grey Seal	<i>Halichoerus grypus</i>	II, V	P
Common Seal	<i>Phoca vitulina</i>	II, V	P
Bottle-nosed Dolphin	<i>Tursiops truncatus</i>	II, IV	P
Harbour Porpoise	<i>Phocaena phocaena</i>	II, IV	P
Otter	<i>Lutra lutra</i>	II, IV	P
FISH			
River Lamprey	<i>Lampetra fluviatilis</i>	II, V	–
Brook Lamprey	<i>Lampetra planeri</i>	II	–
Sea Lamprey	<i>Petromyzon marinus</i>	II	–
Atlantic Salmon (freshwater only)	<i>Salmo salar</i>	II, V	–
Allis Shad	<i>Alosa alosa</i>	II, V	–
Twaite Shad	<i>Alosa fallax fallax</i>	II, V	–
Killarney Shad	<i>Alosa fallax killarnensis</i>	II, V	–
AMPHIBIANS			
Natterjack Toad	<i>Bufo calamita</i>	IV	P
Common Frog	<i>Rana temporaria</i>	V	P
Smooth Newt	<i>Triturus vulgaris</i>	–	P
REPTILES			
Common Lizard	<i>Lacerta vivipara</i>	–	P
CRUSTACEANS			
White-clawed Crayfish	<i>Austropotamobius pallipes</i>	II, V	P
INSECTS			
Marsh Fritillary	<i>Euphydryas aurinia</i>	II	–
MOLLUSCS			
Kerry Slug	<i>Geomalacus maculosus</i>	II, IV	P
Narrow-mouthed Whorl Snail (semi-aquatic)	<i>Vertigo angustior</i>	II	–
Geyer's Whorl Snail (semi-aquatic)	<i>Vertigo geyeri</i>	II	–
Desmoulin's Whorl Snail (semi-aquatic)	<i>Vertigo moulinsiana</i>	II	–
Freshwater Pearl Mussel	<i>Margaritifera margaritifera</i>	II, V	P

Key: EU HD, EU Habitats Directive; II, Annex II (of EU Habitats Directive) animal and plant species whose conservation requires the designation of SACs; IV, Annex IV animal and plant species of community interest in need of strict protection; V, Annex V animal and plant species whose taking in the wild and exploitation may be subject to management measures.

WA, Wildlife Act 1976, and the Wildlife (Amendment) Act 2000; P, animal species listed for protection in the Wildlife Act 1976 and Wildlife (Amendment) Act 2000.

Appendix 5 List of Water-Dependent Bird Species In Ireland

Water-dependent bird species occurring in Ireland. List compiled from Annex I of the EU Birds Directive, and the Red and Amber Lists of the ‘Birds of Conservation Concern’ (BirdWatch Ireland and RSPB Northern Ireland).

Common name	Latin name	Species code	EU BD	R/A*
Chough	<i>Pyrhocorax pyrrhocorax</i>	A346	I	R
Coot	<i>Pulica atra</i>		–	A
Cormorant	<i>Phalacrocorax carbo</i>		–	A
Corn Bunting	<i>Emberiza calandra</i>		–	R
Corncrake	<i>Crex crex</i>	A122	I	R
Crake, Spotted	<i>Porzana porzana</i>		–	A
Cuckoo	<i>Cuculus canorus</i>		–	A
Curlew	<i>Numenius arquata</i>		–	R
Diver, Black-throated	<i>Gavia arctica</i>	A002	I	A
Diver, Great Northern	<i>Gavia immer</i>	A003	I	–
Diver, Red-throated	<i>Gavia stellata</i>	A001	I	A
Dove, Stock	<i>Columba oenas</i>		–	A
Duck, Tufted	<i>Aythya fuligula</i>		–	A
Dunlin	<i>Calidris alpina</i>		–	A
Eagle, Golden	<i>Aquila chrysaetos</i>	A091	I	–
Egret, Little	<i>Egretta garzetta</i>	A026	I	A
Eider	<i>Somateria mollissima</i>		–	A
Flycatcher, Pied	<i>Ficedula hypoleuca</i>		–	A
Flycatcher, Spotted	<i>Muscicapa striata</i>		–	A
Gadwall	<i>Anas strepera</i>		–	A
Gannet	<i>Morus bassanus</i>		–	A
Garganey	<i>Anas querquedula</i>		–	A
Godwit, Bar-tailed	<i>Limosa lapponica</i>		–	A
Godwit, Black-tailed	<i>Limosa limosa</i>		–	A
Goldeneye	<i>Bucephala clangula</i>		–	A
Goosander	<i>Mergus merganser</i>		–	A
Goose, Barnacle	<i>Branta leucopsis</i>	A045	I	A
Goose, Brent	<i>Branta bernicla</i>		–	A
Goose, Greenland White-fronted	<i>Anser albifrons flavirostris</i>	A395	I	A
Goose, Greylag	<i>Anser anser</i>		–	A
Goshawk	<i>Accipiter gentilis</i>		–	A
Grebe, Black-necked	<i>Podiceps nigricollis</i>		–	R
Grebe, Great Crested	<i>Podiceps cristatus</i>		–	A
Grouse, Red	<i>Lagopus lagopus</i>		–	R
Guillemot, Black	<i>Cephus grylle</i>		–	A
Guillemot	<i>Uria aalge</i>		–	A
Gull, Black-headed	<i>Larus ridibundus</i>		–	A

Common name	Latin name	Species code	EU BD	R/A*
Gull, Common	<i>Larus canus</i>		–	A
Gull, Little	<i>Larus minutus</i>		–	A
Gull, Mediterranean	<i>Larus melanocephalus</i>		–	A
Hen Harrier	<i>Circus cyaneus</i>	A082	I	R
Kingfisher	<i>Alcedo atthis</i>	A229	I	A
Knot	<i>Calidris canutus</i>		–	A
Lapwing	<i>Vanellus vanellus</i>		–	R
Martin, Sand	<i>Riparia riparia</i>		–	A
Merganser, Red-breasted	<i>Mergus serrator</i>		–	A
Merlin	<i>Falco columbarius</i>	A098	I	A
Nightjar	<i>Caprimulgus europaeus</i>	A224	I	R
Ouzel, Ring	<i>Turdus torquatus</i>		–	R
Owl, Barn	<i>Tyto alba</i>		–	R
Owl, Short-eared	<i>Asio flammeus</i>	A222	I	A
Partridge, Grey	<i>Perdix perdix</i>		–	R
Peregrine	<i>Falco peregrinus</i>	A103	I	A
Petrel, Leach's	<i>Oceanodroma leucorhoa</i>	A015	I	A
Petrel, Storm	<i>Hydrobates pelagicus</i>	A014	I	A
Phalarope, Red-necked	<i>Phalaropus lobatus</i>	A170	I	R
Pintail	<i>Anas acuta</i>		–	A
Plover, Golden	<i>Pluvialis apricaria</i>	A140	I	A
Plover, Grey	<i>Pluvialis squatarola</i>		–	A
Pochard	<i>Aythya ferina</i>		–	A
Puffin	<i>Fratercula arctica</i>		–	A
Quail	<i>Coturnix coturnix</i>		–	R
Rail, Water	<i>Rallus aquaticus</i>		–	A
Razorbill	<i>Alca torda</i>		–	A
Redpoll, Lesser	<i>Carduelis carbaret</i>		–	A
Redshank	<i>Tringa totanus</i>		–	A
Redstart	<i>Phoenicurus phoenicurus</i>		–	A
Scaup	<i>Aythya marila</i>		–	A
Scoter, Common	<i>Melanitta nigra</i>		–	R
Shearwater, Cory's	<i>Calonectris diomedea</i>		–	A
Shearwater, Great	<i>Puffinus gravis</i>		–	A
Shearwater, Manx	<i>Puffinus puffinus</i>		–	A
Shearwater, Sooty	<i>Puffinus griseus</i>		–	A
Shelduck	<i>Tadorna tadorna</i>		–	A
Skylark	<i>Alauda arvensis</i>		–	A
Snipe	<i>Gallinago gallinago</i>		–	A
Snipe, Jack	<i>Lymnocyptes minimus</i>		–	A
Stonechat	<i>Saxicola torquata</i>		–	A
Swallow	<i>Hirundo rustica</i>		–	A

Common name	Latin name	Species code	EU BD	R/A*
Swan, Bewick's	<i>Cygnus columbianus</i>	A037	I	A
Swan, Whooper	<i>Cygnus cygnus</i>	A038	I	A
Teal	<i>Anas crecca</i>		–	A
Tern, Arctic	<i>Sterna paradisaea</i>	A194	I	A
Tern, Common	<i>Sterna hirundo</i>	A193	I	A
Tern, Little	<i>Sterna albifrons</i>	A195	I	A
Tern, Roseate	<i>Sterna dougallii</i>	A192	I	R
Tern, Sandwich	<i>Sterna sandvicensis</i>	A191	I	A
Twite	<i>Carduelis flavirostris</i>		–	R
Wagtail, Yellow	<i>Motacilla flava</i>		–	A
Warbler, Grasshopper	<i>Locustella naevia</i>		–	A
Warbler, Reed	<i>Acrocephalus scirpaceus</i>		–	A
Warbler, Wood	<i>Phylloscopus sibilatrix</i>		–	A
Whinchat	<i>Saxicola rubetra</i>		–	A
Whitethroat, Lesser	<i>Sylvia curruca</i>		–	A
Wigeon	<i>Anas penelope</i>		–	A
Woodcock	<i>Scolopax rusticola</i>		–	A
Yellowhammer	<i>Emberiza citrinella</i>		–	R

KEY: EU BD, EU Birds Directive; I, Annex I (of EU Birds Directive) bird species

'Birds of Conservation Concern' as agreed by Birdwatch Ireland and RSPB Northern Ireland (after Newton *et al.*, 1999): R, Red List (high conservation concern); A, Amber List (medium conservation concern).

Appendix 6 List of Water-Dependent Flora Species In Ireland

Plant species occurring in Ireland which are protected under Annex II of the Habitats Directive, or the Flora (Protection) Order 1999.

Common name	Latin name	EU HD	FPO
VASCULAR PLANTS			
Orange Foxtail	<i>Alopecurus aequalis</i>	–	+
Perennial Glasswort	<i>Anthrocnemum perenne</i>	–	+
Wild Asparagus	<i>Asparagus officinalis</i>	–	+
Bushgrass	<i>Calamagrostis epigejos</i>	–	+
Starwort	<i>Callitriche truncata</i>	–	+
Divided Sedge	<i>Carex divisa</i>	–	+
Lesser Centaury	<i>Centaureum pulchellum</i>	–	+
Narrow-leaved Helleborine	<i>Cephalanthera longifolia</i>	–	+
Autumn Crocus	<i>Colchicum autumnale</i>	–	+
Bog Hair Grass	<i>Deschampsia setacea</i>	–	+
Chickweed Willow-herb	<i>Epilobium alsinifolium</i>	–	+
Moore's Horsetail	<i>Equisetum X moorei</i>	–	+
Slender Cotton Grass	<i>Eriophorum gracile</i>	–	+
Opposite-leaved Pondweed	<i>Groenlandia densa</i>	–	+
Bog Orchid	<i>Hammarbya paludosa</i>	–	+
Meadow Barley	<i>Hordeum secalinum</i>	–	+
Irish Hydrilla	<i>Hydrilla verticillata</i>	–	+
Canadian St John's Wort	<i>Hypericum canadense</i>	–	+
Hairy St John's Wort	<i>Hypericum hirsutum</i>	–	+
Willow-leaved Inula	<i>Inula salicina</i>	–	+
Sea Pea	<i>Lathyrus japonicus</i>	–	+
Mudwort	<i>Limosella aquatica</i>	–	+
Marsh Clubmoss	<i>Lycopodiella/Lepidotis inundata</i>	–	+
Penny Royal	<i>Mentha pulegium</i>	–	+
Oyster Plant	<i>Mertensia maritima</i>	–	+
Slender Naiad	<i>Najas flexilis</i>	II, IV	+
Wood Cudweed	<i>Omalotheca sylvatica</i>	–	+
Cottonweed	<i>Otanthus maritimus</i>	–	+
Pillwort	<i>Pilularia globulifera</i>	–	+
Alpine Bistort	<i>Polygonum viviparum</i>	–	+
Tufted Salt-marsh Grass	<i>Puccinellia fasciculata</i>	–	+
Round-leaved Wintergreen	<i>Pyrola rotundifolia ssp. maritima</i>	–	+
Great Burnet	<i>Sanguisorba officinalis</i>	–	+
Meadow Saxifrage	<i>Saxifraga granulata</i>	–	+
Hart's Saxifrage	<i>Saxifraga hartii</i>	–	+

Common name	Latin name	EU HD	FPO
VASCULAR PLANTS (CONTD)			
Yellow Marsh Saxifrage	<i>Saxifraga hirculus</i>	II, IV	+
Alpine Saxifrage	<i>Saxifraga nivalis</i>	–	+
Triangular Club Rush	<i>Scirpus triqueter</i>	–	+
Drooping Lady's Tresses	<i>Spiranthes romanzofiana</i>	–	+
Killarney Fern	<i>Trichomanes speciosum</i>	II, IV	+
Globe Flower	<i>Trollius europaeus</i>	–	+
MOSSES			
Blunt Bryum	<i>Bryum calophyllum</i>	–	+
Baltic Bryum	<i>Bryum marratii</i>	–	+
Down-looking Moss	<i>Catocopium nigratum</i>	–	+
Shining Sicklemoss	<i>Drepanocladus vernicosus</i>	II	+
Spruce's Bristle-moss	<i>Orthotrichum sprucei</i>	–	+
Tufted Fen-moss	<i>Paludella squarrosa</i>	–	+
Wilson's Pottia moss	<i>Pottia wilsonii</i>	–	+
Narrow Cruet-moss	<i>Tetraplodon angustatus</i>	–	+
Beaked Beardless-moss	<i>Weissia rostellata</i>	–	+
LIVERWORTS			
Gillman's Notchwort	<i>Leiocolea gillmanii</i>	–	+
Fen Flapwort	<i>Leiocolea rutheana</i>	–	+
Petalwort	<i>Petalophyllum ralfsii</i>	II	+
LICHENS			
Scrambled-egg Lichen	<i>Fulgensia fulgens</i>	–	+
STONEWORTS			
Foxtail Stonewort	<i>Lamprothamnium papulosum</i>	–	+
Slender Stonewort	<i>Nitella gracilis</i>	–	+

Key: EU HD, EU Habitats Directive; I, Annex I (of EU Habitats Directive) habitat types whose conservation requires the designation of SACs; II, Annex II animal and plant species whose conservation requires the designation of SACs; IV, Annex IV animal and plant species of community interest in need of strict protection; FPO, Flora (Protection) Order 1999; +, protected under Flora (Protection) Order 1999.

Appendix 7 Conservation Value – Alternative Scheme

Rating	Criteria for assessing conservation value of water-dependent habitats
A	<p>International value</p> <ul style="list-style-type: none"> • Water-dependent habitats within sites listed as pcSACs or cSACs, or SPAs, or Salmonid Waters (i.e. designated at EU/Community level). • Water-dependent habitats within sites listed as Ramsar sites, Biogenetic Reserves or UNESCO Biosphere Reserves. • Priority habitats (listed in EU Habitats Directive) – which are water dependent. • Good examples of water-dependent habitats listed under Annex I of the EU Habitats Directive. • Habitats which are widely recognised as being of international importance, but are not covered by the above criteria (e.g. large active river flood plains such as the Shannon callows). • Habitats containing significant populations of Annex II water-dependent species (under the EU Habitats Directive) or Annex I species (under the EU Birds Directive).
B	<p>National value</p> <ul style="list-style-type: none"> • Water-dependent habitats within sites listed as pNHAs, NHAs, Statutory Nature Reserves, Refuges for Fauna or Wildfowl Sanctuaries (i.e. designated at national level). • Water-dependent habitats within sites listed as National Parks. • Poorer examples of water-dependent habitats listed under Annex I (EU Habitats Directive). • Good examples of water-dependent habitats which are nationally rare or threatened. • Habitats containing significant populations of water-dependent species that are protected under the Wildlife Act, 1976, the Wildlife (Amendment) Act, 2000 or the Flora (Protection) Order, 1999.
C	<p>High local/county value</p> <ul style="list-style-type: none"> • Semi-natural water-dependent habitat types with high biodiversity in a local context and a high degree of naturalness. • Semi-natural habitats containing significant populations of locally rare water-dependent species. • Habitats containing any Annex II water-dependent species (under the EU Habitats Directive) or Annex I species (under the EU Birds Directive).
D	<p>Moderate local value</p> <ul style="list-style-type: none"> • Semi-natural habitat which is locally important for wildlife.
E	<p>Low local value</p> <ul style="list-style-type: none"> • Artificial or highly modified water-dependent habitats with low species diversity and low wildlife value.

Appendix 8 Ellenberg F and N Values

Examples of WDHs with hydrological requirements calculated by reference to the F value (moisture) and N value (nitrogen) of the dominant species (after Hill *et al.*, 1999).

Habitat name (code) (after Fossitt, 2000)	Species name	F value	N value
Rich Fen (PF1)	<i>Schoenus nigricans</i>	8	2
	<i>Carex nigra</i>	8	2
	<i>Carex dioica</i>	9	2
	<i>Juncus subnodulosus</i>	9	4
	<i>Molinia caerulea</i>	8	2
	<i>Ranunculus flammula</i>	9	3
	<i>Mentha aquatica</i>	8	5
	<i>Succisa pratensis</i>	7	2
	Average	8.25	2.75
Wet Pedunculate Oak–Ash Woodland (WN4)	<i>Quercus robur</i>	5	4
	<i>Fraxinus excelsior</i>	6	6
	<i>Corylus avellana</i>	5	6
	<i>Filipendula ulmaria</i>	8	5
	<i>Primula vulgaris</i>	5	4
	<i>Circaea lutetiana</i>	6	6
	<i>Hedera helix</i>	5	6
	<i>Carex remota</i>	8	6
	<i>Allium ursinum</i>	6	7
	<i>Ilex aquifolium</i>	5	5
	Average	5.9	5.5
Depositing/Lowland Rivers (FW2)	<i>Nuphar lutea</i>	11	6
	<i>Nymphaea alba</i>	11	4
	<i>Potamogeton</i> spp.	avg. 12	avg. 5
	<i>Callitriche</i> spp.	avg. 11	avg. 6
	<i>Sparganium emersum</i>	11	6
	<i>Schoenoplectus lacustris</i>	11	6
	<i>Phragmites australis</i>	10	6
	<i>Iris pseudacorus</i>	9	6
Average	10.75	5.6	
Lower Salt Marsh (CM1)	<i>Salicornia</i> spp.	avg. 7.5	avg. 6
	<i>Suaeda maritima</i>	8	6
	<i>Cochlearia danica</i>	6	5
	<i>Spartina</i> spp.	avg. 9	avg. 6
	<i>Puccinellia maritima</i>	8	6
	<i>Armeria maritima</i>	7	5

Habitat name (code) (after Fossitt, 2000)	Species name	F value	N value
Lower Salt Marsh (CM1) (contd)	<i>Plantago maritima</i>	7	4
	<i>Triglochin maritimum</i>	7	5
	<i>Aster tripolium</i>	8	6
	<i>Halimione portulacoides</i>	8	6
	<i>Limonium humile</i>	8	5
	Average	7.5	5.5
Exposed Rocky Shores (LR1)	<i>Armeria maritima</i>	7	5
	<i>Aster tripolium</i>	8	6
	<i>Festuca rubra</i>	5	5
	+ Numerous algae	–	–
	Average	6.5	5.5
Open Marine Water (MW1)	No flora listed		

Appendix 9 Newbold Water Level Requirement Values

Examples of WDHs with water level requirements of plant species (from Newbold and Mountford, 1997).

Note: ‘-’ water table below ground level; ‘+’ above ground level (depth of water); NA, not available.

Habitat	Species	‘Dry’ (cm)	Preferred (cm)	‘Wet’ (cm)
Rich Fen (PF1)	<i>Schoenus nigricans</i>		-20 to 0	
	<i>Carex nigra</i>	-65	-15 to 0	0
	<i>Carex dioica</i>	-30	-20 to 0	+20
	<i>Juncus subnodulosus</i>	-40	-	+30
	<i>Molinia caerulea</i>	-100	-50 to -25	0
	<i>Ranunculus flammula</i>	-30	-5 to +5	+30(40)
	<i>Mentha aquatica</i>	-60	-10 to +10	+20
	<i>Succisa pratensis</i>	NA	NA	NA
	Average	-54	-20 to -1.5	16
Wet Pedunculate Oak–Ash Woodland (WN4)	<i>Quercus robur</i>	NA	NA	NA
	<i>Fraxinus excelsior</i>	NA	NA	NA
	<i>Corylus avellana</i>	NA	NA	NA
	<i>Filipendula ulmaria</i>	-60	-20 to 0	+5
	<i>Primula vulgaris</i>	NA	NA	NA
	<i>Circaea lutetiana</i>	NA	NA	NA
	<i>Hedera helix</i>	NA	NA	NA
	<i>Carex remota</i>	NA	NA	NA
	<i>Allium ursinum</i>	NA	NA	NA
	<i>Ilex aquifolium</i>	NA	NA	NA
	Average	-60	-20 to 0	+5
Depositing/Lowland Rivers (FW2)	<i>Nuphar lutea</i>	-10 to 0	+30 to +200	
	<i>Nymphaea alba</i>		+30 to +250	
	<i>Potamogeton</i> spp.	+10	+25 to +115	+175
	<i>Callitriche</i> spp.	-11	-	+55
	<i>Sparganium emersum</i>		+20	+100
	<i>Schoenoplectus lacustris</i>	-10		+150
	<i>Phragmites australis</i>	-100	-20 to 0	+50
	<i>Iris pseudacorus</i>	-60	-10 to +10	+60
Average	-30	+12.5 to +100	+98	
Lower Salt Marsh (CM1)	<i>Salicornia</i> spp.	NA	NA	NA
	<i>Suaeda maritima</i>	NA	NA	NA
	<i>Cochlearia danica</i>	NA	NA	NA
	<i>Spartina</i> spp.	NA	NA	NA
	<i>Puccinellia maritima</i>	NA	NA	NA
	<i>Armeria maritima</i>	NA	NA	NA
	<i>Plantago maritima</i>	NA	NA	NA

Habitat	Species	'Dry' (cm)	Preferred (cm)	'Wet' (cm)
Lower Salt Marsh (CM1) (contd)	<i>Triglochin maritimum</i>	NA	NA	NA
	<i>Aster tripolium</i>	NA	NA	NA
	<i>Halimione portulacoides</i>	NA	NA	NA
	<i>Limonium humile</i>	NA	NA	NA
Exposed Rocky Shores (LR1)	<i>Armeria maritima</i>	NA	NA	NA
	<i>Aster tripolium</i>	NA	NA	NA
	<i>Festuca rubra</i>	NA	NA	NA
	+ Numerous algae			
Open Marine Water (MW1)	No flora listed			

Appendix 10 Pollardstown Fen Example – Full Table

Habitat	Species	Ellenberg N value	Ellenberg F Value	Newbold 'Dry' (cm)	Newbold preferred (cm)	Newbold 'Wet' (cm)	Conservation value – Representativity	Hydrological sensitivity	Overall ranking
Calcareous fens with <i>Cladium mariscus</i> and species of the <i>Caricion davallianae</i> (7210)	<i>Cladium mariscus</i>	4	9	-10	0 to +5	30 (40)			
	Average	4	9	-10	0 to +5	30	A	1 (high)	A1
Petrifying springs with tufa formation (<i>Cratoneurion</i>) (7220)	<i>Pinguicula vulgaris</i>	2	8	-30	-10 to -2	0			
	<i>Saxifraga aizoides</i>	2	9	n/a	n/a	n/a			
	<i>Festuca rubra</i>	5	5	n/a	n/a	n/a			
	<i>Briza media</i>	3	5	n/a	n/a	n/a			
	<i>Carex dioica</i>	2	9	-30	-20 to 0	+20			
	<i>Carex flacca</i>	2	5		-5	0			
	<i>Equisetum palustre</i>	3	8	-30	-20 to +20	+30			
	Average	2.5	7	-30	-15 to +3	+12.5	A	1 (high)	A1
Alkaline fens (7230)	<i>Schoenus nigricans</i>	2	8		-20 to 0				
	<i>Eriophorum latifolium</i>	2	9	n/a	n/a	n/a			
	<i>Carex nigra</i>	2	8	-65	-15 to 0	0			
	<i>Carex dioica</i>	2	9	-30	-20 to 0	+20			
	<i>Carex panicea</i>	2	8	-65		+5			
	<i>Juncus subnodulosus</i>	4	9	-40	-	+30			
	<i>Molinia caerulea</i>	2	8	-100	-50 to -25	0			
	<i>Hydrocotyle vulgaris</i>	3	8	-20	-4 to +2	+4			
	<i>Ranunculus flammula</i>	3	9	-30	-5 to +5	+30 (40)			
	<i>Mentha aquatica</i>	5	8	-60	-10 to +10	+20			
	Average	2.5	8.5	-50	-20 to -1	13.5	A	1 (high)	A1