Monaghan Fen Survey 2007

Volume I: Main Report

Internal Report for the Monaghan County Council &
National Parks and Wildlife Service,
Department of the Environment, Heritage and Local Government, Ireland

An Action of the Monaghan Heritage Plan 2006-2010

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Report cover images:
Left: – Quaking transition mire with Many-headed Bog Cotton (*Eriophorum angustifolium*) at Crumlin Lough.
Top: – Transition mire with Cuckoo Flower (*Cardamine pratensis*) and Common Sorrel (*Rumex acetosa*) at Morgan's Lough.
Bottom: – Quaking transition mire dominated by Lesser tussock sedge (*Carex diandra*) at Killyneill Fen.

Start of Executive Summary – Fen Views: 1 – Transition mire with Cuckoo flowers (*Cardamine pratensis*) at Lisnalee; 2 – Lake edge fringing reed and marsh community at Mullaglassan Lough, with a wooded crannóg in the centre of the lake; 3 – Transition mire area in the foreground and the infilling mill pond lake at Aghamullen; 4 – Regenerating fen community on the cutover bog at Drumgallan; 5 – *Carex rostrata* quaking mire on the edge of a small lake (Lough Aportan) at Eshbrack; 6 – Quaking poor fen community rich in *Sphagnum* species and Bog Sedge (*Carex limosa)* in the inter drumlin hollow at Lisarilly Bog NHA; 7 – Lesser tussock sedge (*Carex diandra*) quaking fen on the shores of a small lake at Lough Smiley NHA; 8 – The Alder woodland and reed fringe around the shores of Killyvilly Lough NHA.

Start of Introduction to the Monaghan Fen Survey - Flora of Fens: 1 – Delicate feathered flower head of Bog Bean (*Menyanthes trifoliata*) on Cornaglare Lough; 2 – Water Mint (*Mentha aquatica*) and Water St Johns Worth (*Hypericum elodes*) on quaking transition mire on the shore of Cornaglare Lough; 3 – Cowbane (*Cicuta virosa)* and Water Horsetail (*Equisetum fluviatile*) a plant combination seen on many fen sites in Monaghan; 4 – Seed heads of the Hairy Willow (*Salix aurita*) at Crinkill Lough; 5 - Wild Angelica (*Angelica sylvestris*) in flower in the Kilroosky Lough Cluster; 6 – The Hairy Willow Herb (*Epilobium hirsutum*) at Dummy's Lough; 7 – The thick waxy flower of Yellow Water Lily (*Nuphar lutea*) at Crinkill Lough; 8 – Water pondweed (*Potamogeton polygonifolius*) in a ditch at Dunaree fen; 9 – Pink splendour of Ragged Robin (*Lychnis flos-cucli*) in the fen and adjacent wet grassland at Killycooly Lough.

Start of Introduction to Irish Fens - Fen Mosses: 1 – *Hylocomium splendens* one of the hummock forming species in open wooded, poor fen area at Killyneill fen; 2 – Rich lichen growth on the trunk of a Willow tree at Sheetrim; 3 – *Aulacomnium palustre* a species found on poor fens,

here at Eshbrack; 4 – *Sphagnum squarrosum* on poor fen at Killyneill; 5 – *Plagiomnium* species on the transition mire at Killyneill fen; 6 – *Calliergonella cuspidata* on quaking transition mire at Lisinisky fen; 7 – *Marchantia polymorpha*, a thaloid liverwort in transition mire on Lisinisky fen; 8 – *Drepanocladus revolvens* forming a purple carpet on the fen at Summerhill Lough; 9 – *Sphagnum recurvum* in an area of regenerating poor fen on cutover bog at Cornaglare Lough.

Start of Materials & Methods - Fen Wildlife: 1 – A flock of immature Mallard (*Anas platyrhynchos*) at Crinkill Lough; 2 – The Variable Damselfly (*Coenagrion pulchellum*), one of the many species found on Monaghan fens; 3 – The Common Frog (*Rana temporaria*) found on every site during the Monaghan Fen Survey; 4 – Fen flowers, such as Wild Angelica provide a rich source of food to many insect species including Wasps; 5 – The Smooth Newt (*Lissotriton vulgaris*) one of the vertebrates of fens here at Lough Smiley NHA; 6 – One of the top insect carnivores, the Four-Spotted Chaser dragonfly (*Libellula quadrimaculata*) at Annaghheane Lough; 7 – A Mayfly, one of the many insects seen on fens, here on Lisarilly Bog NHA; 8 – Water mint (*Mentha aquatica*) an important source of nectar to insects; 9 – Caterpillar larvae feeding on Meadowsweet (*Filipendula ulmaria*) leaves at Lough Smiley NHA.

Start of Results - Grasses of Fens: 1 – Bottle sedge (*Carex rostrata*), one of the commoner sedges found on fens in Monaghan; 2 – Star sedge (*Carex echinata*) found on the upland fens at Eshbrack; 3 – Reed Mace (*Typha latifolia*) found on the marginal areas of many fens and around small lakes at many sites; 4 – Lesser tussock sedge (*Carex diandra*) dominated fen at Killyneill. The midlands and north-east, including Monaghan are the headquarters for this fine leaved sedge; 5 – Bog Sedge (*Carex limosa)* a delicate sedge species found on poor fens among *Sphagnum* dominated moss carpets; 6 – Saw sedge (*Cladium mariscus*) forming large stand on lakeshores and in mineral rich alkaline fens; 7 - *Carex diandra* fen community with Cuckoo flower (*Cardamine pratensis*) one of the fen habitats for which Monaghan is a stronghold.

Start of Executive Conclusion - Value of Fens: 1 – When sensitively managed the recreational use of wetlands and their associated wildlife can both benefit (Drumsnat Lough); 2 – Fens can have a high scenic appeal, adding diversity to the countryside (Ramages Lough in the Kilroosky Lough Cluster); 3 – Flushed areas of wetland on Eshbrack have high scenic value and tourist appeal; 4 – Wetland protection and environmentally responsible farming can work well together to benefit both site interests (Mullaglassan Lough); 5 – The use of wetlands for fishing, with the development of appropriate visitor features, such as fishing stands, these generate income to local economies such as at the Kilroosky Bog Cluster; 6 – Lake and marginal reed beds at Drum Lough has benefited local community projects which promote the wildlife value of the area; 7 – Environmental information signs, like those at Cornaglare Lough can help raise awareness of the value and importance of wetlands and fens, though much more work needs be done in this area; 8 – Fen area on Crinkill Lough helps purify the water entering the lake, which is the local water supply for Doohamlet.

Fen Damage: 1 – Infill of fens with soil and building rubble occurred on half the sites surveyed during the Monaghan Fen Survey, here a section of the fen at Aghacloghan is being buried; 2 – Illegal dumping of household waste, here at Ardkirk, seriously degrades the environmental quality of many rural and endangers wildlife areas; 3 – Infill in the middle of fen at Coravilla-Rakeen leading to habitat fragmentation; 4 – An all too familiar road sign seen in Monaghan, here at Bocks Upper; 5 - Dumping on the road edge on Drumgallan Bog; 6 – Careless littering is a threat to wildlife, here at the Kilroosky Lough Cluster SAC; 7 – Hardcore infill causing damage to wetlands and habitat reduction at the edge of Sheetrim; 8 - Illegal dumping of garden and household waste, causing a significant threat to the fen habitats at Lough Smiley NHA.

Contents: Volume I - Main Report

Contents: Volume II - Site Survey Reports

Contents: Volume III - Site Survey Photographic Reports

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1. Executive Summary

1. To date no systematic national survey of fens has been undertaken in Ireland, in contrast to the situation for other habitat types including raised and blanket bogs, woodlands and turloughs.

2. The Monaghan Fen Survey 2007, the first in a series of County fen surveys, aims to address this information deficit, and proposed the following research objectives:

    - develop a methodology for the survey of fens at the county and national level
    - describe in detail a selection of known and possible fen sites recognised as being of conservation value in County Monaghan, and locate additional sites within the constraints of the project;
    - describe and classify the key habitats and in particular fen vegetation types present on each site according to the scheme proposed in National Parks and Wildlife Service National Fen Study 2007;
    - ascertain the extent of the fen type(s) present and the overall site extent;
    - define the water chemistry parameters and peat depth on each site and relate these to the fen habitats recorded;
    - collect baseline hydrochemistry data to aid in developing management requirements of the different fen types that occur in Ireland;
    - identify the main threats and damage present on the sites, and propose management options;
    - rank the conservation importance of sites on a international/national scale and from a local biodiversity perspective.
    - finally the methodologies developed and employed during the Monaghan Fen Survey were to be assessed, and recommendations made on how best to apply these to the on-going National Fen Survey of Ireland.

3. The Monaghan Fen Survey report includes results of a detailed survey of 42 sites in County Monaghan, containing a total of 69 discrete survey compartments with a total site area of 1,919 ha (see Appendix 1 & 3).

4. On sites where fen communities were observed, the sites were described in detail, and the fen types present were recorded (via the collection of vegetation descriptions (relevés) from quadrats within each sites), these relevés were subsequently classified, and hydrochemical analysis of water samples collected from relevés was undertaken. The habitats present were mapped and their extent calculated, threats and damage were noted, management recommendations made and sites were ranked in terms of their conservation value.

5. This survey information was collated, digitised and stored within the National Parks and Wildlife Service (NPWS) Fen Survey Database. Additionally a completed paper based site report was also produced and lodged with the NPWS Research Section and Monaghan County Council.

6. In addition to the 42 sites surveyed in detail, a further 14 sites were assessed for their fen interest (see Appendix 4), which was found to be lacking. Summary results are presented for these sites.

7. The main results to emerge from the sites surveyed in detail as part of the Monaghan Fen Survey (MFS) 2007 are as follows:

    - Of the 42 sites surveyed, only 25 were found to contain fen communities, the remainder contained a series of wetland habitats including marsh, reedbed and wet woodland;
    - On 11 sites the survey found that the fen habitats believed to be present, differed from those actually recorded;
    - Transition Mire 7140 (PF3) is the most frequently occurring fen habitat type in Monaghan, with a total fen habitat area of 77.2 ha;
    - The total area of fen recorded on sites during the MFS was 95.6 ha, considerably less than that predicted by earlier studies;

- Four main fen types were recognised in Monaghan, namely Poor fen PF2, Transition Mire 7140 PF3, Cladium fen 7210 PF1 and Alkaline fen 7230 PF1;
- Petrifying Spring 7220 FP1, which was believed to occur at one site in the County was not in fact recorded, and this habitat may not in fact occur within the County;
- Of the 42 sites surveyed, 3 sites were deemed to be of International Conservation Value; 16 of National Conservation Value and 8 of County Conservation Value; with a further 10 being of Local Biodiversity Value (High and Moderate local value);
- Future conservation of these sites will require appropriate designation, listing and planning control by the NPWS and Monaghan County Council;
- Five of the sites surveyed cross the international border with Northern Ireland. Discrepancies in conservation designations occur at each of these sites which may hinder the long term conservation of these areas. These issues should be addressed by National Parks and Wildlife Service (ROI) and the Environment and Heritage Service (NI);
- Three sites surveyed during the current MFS, which had an existing conservation designation prior to the survey, were found to have been seriously affected by drainage activities, resulting in habitat deterioration and loss of most if not all of their conservation value;
- The majority, if not all, of the fens surveyed during the MFS were found to have been negatively affected by some degree of damage or modification from their natural state. The most significant damage observed was from drainage of wetlands, water pollution and infilling associated with land reclamatation. These issues will need to be addressed if sites are not to suffer further degradation and subsequent loss of habitat and conservation value;
- Due to the abundance of wetland sites in County Monaghan it was not possible in the context of the MFS to survey all sites within the County. From an analysis of the distribution of wetland units within the county and the current habitats occurring there, it is likely that further fen areas still exist within the county that require survey.

8. 149 plant species (higher plants, mosses and liverworts) were recorded on sites during the Monaghan Fen Survey;

9. Classification of vegetation relevés showed five main vegetation types were recorded and will provide further understanding of the vegetation of the different fen types that occur in Ireland. The data collected should prove useful for future studies into the phytosociology of fens in Ireland.

10. Hydrochemical analysis of water samples confirmed a clear gradient from base-poor acid conditions prevalent at Poor fen sites to intermediate neutral conditions of Transition mires to base rich alkaline conditions prevalent at the Alkaline Fen and *Cladium* Fen sites. The hydrochemistry data collected provides good baseline data for these fen habitat types.

11. Although the main plant nutrients Phosphorus and Nitrogen were analysed, the concentration of these nutrients was not found to be directly related to differences in vegetation types.

12. To ensure the long term protection of conservation worthy sites identified by the MFS, with an International, National or County Conservation Value, these sites must be listed in the County Development Plan and in Local Area Plans where appropriate.

13. On sites that are earmarked for conservation, strict planning controls must be enforced by the County Council.

14. As many of the sites identified, both those with an existing conservation designation and those being proposed for conservation, are in private ownership, their conservation will depend on voluntary co-operation with landowners and various stakeholders. The County Council should foster a wider understanding among these parties.

15. To foster a more positive attitude to the conservation value of wetlands and fen areas in particular, a greater public information programme might be considered by the County

Council which should include interpretation at the most important and accessible sites identified.

16. A methodology for the detailed survey of fen sites has been developed and trialled on during the MFS. This survey scheme allows the creation of a full digital record of the sites surveyed to include site and final site habitat maps, photographic site record, and a digital description and account of the site and habitat particulars, together with phytosociological and hydrochemical data on the fen communities present.

17. Survey limitations encountered during the current survey that should be addressed prior to further surveys being carried out included
    - difficulties accessing old non-digitised records of previous ecological surveys of the county. Information sources should be collated and digitised where possible within NPWS and other possible sources
    - due to resource constraints it was not possible to carry out an extensive remote sensing exercise to identify all possible fen habitat within the county

18. Recommendations for the on-going National Fen Survey. These include:

    - more detailed GIS examination of air photography to shortlist possible fen sites should be undertaken, possibly at national level
    - greater efforts made to contact local specialists and stakeholders seeking site information
    - the development of a Phase I Fen Survey system to identify fen sites and exclude those site with other related wetland habitats including marsh; wet woodland; and reed bed communities, prior to full fen survey
    - preparation of methods manuals should be undertaken so that future surveys can follow a standard methodology, we propose both a:
        - Phase I survey manual to follow when carrying out the initial county wetland survey to identify potential fen sites within a county
        - Phase II manual for the detailed survey of fen sites as outlined in detail in this report
    - training programme for surveyors in particular to assist with habitat identification
    - each survey team should comprise at least two individuals
    - consideration be given to an invertebrate survey of a selection of fen sites to give greater understanding of the species diversity of fens in Ireland, as has been done in parts of Northern Ireland
    - habitat action plan for each fen type should be drawn up

2. Introduction to the Monaghan Fen Survey 2007

2.1 Background

The present survey of fens in county Monaghan was commissioned by Monaghan County Council and the National Parks and Wildlife Service (NPWS) of the Department of Department of the Environment, Heritage and Local Government. The survey is an Action of the Monaghan Heritage Plan 2006-2010.

There were two principal reasons for undertaking the survey in 2007, namely to devise a fen survey methodology which could be applied to a National Fen Survey of the entire country, to be undertaken by the NPWS, and the second was to obtain data on existing and newly proposed fen sites reported in 2006 in County Monaghan to the NPWS Fen Study Project (Foss 2007).

2.2 The National Fen Survey

To date no detailed field survey focusing exclusively on fens to identify those of conservation value has been undertaken in Ireland. Any information on fens of conservation value that has been recorded in other surveys has often been coincidental.

This lack of a national field based fen survey and the difficulties caused by the lack of accurate data on sites has been highlighted in the most recent NPWS Fen Study Project (Foss 2007), Irish Peatland Conservation Council (IPCC) Bogs & Fens of Ireland Conservation Plan (Foss, O'Connell & Crushell 2001), Crushell (2000, 2002), Doyle & O Críodáin (2003), and Dwyer (2000) inter alia.

This lack of a national fen survey is in contrast to extensive NPWS surveys which have been conducted on the two other peatland types in Ireland, namely raised bogs and blanket bogs (Cross 1990; Douglas et al. 1984, 1985, 1986, 1987, 1989a, 1989b, 1989c, 1990; Foss & McGee 1987; Mooney 1991; O'Connell & Mooney 1983; inter alia).

The absence of a national fen survey has presented difficulties in the past in ensuring that a representative sample of the most important fen sites are given adequate conservation designation and protection within the Natural Heritage Area (NHA) and Natura 2000 Special Areas of Conservation (SAC) networks (Dwyer 2000; Crushell 2002; Foss et al. 2001).

Furthermore, variability and reliability of known fen data, in terms of recency and quality of data varies considerably among sites, making it difficult to compare sites across the country when trying to compile an inventory of the most important fens of a particular type and those that should be prioritised for conservation.

As Ireland has an obligation to report and provide updates on its conservation actions on sites within the Natura 2000 network, this survey of fens in Monaghan and future fen surveys aim to provide information to the Natura 2000 reporting process for the four Annex 1 fen habitats occurring in Ireland.

The present survey is the first stage in the implementation of a national fen survey which is to be undertaken by the NPWS over the coming years. It is envisaged that the methodology developed during the survey of fen sites in County Monaghan will be applied to the national survey of sites proposed by the NPWS.

2.3 The Monaghan Fen Survey

The Monaghan Fen Survey 2007 addressed the following research objectives:

- to describe the vegetation of each sites with particular emphasis on the fen communities that are present;
- identify and classify the key fen habitat and vegetation types present on each site according to the scheme proposed in Foss (2007) (see Appendix 13);
- ascertain the extent of the fen type(s) present and the overall site extent;
- investigate the water chemistry parameters of each site and relate it to the fen communities that occur;
- measure peat depth associated with the fen types recorded;
- identify the main threats and damage present on the sites, and propose management options;
- to estimate the extent of fen habitat throughout the county and assess the conservation significance of the resource;
- rank the conservation importance of sites on an international/national scale (NHA and SAC) and from a local biodiversity perspective.

3. Introduction to Irish Fens

3.1 What are wetlands and why are they important?

The Ramsar Convention on Wetlands of International Importance (to which Ireland is a signatory) defined wetlands in the broadest sense, of which fens are a particular type, as "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."

Wetlands have many important roles including water supply, flood storage, pollution control, groundwater recharge, habitats for a wide range of plants and animals, a major resource for fisheries, water sports and recreation, cultural and tourism value and aesthetic areas of great beauty. These benefits, often referred to as wetland functions and values, usually play a vital (and sometimes under-valued) role in recreation, tourism, and the economy.

Ireland is particularly rich in wetlands, due to a combination of climate, geology, local topography and soil types. Of the mean annual rainfall of 1,150 mm per year, only approximately 38% is lost to evaporation and transpiration. The remaining 62% of rainfall constitutes the annual average surface run-off supplying streams, rivers, lakes, wetlands and ground water fed aquifers in Ireland (Reynolds 1996).

County Monaghan has an average annual rainfall of between 800 and 1,199 mm, and this when taken together with the drumlin topography over much of the county, soil type and geology dictate that many small areas of water collection occur throughout the county. The wetlands that develop in these areas are often small by nature and for this reason many have been overlooked as valuable conservation areas in the past.

3.2 What is a Fen?

A fen is a wetland system with a permanently high water level at or just below its surface, that receives nutrients via direct contact with mineral enriched surface or groundwater. The vegetation is usually rich in or dominated by sedges (grass-like plants) and mosses. Organic matter is often accumulated as an alkaline or slightly acidic peat. Due to this peat – forming characteristic, fens are regarded as a distinct peatland type.

The source of water is what distinguishes fens from bogs, in fens the source of water is mineral enriched surface or groundwater whereas in the case of bogs the source of water is exclusively from the atmosphere in the form of rainwater. Features which distinguish fens from other peatland types in Ireland are presented in Table 3.1.

Table 3.1. Features which distinguish fens from other peatland types in Ireland

	Raised Bog	**Blanket Bog**	**Fen**
Formed	Lake Basin	Sloping ground / mountain	Lake Basin / sloping ground
Peat Depth	Up to 16m	Up to 6m	3 m
Precipitation (/yr)	>800mm	>1200mm	800-900mm
pH	<4	<4.5	>4.5
Source of nutrients	Atmosphere / rain	Atmosphere / rain	Ground-water / surface-water
Vegetation	Heather, *Sphagnum* moss	Purple Moore-grass, Heather, *Sphagnum* moss, Sedges	Reeds, Sedges and Brown mosses
Distribution Ireland	Midlands	West and Uplands	Scarce but widespread distribution

Two broad categories of fen types are recognised, poor fen and rich fen. A "poor" fen has very low concentrations of plant nutrients and floristically has similarities to a bog. A "rich" fen has relatively high concentrations of mineral nutrients, but is still characterised by the accumulation of peat (though this is likely to be primarily from the remains of plants other than *Sphagnum* mosses, most notably sedges and brown mosses).

Fens, are usually peat-forming wetlands that receive mineral nutrients (magnesium, iron and in particular calcium) from sources other than precipitation: usually from upslope sources through drainage from surrounding mineral soils and from groundwater movement, and are not generally so acidic as bogs. In general they are poor in nitrogen and phosphorus, the latter of which tends to be the limiting nutrient in fen systems. Studies of wetlands in western Europe frequently show that nutrient enrichment (with nitrogen and phosphorus) leads to changes in species composition, decline in overall plant species diversity, and loss of rare and uncommon species (Doyle & O Críodáin 2003, Sheehy Skeffington & O'Connell 1998).

Some contain a rich selection of higher plants; up to and occasionally more than half Ireland's species of dragonflies, several thousand other insect species, as well as being an important habitat for a range of invertebrates and birds.

Fens, like wetlands in general, provide important benefits in a watershed, including preventing or reducing the risk of floods, improving water quality, and providing habitats for unique plant and animal communities.

Fens often occur in mosaics with other wetland communities such as reed beds, bogs or open water in which case they may be of relatively limited extent. Although fens can be found as discrete habitats in their own right, they may also occur in association with (or within) a range of other habitats including blanket bog, raised bog, turlough, dune slack, machair, wet heathland, wet grassland, woodland, karst areas, lacustrine and riverine habitats and systems.

Due to their occurrence in such a wide range of habitats, and the dependence of fens on a continuous supply of water, natural or anthropogenic influences can greatly affect the maintenance, creation or loss of these dynamic wetland habitats.

Typically fens are an early successional stage in the natural formation of raised and in some cases blanket bogs, or occurred at the edges of such acid peatlands. As these acid peatland systems expanded, through the accumulation of peat and their spread across the landscape, marginal fens often experienced a natural decline in area (Rieley & Page 1990).

The abundance of fens on former acid bog areas may, however, also increase through the influence of man. On raised bogs, which have been extensively mined or cut away for fuel, and the surface layer of the "bog" has been reduced so that it is at or below the surrounding ground water level, conditions will be created that favour the development of secondary fens. In such cases, once peat extraction ceases, the vegetation that naturally regenerates will be a fen, rather than bog communities, influenced by ground water inputs. Secondary fens of this type are common in County Monaghan where there is a history of extensive peat extraction (Moloney 2006).

More recently, like most peatland types in Ireland, fens have also experienced a decline in area, mostly from human activities such as peat mining, draining for cropland, fuel extraction, and fertiliser pollution and eutrophication. Because of the large historical loss of this ecosystem type, the remaining fens are that much rarer, and it is crucial to protect a representative selection of the best examples of each (Foss et al. 2001, Crushell 2000).

Fens are important wetland systems, whose conservation value has been recognised by the EU Habitats Directive as Special Areas of Conservation (SACs); as Wetlands of International Importance under the Ramsar Convention; and as Special Protection Areas (SPAs) under the EU Birds Directive.

3.3 Fen types and their classification

Irish Fens have been classified using a number of different schemes based on a variety of key ecological factors including the peat type on which they occur, features and composition of their surface vegetation, hydrological conditions and their topographic location (Foss 2007).

A number of the most popular fen classification schemes used are reproduced in Appendix 13 (after Foss 2007), to demonstrate how the classification systems differ and relate to one another, and introduce the reader to the features and terms used in relation to the classification and description of Irish fens.

In summary, within the context of the Monaghan, and by extension the National Fen Survey, 6 fen categories are recognised, namely: Transition mires and quaking bogs; Alkaline fens; Calcareous fens with *Cladium mariscus;* Poor Fens; Petrifying springs with tufa formation and Non-Calcareous springs.

Table 3.1 lists the 6 main fen types recognised in Ireland and details in brief how these fen types relate to the other fen classification schemes (i.e. Phytosociological classification, EU Habitats Directive fen types; Fossitt classification scheme etc.). The table also lists key species which occur within each fen type and the main habitat areas in which they occur.

The classification scheme is based primarily on the floristics of vegetation types that correspond to these fen types, as well as certain key habitat features associated with these fen categories. These fen types are then defined in more detail below.

This classification scheme also takes account of Irelands obligations under the EU Habitats Directive to protect key sites which have been identified for the Annex 1 habitats: 7140 Transition mires and quaking bogs; 7210 * Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae;* 7220 * Petrifying springs with tufa formation (*Cratoneurion*); 7230 Alkaline fens. Two of these habitats, marked by an *, are priority habitats for conservation.

The classification scheme is based on previous classification schemes including those proposed by Ó Críodáin & Doyle 1994, Doyle & Ó Críodáin 2003, Ó Críodáin 1988, Rieley & Page 1990, Foss 2007, Fojt 1993, Fossitt 2000, Sheehy-Skeffington & O'Connell 1998 and White & Doyle 1982. This classification scheme for Irish fens is based on available data collected by these researchers, which in the absence of a national fen survey to date, may be somewhat incomplete and not have identified all the fen community types likely to occur throughout the country.

One of the aims of the Monaghan Fen Survey, was therefore to test this classification scheme during the survey period, and see if the scheme was applicable in the field and whether any other fen community types not previously identified could be defined.

Table 3.1 Main fen types recognised in Ireland as part of the National Fen Survey, and their relationship to other classification schemes, phytosociological classification, together with details of key species and habitat features.

NPWS Fen Survey Habitats Classification Scheme	**EU Habitats Directive Habitat;** CORINE Habitat; **Fossitt Habitat Scheme**	**Phytosociological Classification**	**Key Species**	**Habitat Examples**	**Site Examples**
Transition Mire	**7140 Transition mires and quaking bogs;** 545 Transition mires; **PF3 Transition mire and quaking bog**	Scheuchzerietalia palustris to Caricetalia nigrae to Caricetalia davallianae	*Carex limosa, C. diandra, C. lasiocarpa, C. viridula, Eriophorum angustifolium, E. gracile, Agrostis stolonifera, Molinia caerulea, Menyanthes trifoliata, Potentilla palustris, Pedicularis palustris, Sphagnum spp., Calliergon spp., Scorpidium spp.*	Quaking areas on blanket and raised bogs; bog laggs; secondary fen areas of cutover and cutaway bogs	Scragh Bog, Westmeath; Holdenstown Bog, Wicklow; Glenamoy bog complex, Mayo
Alkaline fen	**7230 Alkaline fens;** 542 Rich Fens Caricion davallianae & 5421 Black bog rush fens & 5422 Fens not Schoenus dominated; **PF1 Rich fens and flushes**	Caricetalia davallianae	*Schoenus nigricans, Homalothecium nitens, Carex viridula, C. nigra, C. dioica, C. panicea, Juncus subnodulosus, Molinia caerulea, Hydrocotyle vulgaris, Ranunculus flammula, Mentha aquatica, Galium palustre, Parnassia palustris, Pinguicula vulgaris*	Topogenous fens in valleys or depressions ; within transition mire and tall reed beds; calcium rich flush areas in blanket bogs; dune slack areas; wet hollows in machair	Pollardstown fen, Kildare
Cladium Fen	**7210 *Calcareous fens with Cladium mariscus and species of the Caricion davallianae;** 533 Fen Sedge Beds; 5331 Fen Cladium Beds; **PF1 Rich fen and flush**	Magnocaricion - Cladietum marisci to Caricetalia davallianae	*Cladium mariscus* and species of Alkaline fens (see above)	Fen beds of the emergent plant zones of lakes; Cladium stands in blanket bog flushes and fens	Pollardstown Fen, Kildare; East Burren complex, Clare

Table 3.1 (cont.) Main fen types recognised in Ireland as part of the National Fen Survey, and relationship to other classification schemes, phytosociological classification, together with details of key species and habitat features.

NPWS Fen Survey Habitats Classification Scheme	**EU Habitats Directive Habitat;** CORINE Habitat; **Fossitt Habitat Scheme**	**Phytosociological Classification**	**Key Species**	**Habitat Examples**	**Site Examples**
Poor Fen	**Habitats Directive – NA;** 544 Acidic fens; **PF2 Poor fen and flush**	Caricetalia nigrae	*Hammarbya paludosa, Juncus effusus, Carex rostrata, C. nigra, C. curta, Sphagnum recurvum, S. teres, Calliergon stramineum*	Poor fen flushes in blanket bog; soligenous depressions among grassland, cutover bogs and heath	Carrigower Bog, Wicklow; Liffey Head flush, Wicklow
Petrifying Spring with Tufa	**7220 * Petrifying springs with tufa formation (Cratoneurion);** 5412 Hard Water Springs Cratoneurion; **FP1 Calcareous Springs**	Cratoneurion	*Saxifraga aizoides, Carex dioica, C. pulicaris, C. flacca, C. nigra, Pinguicula vulgaris, Equisetum palustre*	Calcium rich spring areas in fens, woodland, sea cliffs, esker ridges, limestone areas, blanket bogs	Pollardstown fen, Kildare; Knocksink Wood, Wicklow; Bellacorick Iron Flush
Non-Calcareous Spring	**Habitats Directive – NA;** 541 Springs Montio-Cardaminetea & 5411 Soft Water springs Montio-Cardaminetea; **FP2 Non-Calcareous Springs**	Montio-Cardaminetea	*Saxifraga hirculus, Sphagnum auriculatum, Calliergon sarmentosum, Polytrichum commune, Juncus bulbosus, Viola palustris, Ranunculus flammula, Hydrocotyle vulgaris*	Cold springs, commonly dominated by bryophytes within blanket bog complexes, clay and rock cliffs poor in lime	Glenamoy Bog Complex, Mayo

Transition mires and quaking bogs

(Habitats Directive – 7140; Fossitt - PF3)

Scheuchzerietalia palustris to Caricetalia nigrae to Caricetalia davallianae communities
Heterogenous fen type, characterised by a scraw of floating or quaking mire vegetation, with medium sized or small sedge communities with *Sphagnum* or brown mosses. Vegetation is rooted in a layer of light, fen peat which as the water level rises and falls, floats on the surface, preventing submergence of the above ground parts of the vegetation.
Water pH range: 5.0-7.5

Fen vegetation corresponding to this fen category can be found in or association with:

- Floating carpets or quaking mires in larger blanket bog systems
- Floating carpets or quaking mires in raised bog systems
- Secondary fen areas on cutover and cutaway bogs
- Minerotrophic quaking fens outside of larger mire complexes
- Small fens in the transition zone between water (lakes, ponds) and mineral soil

Examples of this fen type:

- Lough Roe, Clara Bog, Offaly
- Scragh Bog, Westmeath
- Holdenstown Bog, Wicklow
- Killyneill Fen, Monaghan
- Fenor Bog, Waterford
- Meenaguse Scragh, Donegal

Alkaline fens

(Habitats Directive – 7230; Fossitt - PF1)

Caricetalia davallianae communities
Small sedges communities and brown mosses, with or without *Schoenus nigricans*, and possible patchy cover of *Phragmites australis*, *Cladium mariscus*, *Typha* spp. or *Carex paniculata*. Vegetation of mineral-rich fens and base-rich fens on calcareous, alkaline peats. Not forming a floating or quaking mire community.
Water pH range: 4.6-8.5

Fen vegetation corresponding to this fen category can be found in or association with:

- Fens outside of larger mire complexes
- With spring communities developing in depressions
- Within tall sedge and reedbed communities
- In association with Cladium fen sedge beds
- Small areas in dune slack systems
- In association transition mires
- In wet grasslands
- On tufa cones
- Within machair
- Within turloughs

Examples of this fen type:

- Pollardstown Fen, Kildare
- Buckroney-Brittas Dunes & Fen, Wicklow
- Scragh Bog, Westmeath
- Bunduff Lough & Machair, Sligo
- Askeaton Fen Complex, Limerick
- Bellacorick Bog Complex, Mayo
- East Burren Complex, Clare

Calcareous fens with *Cladium mariscus*

(Habitats Directive – *7210; Fossitt - PF1)

Magnocaricion - Cladietum marisci to Caricetalia davallianae communities
Variety of fen types in which *Cladium mariscus* occurs in association with species rich alkaline to poor fen communities, but where *Cladium* is not mono-dominant in character.
Water pH range: 4.6-8.5

Fen vegetation corresponding to this fen category can be found in or association with:

- *Cladium mariscus* beds of the emergent-plant zones of lakes
- Cladium stands in blanket bog flushes
- Cladium stands on regenerating cutaway bog
- Contact areas within calcareous fens (7230)
- Contact areas within acid fens
- Contact areas with reed beds and tall sedge communities
- Extensive wet meadows

Examples of this fen type:

- Pollardstown Fen, Kildare
- East Burren Complex, Clare
- Lough Lurgeen, Galway
- Connemara Bog Complex, Galway
- Askeaton Fen Complex, Limerick

Poor Fens

(Fossitt - PF2)

Caricetalia nigrae to Scheuchzerietalia palustris communities
Medium to small sedge communities with *Sphagnum* present and occasional brown mosses, and possible patchy cover of *Phragmites australis*. Vegetation of swamps, rheotrophic mires, some acid grasslands and drainage channels. Not forming a floating or quaking scraw mire community, usually on firmer peat or *Sphagnum* peat substrate.
Water pH range: 3.1-7.5

Fen vegetation corresponding to this fen category can be found in or association with:

- Poor fen flushes in blanket and raised bog systems
- Soligenous mires on peat or peaty mineral soils in blanket bog
- Soligenous depressions among grassland
- Flushes in wet heath
- Regenerating communities on cutover bog

Examples of this fen type:

- Bellacorrick Bog Complex, Mayo
- Boleybrack Mountain, Leitrim
- Cloghernagore Bog and Glenveagh National Park, Donegal
- Connemara Bog Complex, Galway
- Ox Mountain Bogs, Sligo
- Wicklow Mountains National Park, Wicklow

Petrifying springs with tufa formation

(Habitats Directive – * 7220; Fossitt - FP1)

Cratoneurion communities

Spring head or seepage areas, fed by meso- to eutrophic water rich in lime, usually dominated by bryophytes in which small vascular plants root. On contact with the atmosphere the lime rich water in the spring often deposits a hard deposit of calcium carbonate known as "tufa".

Fen vegetation corresponding to this fen category can be found in or association with:

- Forest environments
- Open countryside
- Heathlands
- Contact areas within calcareous fens (7230)
- Calcareous / Machair grasslands
- At base of esker ridges
- Karst / Limestone areas
- Seepage lines on lime rich inland and sea cliffs

Examples of this fen type:

- Pollardstown Fen, Kildare
- Knocksink Wood, Wicklow
- Benbulbin plateau, Lafargy Bog, Sligo
- Errisbeg, Galway
- Ballyman Glen, Wicklow

Non-Calcareous springs

(Fossitt - FP2)

Montio - Cardaminetea communities

Spring head or seepage areas, fed by oligo- to mesotrophic water, poor in lime, usually dominated by bryophytes in which small vascular plants root.

Fen vegetation corresponding to this fen category can be found in or association with:

- Vegetation of cold springs, commonly dominated by bryophytes
- Warm water springs
- Springs in blanket bog
- Seepage lines on cliffs and base of clay cliffs poor in lime

Examples of this fen type:

- Bellacorick, Mayo

Further information on fen types recognised in Ireland and the different classification systems that have been used to define fens can be found in Appendix 13.

3.4 Monaghan fens in a National Context

Historical evidence from the Plantation period indicates that peatlands or bogs, and by extension fens, which are often associated with the margins of acid bog systems, were common in County Monaghan (Moloney 2006). On maps from this period, the surveyors of the 17th Century indicated many extensive stretches of bog occurred in Monaghan which were marked with the name "bog" or "bog common" on maps, though no reliable county estimates for the area of bog are available. In addition some areas at the margins of bogs were marked as "moss and rushy pasture" , areas which were used as summer grazing when the ground was drier (Moloney 2006). These areas are likely to have contained fen communities in some cases.

As Moloney reports during the 17th Century there was an extensive cover of bog in County Monaghan and a relatively sparse population, so inhabitants were well supplied with fuel, the main use to which bogs were put. In addition rent was only charged on "profitable land" which bog was not considered to be.

This situation did not change significantly until the late 18th century when there was a major re-letting of estate lands and landowners re-assessed the income that could be generated from their estates. One of the changes that occurred at this time was that the extraction of peat was associated with the generation of income or at least a turf duty whereby tenants had to supply a quantity of free fuel to landlords or their agents.

In the early 19th Century, the population of Monaghan increased significantly and pressure on dwindling bogs allowed landlords to introduce a series of schemes to charge tenants a rent for bogs (Moloney 2006). By the 1840's with the population at its peak, income from bog rents played a significant part in some estate budgets.

The removal of peat by this growing population resulted in many worked out bogs, which when abandoned became ideal locations for the formation of secondary fen habitats.

It is not until recently, that the first major report was produced which included accurate figures for the extent of bogs and fens in the County. This was the 1979 Hammond report entitled the "Peatlands of Ireland" (which was accompanied the Peatland Map of Ireland).

Although the "Bog Commission" established by Government in 1809 might be expected to be the first source of data on bogs in County Monaghan, because upland bogs were excluded and only large extensive bog areas were surveyed, the bogs of Monaghan were not examined, and no report was ever produced for the county by this Commission.

The Hammond report and survey, which incorporated a range of data sources, published and unpublished, to compile information on the extent of fen peat soils in Ireland (National Soil Survey programme of An Foras Taluntais operated from 1968; Aerial Photograph series 1973/74 undertaken by the Geological Survey of Ireland; 1920 Geological Survey Peat Map; inter alia) represents the first major project to quantify the area of the different peat types, including fens, in Ireland on a county by county basis.

A major drawback of the Hammond study is that he defined and recorded only a man-modified fen category in his survey. In his word "Undisturbed fens are rare and can only be found in a few counties in Ireland. Owing to their small size their representation on the map is not possible, even their continued existence as natural entities is under threat from agriculture and urban pressures".

It would also appear from this report that only fens with a deep peat layer (greater than 30 cm) were included. Therefore the report of Hammond relates to only the most extensive fen areas generally found in association with larger raised bog areas.

It is therefore likely that the total area of fen in Ireland recognised in Hammond, some 92,510 ha, is an under representation of the total extent of fens in Ireland at that time (Foss 2007).

This argument is further supported by the fact, that this first national assessment of fens listed no fen in County Monaghan, a situation which was subsequently found to be inaccurate by later studies.

The first group to attempt to compile a list of intact fens of conservation value in Ireland, as part of a larger examination of heritage sites was An Foras Forbartha (AFF) (Anonymous 1981).

Their survey commenced in 1968 when they started compilation of a National Heritage Inventory which included both man-made and natural structures, and finished in 1974. Initially the information collected was published in a series of reports on Areas of Scientific Interest (ASIs) in each county. This data was subsequently collated in a Areas of Scientific Interest in Ireland report in 1981, which AFF hoped would act as a baseline for further studies.

Their report lists a total of 99 fen sites nationally with a total area of 24,472 ha in Ireland. This report lists a total of 5 fen sites with an area of 96 ha in County Monaghan. The first time the habitat with a specific area was scientifically recognised as occurring in the county.

The work of the Irish Peatland Conservation Council (formerly the National Peatland Conservation Committee) since 1982 has been instrumental in expanding and refining our knowledge of the list of fens of conservation value in Ireland. This non-governmental group has published a series of peatland action and conservation plans since the early 1980's which have consistently listed all known and recently discovered intact fen sites of conservation value in Ireland (Anonymous 1986; Anonymous 1989; Anonymous 1992; Foss & O'Connell 1996; Foss, O'Connell and Crushell 2001). These lists of sites were compiled from published information sources (e.g. An Foras Forbartha ASI report; NPWS NHA site lists; private sources and their own site surveys).

In addition in 1999 the IPCC undertook an Irish Fen Inventory study (Crushell 2000), in the absence of any Government based national fen survey. The IPCC called on assistance of fen experts and contacts nationally to provide data on existing and as yet undesignated sites that might nevertheless have a conservation value.

In 2001 the IPCC's analysis (Foss, O'Connell and Crushell 2001) showed that the area of fen nationally amounted to 19,660 ha in a total of 367 sites. This group listed a total of 13 fen sites with an area of 214 ha in County Monaghan.

The results of the study also fed into the EU Habitats Directive Natura 2000 process undertaken jointly by the non-governmental organisations (Crushell 2002; Dwyer 2000) in Ireland to ensure that where key habitats were underrepresented in the national list a greater number of (fen) sites would be considered for designated as Special Areas of Conservation (SAC).

As part of the SAC designation process an internal NPWS report prepared by Ó Críodáin in 1995 estimated the national extent of fens in Ireland of some 20,500 ha, close to the IPCC's area figure. In 2003 Doyle & Ó Críodáin provided additional data from NPWS which indicated the number of sites proposed as candidate SAC's for fen habitats and the area of fen protected within these sites which amounted to 3,620 ha in total within 35 sites.

The most recent information available within NPWS (based on information published on the official NPWS web site in 2007) indicates that the number of sites proposed for designation as SAC under one of the four Annex 1 fen habitat types has increased from the 2003 figure of 35 sites to a 2006 figure of 92 sites.

Just one of these SAC sites the Kilroosky Lough Cluster (1786) occurs in County Monaghan.

Outside of this information on SAC's, the NPWS Natural Heritage Area (NHA) database, created to hold data on these sites, indicated that in 2006, 478 sites nationally were classified as containing Fens & Flushes vegetation. There is no indication how many occurred in County Monaghan.

The most recent evaluation of data held by NPWS on fens, was undertaken in 2006 as part of the NPWS Fen Study (Foss 2007). This report collated all information on known and possible fen sites nationally, the particular fen type present and the area of each on any given site. The study found that nationally there was an estimated 22,180 ha of fen in 681 discrete sites.

The NPWS Fen Study report indicated that there were 190 ha of fen in 30 sites in County Monaghan. The area figure of 190 ha was believed to be a minimum area for fen in the County. Five fen types were recognised as occurring in Monaghan including Cladium fen (PF1), Alkaline fen (PF1), Poor fen (PF2), Transition mire (PF3) and Tufa springs (FP1). Transition mire was by far the most abundant fen type with 126 ha of this habitat recorded on 14 sites.

3.5 Where might fens occur today in County Monaghan?

Three main sources of data exist which provide information on where fens might occur in County Monaghan, which would be of value in undertaking a county survey of this habitat type.

The first, referred above is the NPWS Fen Study (Foss 2007) which provided relatively reliable information on the location of some 30 fen sites (or potential sites) with an area of 190 ha in the county.

In addition, with more than 253 areas of open water in the county (listed as areas of open water on the OS Discovery map series) with an area of 2,004 ha, and a further 2,267 cutover raised bog areas defined in the GIS quaternary deposits map of the County (Meehan 2004), covering some 12,247 ha, County Monaghan has a rich wetland resource (Foss 2007). Many of these wetland or in particular the cutover bog areas which have not been drained, are potential locations for the occurrence of fens.

A further source of information on the location of fen sites within the County is that held by heritage, botanical and ecological experts who have first hand experience of these habitats within the county.

The Monaghan Fen Survey aimed to access these three information sources to obtain a more detailed understanding of the location of fen sites within County Monaghan and assess their ecological value.

4. Materials and Methods

4.1 Introduction

The Monaghan Fen Survey was undertaken over the period from the 1st May 2007 to the 30th October 2007.

Background research on sites, data collection and survey preparations (maps; survey folders etc.) was undertaken from the 1st May to 21st May 2007 in the National Parks and Wildlife Service Research Headquarters, Dublin and in the offices of Monaghan County Council.

The survey of sites in Monaghan was undertaken from 22nd May to 17th June 2007. From 18th June to 30th July survey results including relevé data, water chemistry data, site descriptions, surveys notes, site evaluations and final survey maps with habitat areas mapped were collated and digitised in the National Parks and Wildlife Service Research Headquarters, Dublin. Data analysis was undertaken during late July and August. The report of the survey was prepared in September and submitted in final format in October 2007.

4.2 Identification of Sites

A number of existing data sources were used to compile the lists of sites, and gather relevant information on these, during the 2007 Monaghan Fen Survey. These data sources are listed below.

4.2.1 Sites recorded in the NPWS Fen Study Database 2007

At the outset of the project the National Parks and Wildlife Service (NPWS) Fen Study database (Foss 2007) contained a list of 30 sites (see Appendix 3) with known or possible fen interest in County Monaghan. This list was compiled during 2006, as part of a data collation exercise undertaken by NPWS to consolidate all known information on fens in Ireland. Some of these 30 sites were relatively large and contained a number of discrete lakes or areas where fen habitats might be likely to occur, bringing the actual number of survey compartments up to 51.

4.2.2 Additional Sites Reported by Experts

Following discussions with the Monaghan County Council Heritage Officer at the start of the project in May 2007 a further 2 sites were proposed for survey (Site codes MFS02, MFS03).

A list of fen sites of possible conservation value was also submitted by Dr Alan Hill, Botanical Society of Britain and Ireland (BSBI) Vice County recorder for Monaghan. The list contained 39 sites (see Appendix 5). Of these sites 6 were surveyed in detail (two of these sites being new additions to the Monaghan Fen Survey site list), and a further 5 were assessed for their fen interest during a brief site visit. The remaining sites on the list were not surveyed and may merit survey as part of any future survey of sites in County Monaghan.

4.2.3 Sites Identified from Air Photography

During the preparation of maps and air photographs to be used on Monaghan Fen Survey 2007, and during the actual survey of sites in Monaghan, a number of additional sites were recognised that were considered worthy of detailed examination for their fen interest.

A further four sites (site Codes MFS01, MFS04, MFS05, MFS06) were found to have a fen interest and surveyed in detail as part of the Monaghan Fen Survey.

In addition 14 further sites were assessed for their fen interest during a brief site visit (see Appendix 4), but did not have any significant fen areas present.

4.2.4 NPWS River Finn & Blackwater Drainage Report

During the early 1980's the NPWS undertook a detailed survey of lakes and wetlands in County Monaghan to assess the likely impacts of drainage works proposed for the River Finn and River Blackwater catchments by the then Office of Public Works (Douglas & Ryan 1981; Douglas *et al* 1983).

During the compilation of the list of sites to be surveyed in the Monaghan Fen Survey 2007 the site lists from the Finn and Blackwater catchment surveys were examined to determine whether additional sites might be included in the present survey. By cross referencing sites information from the river surveys with NHA data for County Monaghan four potential fen sites worthy of survey were identified and added to the current survey list (see Appendix 3).

In total 42 sites were surveyed in detail for their potential fen interest during the Monaghan Fen Survey 2007, which contained a total of 69 discrete sub-site compartments requiring survey.

4.3 Background Site Research

Once the list of sites had been compiled a site folder was created for each site which included:

- Air photograph of each site with provisional survey boundary, which was overlaid with either a 100 or 200 meter square survey grid to aid in estimation of site boundaries on the field survey;
- Six inch map of each site with provisional survey boundary, overlaid with either a 100 or 200 meter square survey grid;
- Air photograph overlaid with six inch map and provisional survey boundary;
- Previous survey reports and site descriptions where these were available;
- NPWS Ecologists Survey reports or NPWS Ranger Reports from the NHA survey conducted in the mid 1990's, where these were available for sites;

In addition a variety of Geographic Information System (GIS) data sets were used to compile background information on sites, including data on underlying solid geology, quaternary deposits and river catchment information as described below.

This GIS information, together with site descriptions and previous survey information, was entered in respect of each site for which data was available, into the NPWS Fen Survey Database (see below).

4.3.1 GIS Map Data

ArcView 8.1 GIS software package was used throughout the Monaghan Fen Survey 2007 for all mapping purposes. Digitised base-maps were supplied by Monaghan County Council which included a full series of colour aerial photographs produced by Ordnance Survey of Ireland, the OS 6 Inch series of maps and the discovery series 1:50,000 maps.

Shape files of survey boundaries for each site were created, in the case of existing designated sites, those boundaries as drawn by NPWS were used, but in the case of new sites, boundaries were drawn to include all semi-natural habitat adjoining the fen site. The extent of each site was calculated and recorded in the MFS site database. Maps and aerial photographs were produced for each site for use during the field survey.

Following site surveys, habitat maps were produced. For every site, fen habitat was mapped according to the fen type recorded. On those sites that were ranked as being of low ecological importance no further mapping was undertaken. For those sites that were deemed to be of high local importance and greater, all habitats were mapped using ArcMap 8.1. The habitats within each site have been classified according to *A Guide to Habitats in Ireland* (Fossitt 2000). The terminology used follows this guide and the alphanumeric codes are used where possible both on maps and in the text.

The colour coding for habitat mapping follows the Heritage Council Draft Guidelines (Anonymous 2002). A final habitat map (overlain on the 6 inch OS maps) of each site was produced for

inclusion in the site file and the final report. The extent of fen types and habitat types associated with each site was calculated using ArcMap 8.1 and recorded in the MFS site database.

4.3.2 GIS Quaternary Deposit Data

A digital version of the sub-soil map of county Monaghan produced by Teagasc (Meehan 2004) was used in determining the quaternary geology of each site. The underlying subsoil of each site was entered into the MFS site database. This map was also used in a desktop survey of potential wetland areas within the county as described in section 4.3.5 below. A map showing the location of MFS sites overlaying the subsoil map is presented in Appendix 15B.

4.3.3 GIS Geological Data

The 1:100,000 bedrock geology map of county Monaghan (Geraghty et al. 1997) was used to determine underlying geology at each site. Data gathered through this exercise was entered into the MFS site database. A map showing the location of MFS sites overlaying the bedrock geology map is presented in Appendix 15A.

4.3.4 GIS River Catchment Data

A digital river catchment map produced by Ordnance Survey of Ireland was used to determine the river catchment of each MFS site. A map showing the location of MFS sites overlaying the river catchment map for Monaghan is presented in Appendix 15C.

4.4 Estimation of Wetland Area in County Monaghan

Subsequent to establishing the GIS database for use in the MFS and on analysing the underlying parent material of each fen site (Meehan 2004), it became clear that the majority of fens occur on cutover raised bog areas. It also became evident that due to the vast number of wetlands in the county, it was not feasible to carry out detailed field surveys of all potential fen areas in the county.

Due to time and resource constraints, it was not possible to carry out an aerial-photo survey of the entire county to determine the location of all possible fen sites. In an attempt to determine whether there may be additional sites and to quantify the potential area of fen habitat, and the number of sites, remaining in the county a desk-top survey was carried out using aerial photography and subsoil data.

Four representative 5km square quadrats were selected within the county, the quadrats were representative of the variation in geology and were also selected to give a good geographical spread (northern, southern, eastern and western quadrat) as is illustrated in Figure 5.8 (see Chapter 5).

The aims of the desk-top survey were:

- To determine the number and extent in hectares of wetland habitats within each of the four 5 X 5 km quadrats.
- To estimate (based on the results of the four sample areas), the total area and number of wetland sites that occur within the county, which potentially contain fen habitat.
- To calculate the area of wetland habitat within the four sample areas that has been lost as a result of land improvement and drainage.

All cutover bog units within each quadrat were examined using colour aerial photographs and the present day habitat recorded. Analysis of this data was subsequently undertaken to see what proportion of sites still contain natural or semi-natural wetland habitats, and the results were extrapolated to estimate total county values (see Figure 4.1 below).

4.5 NPWS Fen Survey Database

As part of the 2006 NPWS Fen Study (see Foss 2007) a database was created to hold a variety of information on the fen sites recorded during the course of this desktop study.

In summary the main NPWS Fen Study database held information on site provenance, site names, county, SAC and NHA codes, national grid reference, site conservation designations, habitat information on the specific fen vegetation type(s) present and the area of each (or an estimate where no accurate data was available), information on rare species of note, a summary of previous published reports holding information on the site, and a site evaluation section which ranked each site in terms of its conservation importance, area information, survey information, and survey priority (For a full list of data fields recorded in the NPWS Fen Study database see Appendix 5 in Foss 2007).

Two secondary relational databases (linked to one together by use of site record number and reference code number), held a list of reports and publications referring to fens within the database, and a publications / report site records database, made up the complete NPWS Fen Study database.

The database was created using the Filemaker Pro 8 database package which runs on both PC and Mac platforms.

As part of the Monaghan Fen Survey 2007 the NPWS Fen Study database was expanded and new or adjusted data fields were created to hold the additional information that would be obtained during the current field survey process. The database was renamed the NPWS Fen Survey Database. A series of new data input layouts and reporting layouts were created to hold and display this survey information. Following the current field survey, vegetation results, habitat extent data, site descriptions, field survey notes, hydrochemistry data *inter alia*, were entered in the NPWS Fen Survey database (Version 1.4).

The additional survey information fields added to the NPWS Fen Survey database are listed in Appendix 12. Appendix 1 shows the main reporting layout for a site which has been surveyed and the information which was recorded.

4.6 Field Survey Relevé Card

One of the main objectives of this survey was to record, by means of relevé data, the fen vegetation types occurring on the sites to be surveyed. A relevé is a list of all the plant and bryophyte species recorded within a given quadrat area, to which a percentage cover value is assigned within a series of cover classes. Cover values used, based on Braun-Blanquet scheme, were: **+:** a few individuals; **1:** <5% cover; **2**: 5-25% cover; **3**: 26-50% cover; **4**: 51-75% cover; **5**: >75% cover.

To allow efficient collection of relevé species data information, together with related environmental, photographic, soil and hydro chemistry data a relevé field card was designed. A sample of this relevé card, with revisions following survey work, is shown in Appendix 7.

Species identification, where necessary, for vascular plants and bryophytes, were made using Webb, Scannell & Doogue (1996); Watson (1981); Smith (1980); Jermy et al (1982), while nomenclature for species follows that provided National Biodiversity Network Gateway website at http://www.searchnbn.net. Species abbreviations used on the relevé card (to maximise on available space) are given in full, in both Latin and English, in Appendix 6D.

4.7 Monaghan Fen Field Survey

For those sites surveyed in detail as part of the Monaghan Fen Survey the following survey procedure was adopted:

- Prior to the site visit any previous reports available from the site were consulted and potential fen areas were noted;
- On arrival at the site, the site was examined with binoculars and note was taken of areas that might contain fen communities, and access to site was selected;
- During the survey, note was taken of drainage features, damage and possible threats to the site. These were marked on the air photograph of the site;
- The site was walked and note was taken of the location of different community types within the site, which were mapped onto the air photograph of the site, and a general species list was compiled;
- Fen areas, where present, were examined and relevé site(s) were selected based on areas of homogenous vegetation, usually ranging in size from 1 to 4 meters square;
- At the relevé location peat depth was probed using a 2 meter steel rod, substrate type was described and the water table depth was recorded;
- Relevés were recorded (two per site) using a pre-printed field card (see above) and cover values were assigned, based on Braun-Blanquet cover value system;
- Where possible a 1 litre water sample was collected from within each relevé quadrat. Where this was not possible, a water sample was taken from an adjacent area, as close as possible to the relevé site;
- A digital photographic record of each site was made, to include the appearance of the site in general, areas with fen communities, boundary and drainage features and damage occurring on the site;
- Any species not identified in the field (in particular Bryophytes) were collected and subsequently identified in the laboratory.

For some of the sites proposed for survey, the initial binocular survey of site showed that no suitable areas occurred where fen communities might occur. Where this was the case, the site was described in brief, a photographic record was made and no further survey work was undertaken.

4.8 Site Hydrochemistry

Where possible, two 1 litre water samples were collected from each of the sites surveyed in detail during the Monaghan Fen Survey. Samples were taken at or as close as possible to relevé locations. In some situations, due to a low water-table, samples were taken from the nearest area of surface water.

Samples were collected in polyethylene bottles, labelled and were stored at 4°C until further analysis. pH of water samples was measured within 12 hours of collection and recorded in the MFS database. Samples were delivered to EPA regional inspectorate (NAB accredited laboratory) within 24 hours for detailed chemical analysis. Determination of metal concentrations was carried out by Inductively Coupled Plasma Mass Spectrometry (ICPMS) at the EPA Richview Laboratory, Dublin.

All chemical parameters measured are listed in Table 4.1 along with the methods used in determination.

Appendix 8 presents a table showing the limits of Quantification (LOQ), the maximum uncertainty of the analysis and the EPA laboratory method reference number (internal Monaghan Inspectorate document) for each parameter.

The hydro chemistry data is presented in tabular form in (see Appendix 8). Standard descriptive statistics were carried out to summarise the hydrochemistry data. The hydrochemistry data was used in an analysis to investigate the effects of environmental factors on vegetation composition (see section 4.8 below). The mean and range of each parameter within each fen type was calculated to show variation of environmental variables between different fen types in an attempt to establish the requirements of each fen type.

Data were tested for normality (Kolmogorov-Smirnov test (KS-test)) and equality of variance (Levene test) prior to further analysis. Our data did not always meet the assumptions of homogeneity of variance and normality. Since analysis of variance appears not to be greatly influenced if the assumptions of equality in variances or normal distribution are not met as long as sample size is similar (Heath 1995), we proceeded our analysis without transformations. To test whether differences in the mean value of various environmental parameters between different fen types, one-way ANOVA (Analysis of Variance) was carried out. Statistical software used for data analysis included SPSS for windows and Microsoft Excel.

Table 4.1. Chemical parameters determined by the EPA, laboratory and methods used.

Parameter	Laboratory	Method of Determination
Electrical Conductivity	EPA, Monaghan	Electrometrically using a conductivity meter
pH	EPA, Monaghan	Electrometrically using a pH meter.
Ammonia	EPA, Monaghan	Absorption spectrophotometry using a flow injection analyser - salicylate method.
Ortho-phosphate	EPA, Monaghan	Absorption spectrophotometry using a flow injection analyser - scorbic/molybdate method.
Total Oxidised Nitrogen	EPA, Monaghan	Absorption spectrophotometry using a flow injection analyser – cadmium reduction/sulphanilamide & NED.
Total Phosphorus	EPA, Monaghan	By acid digestion and absorption spectrophotometry using a flow injection analyser – ascorbic/molybdate method.
Alkalinity	EPA, Monaghan	Titration with sulphuric acid and methyl orange.
Sulphate	EPA, Monaghan	Ion chromatography
Metals (Calcium, Magnesium, Iron, Potassium, Sodium, Manganese, Copper, Zinc)	EPA, Richview, Dublin.	Inductively Coupled Plasma Mass Spectrometry (ICPMS)

4.9 Fen Habitat & Vegetation Classification

During the Monaghan Fen Survey the fen classification scheme described in Chapter 3 of this report was used during the field survey to characterise the fen communities found on the sites visited. The field based classification of the fens visited was subsequently confirmed by reference to the relevé data that had been collected from sites. Where necessary, the site fen type was redefined following this phytosociological analysis.

Following input of the relevé data into a computer database, TWINSPAN (Two Way Indicator Species Analysis) analysis (Hill 1979) was carried out to assist in classifying the relevés into community types.

The Twinspan ordination of the relevé data, is presented in Appendix 6B. Subsequent to the computer classification of data a degree of manual manipulation of the relevé table was undertaken (relevé and species order) to produce the final relevé table (see Appendix 6A). A synoptic table of the classified relevé, showing constant value and a summary range of relevé parameters is shown in Appendix 6C.

Classification of relevés was based on the phytosociological classification scheme for Irish fens defined by Ó Críodáin & Doyle 1994, and White & Doyle 1982, which is outlined in Chapter 3 of this report and in greater detail in Appendix 13.

Following the final classification of plant communities Detrended Correspondence Analysis (DCA) (Hill & Gauch 1980) was carried out to establish the effect of measured environmental factors in

relation to differences in vegetation types. The resulting ordination diagrams are useful in determining correlations between vegetation types and environmental variables such as water chemistry. TWINSPAN and DCA were both carried out using the computer programme PC-ORD 4.0 for Windows (McCune & Mefford 1997).

4.10 Threats and Damage to Fens

Wetlands, and fen areas in particular have historically been regarded as less productive than adjacent agricultural land and measures have been taken to improve their quality. The principal method of land improvement has usually involved some form of drainage. In addition, a more recent trend has been the use of small inter-drumlin fens as areas to dispose of rubbish and landfill materials.

During the survey past and existing damage to wetlands and threats to the future functioning of the wetland were noted.

4.11 Site Evaluation and Ranking

Determining the conservation value of sites was one of the primary aims of the Monaghan Fen Survey. To assess the potential value of site, sites were assessed on a range of criteria and scores were applied to these. Sites were then ranked according to conservation value of the overall sites based on the ranking system described below.

4.10.1 Site Evaluation:

Following completion of the site survey each site surveyed in detail was evaluated on a series of 15 criteria. These criteria included Naturalness, Non-recreatability, Potential value, Typicality, Size, Habitat Diversity, Fen value, Rarity of species and habitats, Viability, Recorded History, Educational value, Management needs, Intrinsic appeal and Expert opinion. 13 of these criteria are based on those listed in the National ASI Survey, Guidelines for Ecologists (Lockhart et al. 1993), and were assessed according to the guidelines in that report, while Fen Value and Expert Opinion were added as part of the current conservation assessment of sites.

A brief definition of the criteria, their meaning in the context of this survey and the scoring system applied are provided here. For full details and discussion of the selection criteria see Lockhart et al. 1993.

Naturalness
An assessment of site damage and alteration, disturbance and human interference noted. Scoring: 0 = high degree of disturbance; 5 = no or minimal disturbance.

Non-recreatability
Feasibility of re-creating a given site and/or habitat type. Scoring: 0 = easy to re-create; 5 = difficult to re-create.

Potential value
Whether site value can be improved in a reasonable timescale. Scoring: 0 = no improvement possible on site, or the site close to its maximum potential; 5 = significant improvement possible/ site not at its maximum potential

Typicality
Degree to which a site displays typical habitat features. Scoring: 0 = habitat not representative; 5 = excellent example of habitat.

Educational value
Site suitability for educational use. Scoring: 0 = no educational value; 5 = highly suitable as an educational site.

Size
Relative site size in relation to habitats present and at scale of habitats within County. Scoring: 0 = Site habitat area too small to be viable; 5 = site habitat size large and viable.

Diversity
Range of habitats and species within site. Scoring: 0 = poor habitat / species diversity; 5 = excellent habitat / species diversity.

Fen value
Quality of fen habitat(s) on the site. Scoring: 0 = no fen habitats present; 5 = good quality and quantity of fen habitats present.

Rarity of species
Rare or notable species present on site. Scoring: 0 = no species of note recorded; 5 = rare species of note confirmed on site.

Rarity of habitats
Rare or notable habitats present on site (in the context of the EU Habitats Directive). Scoring: 0 = no habitats of note recorded; 5 = rare habitat of note confirmed on site.

Viability
Whether interest of site will persist even with protection measures. Scoring: 0 = site unviable; 3 = viable but only with management measures; 5 = site viable in its current state.

Recorded History
Previous research information available on the site. Scoring: 0 = no previous information/research; 5 = extensive site information available.

Management needs
Degree to which management is required on site to adequately conserve the ecological interest. Scoring: 0 = Site requires major management / restoration initiatives; 5 = site requires little or no change in current management regime.

Intrinsic appeal
Scenic and landscape appeal of site. Scoring: 0 = no scenic/landscape appeal; 5 = high scenic/landscape appeal.

Expert opinion
Overall surveyors opinion of site value and conservation potential. Scoring: 0 = site has little value for conservation; 5 = site has high value for conservation

4.10.2 Site Ranking:

Site scores were totalled for each site, and ranked. Those sites with the highest score were ranked as being of highest importance. Following this, sites were assigned to one of six classes as described in Table 4.2 below. The six classes were created with reference to a the National Roads Authroity (Anonymous 2004) site evaluation scheme on an importance scale ranging from International -> national -> county -> local value. As most sites fit within the local scale of importance, this was further split into three classes: high local value -> moderate local value -> low local value. The criteria of each of the evaluation classes are presented in Table 4.3.

The results of the conservation evaluation are presented in Appendix 9.

Table 4.2. The conservation value score system and ranking scheme applied to sites on the Monaghan Fen Survey 2007.

Site Conservation Status	Score Value	Ranking Code
International Value	30-75	A
National Value	30-75	B
County value	25-29	C
High local value	20-24	C+
Moderate local value	11-19	D
Low local value	0-10	E

Site rating were based on the ecological and site evaluation criteria presented in Table 4.3 below.

Table 4.3. Site ranking criteria used on the Monaghan Fen Survey 2007 (modified from NRA (2004).

Ranking	***Qualifying Criteria***
A	**Internationally important** Sites designated (or qualifying for designation) as SAC* or SPA* under the EU Habitats or Birds Directives. Undesignated sites containing good examples of Annex I priority habitats under the EU Habitats Directive. Major salmon river fisheries. Major salmonid (salmon, trout or char) lake fisheries.
B	**Nationally important** Sites or waters designated or proposed as an NHA* or statutory Nature Reserves. Undesignated sites containing good examples of Annex I habitats (under EU Habitats Directive). Undesignated sites containing significant numbers of resident or regularly occurring populations of Annex II species under the EU Habitats Directive or Annex I species under the EU Birds Directive or species protected under the Wildlife (Amendment) Act 2000. Major trout river fisheries. Water bodies with major amenity fishery value. Commercially important coarse fisheries.
C	**County value** Sites containing semi-natural habitat types with high biodiversity in a county context and a high degree of naturalness, or significant populations of species which are rare in the county. Small water bodies with known salmonid populations or with good potential salmonid habitat. Sites containing resident or regularly occurring populations of Annex II species under the EU Habitats Directive or Annex I species under the EU Birds Directive. Large water bodies with some coarse fisheries value.
C+	**High value, locally important** Sites containing semi-natural habitat types with high biodiversity in a local context and a high degree of naturalness, or significant populations of locally rare species. Small water bodies with known salmonid populations or with good potential salmonid habitat. Sites containing any resident or regularly occurring populations of Annex II species under the EU Habitats Directive or Annex I species under the EU Birds Directive. Large water bodies with some coarse fisheries value.
D	**Moderate value, locally important** Sites containing some semi-natural habitat or locally important for wildlife. Small water bodies with some coarse fisheries value or some potential salmonid habitat. Any water body with unpolluted water (Q-value rating 4-5).
E	**Low value, locally important** Sites containing some remnant semi-natural habitat or locally important for wildlife, but where disturbance has significantly altered habitat and/or continues to threaten future survival of the site.

*SAC = *Special Area of Conservation*
SPA= *Special Protection Area*
NHA= *Natural Heritage Area*

4.12 Completed Fen Survey Site Record

Following completion of the site survey, a site folder for each site surveyed was created containing the following documents and information (two replicates of each folder were made, one deposited with Monaghan County Council and the other with NPWS):

- Completed relevé cards
- Photographic record of survey with explanatory notes to photographs
- Site description output from the NPWS Fen Survey database which included all site particulars, site description, survey notes, water chemistry data, information on site threats and damage and site conservation evaluation *inter alia*
- Six inch map of the site with the location of site notes shown
- Colour air photograph of the site
- Previous site reports and survey information
- And where the site was proposed for NHA/SAC designation, a completed NPWS NHA site form

5. Results

5.1 General Survey Findings from the Monaghan Fen Survey 2007

A detailed habitat survey of 42 wetland sites was undertaken (containing a total of 69 sub-site compartments) in County Monaghan during the current field survey, together with a brief site evaluation of a further 14 sites which revealed no fen interest.

The location of sites surveyed in detail is shown in Figure 5.1, the location of the 14 sites evaluated in brief is shown in Figure 5.2, with site names, site code and grid reference. Site lists are presented in alphabetical order by site name in Table 5.1 and 5.2 respectively. Further details of these sites are presented in Appendix 3 & 4. Detailed individual site reports, for the sites surveyed in detail, are presented in Appendix 1 (see report Volume II).

The survey data collected from the detailed survey of each site, included all habitat types recorded, fen interest on the site, fen extent data, site description, field notes *inter alia* was compiled in a Filemaker Pro 8 database. Version 1.4 of the NPWS Fen Survey Database, based on the subset of sites listed for County Monaghan, is included on the CD accompanying this report.

In addition to the data for each site held within the survey database a photographic record with notes was compiled for each site and in presented in Appendix 2 (see report Volume III). This information together with a site air photograph, six inch map with the location of field notes, and a detailed habitat map constituted a full site survey report in the context of this survey. The complete site survey reports (for the 42 sites surveyed in detail) are presented in Appendix 1 in Volume II of this report.

In addition to the site survey reports presented in this final project report, a detailed paper based site folder for each site surveyed in detail was created and is lodged with the NPWS Research Branch, Dublin and with Monaghan County Council. These site folders contain the same information as in the database site report with the addition of previous reports and survey data where this was available for a site, together with field notes taken during this survey, original releve cards and where the site was proposed for NHA designation, a completed NPWS Natural Heritage Area (NHA) form.

5.2 Change in Fen Habitats Confirmed by the Monaghan Fen Survey

Based on the results of the NPWS Fen Study (Foss 2007), which compiled a list of all known sites in Ireland with a possible fen interest, together with fen types and areas estimates on each site, a total of 30 fen sites were originally identified for survey in County Monaghan.

Based on available information, these 30 sites were believed to contain a range of fen habitats including Poor fen PF2, Transition Mire 7140 PF3, Cladium fen 7210 PF1, Alkaline fen 7230 PF1 and Petrifying Spring 7220 FP1, with a total estimated site area in the County of 190 ha. It should be noted, however, that for 10 of the original sites no fen area estimates were available prior to the survey, making the 190 ha of fen estimated in the County a minimum area estimate.

See Appendix 3 (table includes data based on Foss 2007) for further details of the fen type and area data on each of the 30 sites originally proposed for survey as part of the Monaghan Fen Survey. In addition to the 30 original fen sites proposed for survey, Appendix 3 also shows the sites added at a later stage to the Monaghan survey list, which were located during the mapping or actual survey work, which brought the total number of sites to 42. For these additional site only the actual fen habitat type recorded and actual extent data based on the results of the current survey are shown in Appendix 3.

Table 5.1. The sites surveyed in detail as part of the Monaghan Fen Survey 2007.

MFS Site Code	Site Name	Grid Reference
002900	AGHABOY TOWNLAND FEN	H 620 350
002902	AGHACLOGHAN	H 807 087
002904	AGHNAMULLEN	H 682 172
001780	ALLAGESH LOUGH NHA	H 590 346
001836	ANNAGHGHEANE LOUGH NHA	H 469 181
MFS-03	ARDKIRK FEN	H 872 144
MFS-06	BOCKS UPPER	H 794 091
002901	CORAVILLA - RAKEEN	H 660 245
MFS-01	CORNAGLARE & CRUMLIN LOUGH	H 648 300
MFS-07	CRINKILL LOUGH	H 767 195
MFS-04	CRUMLIN LOUGH	H 642 330
MFS-02	DRUM LOUGH	H 561 183
001841	DRUMCOR LOUGH NHA	H 472 171
002732	DRUMGALLAN BOG	H 813 283
002903	DUNAREE	H 795 105
001603	ESHBRACK BOG NHA	H 550 430
002898	GRAFFAGH AND CORINSHIGO	H 595 338
002897	GREAGHGLAS	H 705 307
MFS-08	KILLYCOOLY LOUGH	H 794 091
001782	KILLYHOMAN MARSH NHA	H 630 523
002755	KILLYNEILL FEN	H 730 354
001839	KILLYVILLY LOUGH NHA	H 551 334
002899	KILNACLAY FEN	H 635 305
001786	KILROOSKY LOUGH CLUSTER SAC	H 490 275
001835	LISABUCK LOUGH NHA	H 503 230
001781	LISARILLY BOG NHA	H 582 268
002911	LISINISKY MARSH	H 706 096
001840	LISLANNAN BOG NHA	H 549 303
002893	LISNALEE	H 689 277
002896	LISQUIGNY (CORLONGFORD) FEN	H 732 267
001607	LOUGH SMILEY NHA	H 82 21
MFS-05	MORGANS LOUGH	H 502 279
002531	MOYLAN LOUGH	H 855 085
001785	MULLAGHMORE LAKE (SOUTH) NHA	H 624 381
001837	MULLAGLASSAN LOUGH NHA	H 573 327
002077	NAFARTY FEN NHA	H 833 045
002614	PRIESTFIELD LOUGH	H 650 310
001606	RAFINNY LOUGH NHA	H 620 265
001784	ROSEFIELD LAKE AND WOODLAND NHA	H 633 337
002892	SHEETRIM	H 679 315
002894	TIRAGARVAN	H 815 045
002895	TOSSY CROSS	H 769 154

Table 5.2. The sites evaluated in brief as part of the Monaghan Fen Survey 2007.

Site Name	Grid Reference
AGHABOY LAKE	H 590 346
DRUMSNAT LOUGH	H 611 308
KILCORRAN LOUGH	H 560 334
DRUMBERAGH	H 802 098
SHANKILL LOUGH	H 729 086
LOUGH BANE	H 739 095
CORRACHARRA	H 715 092
LAUREL LOUGH	H 463 180
CORCONNELLY LOUGH	H 505 217
CARRAGHMORE FEN	H 736 078
CORLOUGHAROE LOUGH	H 567 222
EMY LOUGH	H 69 44
KILLY LOUGH	H 63 42
DERNAHAMSHA	H 575 348

Following the Monaghan Fen Survey (MFS) the following survey findings emerged in relation to fen habitats recorded and the extent of these on the sites surveyed:

- On 12 of the original 30 sites proposed as possibly containing a fen habitat present, no fen interest was found on the sites following the present survey. While on 17 of the total 42 sites where fen habitats were believed to be present at the start of the project, survey results showed that there were no fen habitats on these sites;
- On 11 sites the survey found that the fen habitats believed to be present, differed from those actually recorded. In general this difference in fen type present related to confusion in the original classification of the site as Poor fen, which subsequently was found to be Transition mire;
- No Petrifying Spring 7220 habitat was found on any Monaghan fen site (originally one site was proposed for this fen type), indicating that this habitat may in fact not be present within the county;
- The accurately mapped and calculated area of fen in Monaghan, based on the current survey results, was found to be 95.6 ha, considerably less than the previous estimate of 190 ha;
- Transition Mire 7140 (PF3) is the most frequently occurring fen habitat type in Monaghan, with a total fen habitat area of 77.2 ha. This represents 80 % of the known fen resource (95.6 ha) in County Monaghan.

Of the 30 original fen sites identified in Monaghan, based on information from the NPWS Fen Study (Foss 2007), the results of the present survey show that 12 sites in fact had no fen interest following detailed survey. These results may have significant implications for the assessment of the extent and abundance of wetland sites throughout Ireland made in the NPWS Fen Study Report (2007).

If the results from Monaghan were to be repeated nationally, more than 40% of the sites believed to contain fen habitats might in fact be found to contain no significant fen areas. Such a decline in the list of sites with fens would make the remaining sites with fen habitat rarer nationally and increase the conservation value of sites which do contain fen.

Figure 5.1. The location of sites surveyed in detail as part of the Monaghan Fen Survey 2007.

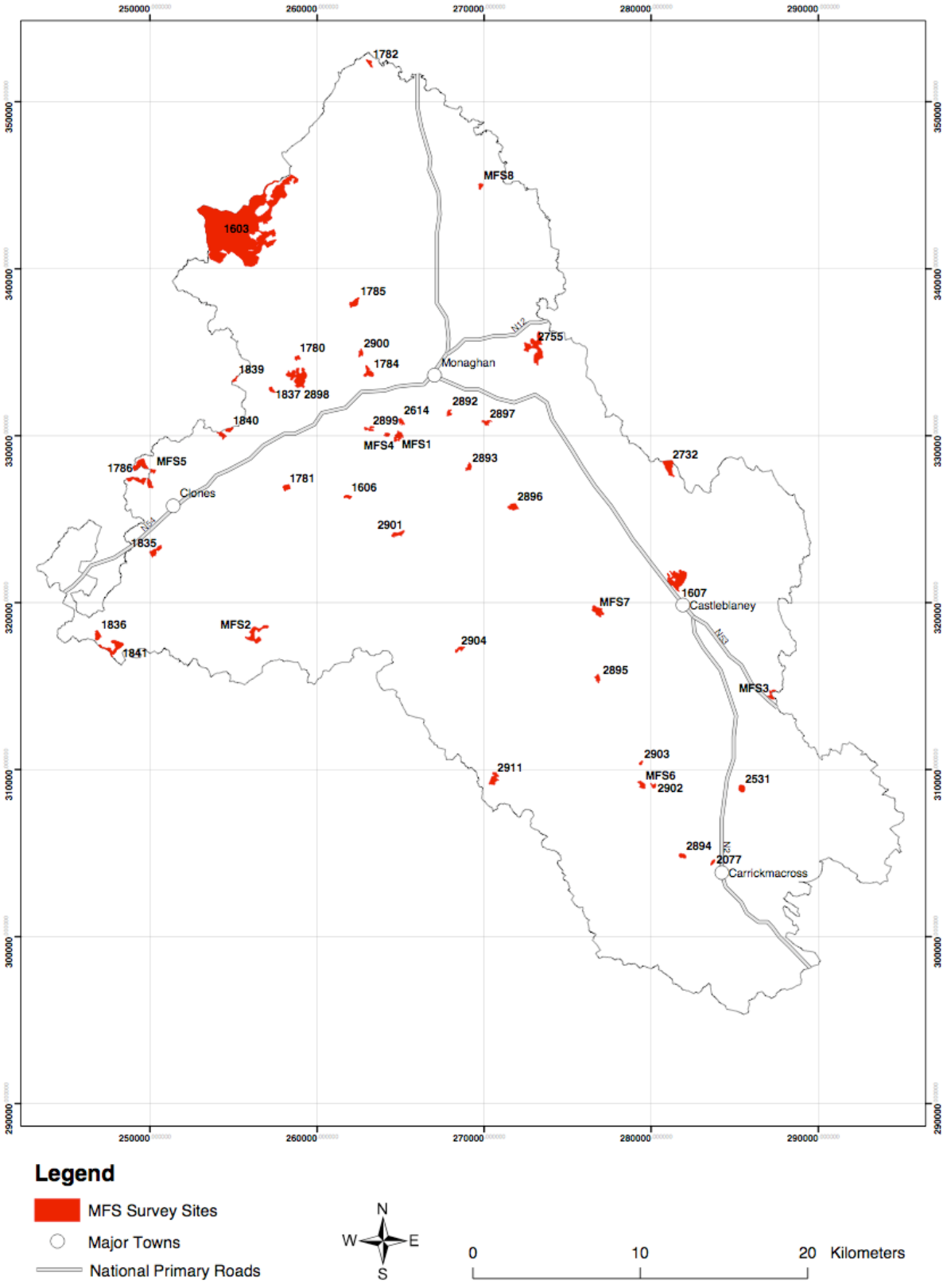
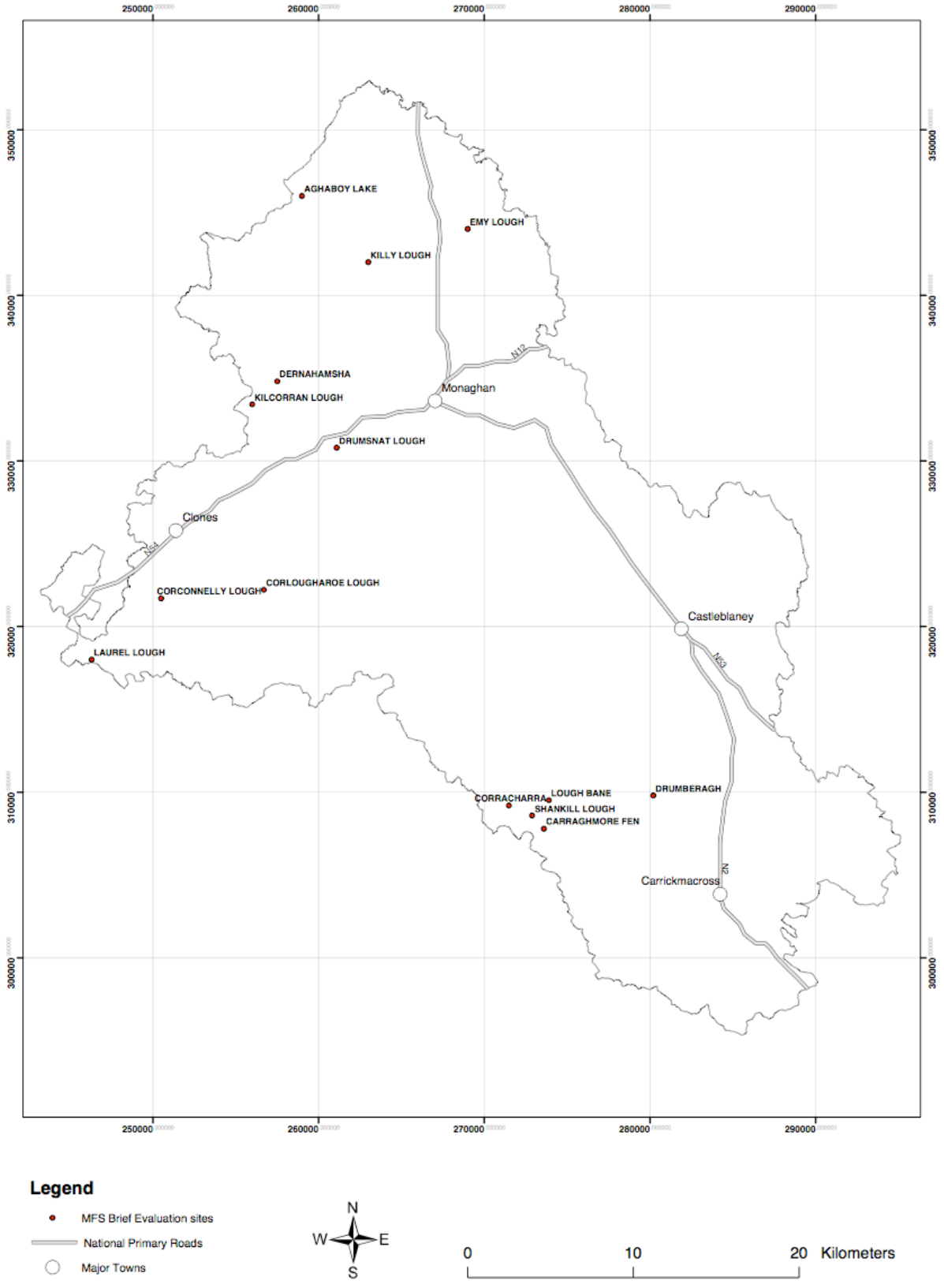


Figure 5.2. The location of sites surveyed in brief for their fen interest as part of the Monaghan Fen Survey 2007.



5.3 Phytosociological Classification of Fens in County Monaghan

A total of 54 relevés were collected during the course of the Monaghan Fen Survey from 26 of the 42 sites surveyed in detail. Relevés were only sampled on those sites with possible or clearly identifiable fen vegetation communities. These relevés were classified, during the field survey, according to the fen classification scheme outlined earlier in Chapter 3.

The completed relevés were then entered into an electronic spreadsheet to allow more detailed analysis and subsequent classification.

Initially a statistical analysis of the relevé data (using TWINSPAN) was undertaken (Hill 1979). The resulting output of the TWINSPAN analysis is presented in Appendix 6B. Five distinct relevé groups were identified by this ordination, which upon examination included an Alkaline fen, Cladium fen, Poor fen and two distinct Transition mire groups.

Following the statistical TWINSPAN analysis, the relevé and species data, was selectively manually re-ordered and the relevés were classified according to the phytosociological classification scheme for Irish fen outlined in Appendix 13. It should be noted that due to the small sample size of some of the communities identified during the MFS, and the lack of a completed national fen survey which would have identified all the significant fen vegetation types present in Ireland, the classification presented here is based on best available data (see Table 5.3 below). It is possible that future research and data collection may require alteration of the classification scheme presented here. The final classification of relevés from the MFS is presented in Appendix 6A.

The relevés recorded during the MFS were assigned to 4 fen phytosociological groups, namely Cladium fen (relevé table no. 1 to 3) which can be assigned to the order Caricetalia davallianae, Alkaline fen (relevé table no. 4 to 7) which can be assigned to the order Caricetalia davallianae, Transition mire (relevé table no. 8 to 40) which can be assigned to the order Scheuchzerietalia palustris to Caricetalia nigrae and Caricetalia davallianae and Poor fen (relevé table no. 41 to 52) which can be assigned to the order Caricetalia nigrae, as well as two relevés (no. 53 and 54) which were classified as marsh rather than fen vegetation.

A synoptic table of the resulting relevé classification, showing constancy values and a summary range of relevé parameters is shown in Appendix 6C.

These four phytosociological fen groups recognised during the MFS are described in further detail below.

5.3.1 Cladium fen (relevé table no. 1 to 3)

The community is characterised by the occurrence of a number of species indicative of the Caricion davallianae (rich fen) in the ground layer and by the presence of a low to moderate cover value for the Saw sedge, *Cladium mariscus*. Caricion davallianae species occurring in the relevés included in this group are: *Carex panicea, Carex viridula ssp. oedocarpa, Campylium stellatum, Carex pulicaris, Briza media, Cirsium palustre, Drepanocladus revolvens, Pedicularis palustris, Calliergonella cuspidata and Carex nigra*. Other species of note include *Molinia caerulea* and *Succisa pratensis.*

pH of water samples collected from these sites ranged from 8.03 to 8.07.

This fen community type is rare in Monaghan. The importance of sites with this community type is further enhanced by the fact that *Cladium* fen is a priority habitat for conservation under the EU Habitats Directive.

Cladium mariscus fen was recorded at two sites during the MFS survey, at Killyvilly Lough and in the Kilroosky Lough Cluster SAC at Kilroosky Lough and Summerhill Lough.

5.3.2 Alkaline fen (relevé table no. 4 to 7)

Four Alkaline fen relevés are presented in Table 6B (in addition to those relevés in the *Cladium* fen group mentioned above). These relevés include species indicative of the Caricion davallianae (rich

fen), including *Carex viridula ssp. oedocarpa, Campylium stellatum, Carex panicea, Drepanocladus revolvens, Ctenidium molluscum inter alia*.

pH of water samples collected from these sites ranged from 6.5 to 8.1.

This fen community type is rare in Monaghan, and was only recorded at two sites during the MFS survey, at Eshbrack Bog where the community occurred in a flushed valley basin, and in the Kilroosky Lough Cluster SAC where the community occurred on the shore of Kilroosky Lough, Dummys Lough and Summerhill Lough, all of which are oligotrophic, alkaline or hard water lakes.

5.3.3 Transition Mire (relevé table no. 8 to 40)

Table 6B reveals that Transition mire, was the most abundant fen type recorded during the course of the Monaghan Fen Survey, with 33 of the 54 relevés recorded in total, being assigned to this fen type. This fen type was recorded from 22 sites of the 42 sites surveyed as part of the MFS (See Appendix 6A).

This fen type occurred most commonly in regenerating inter drumlin cutaway bog areas, where peat was extensively cut out by the end of the last century and secondary fen regeneration had proceeded for a considerable period of time, in low lying cutover bog hollows between peat hags, or on the infilling margins of lakes. A feature of all of the relevés assigned to this group was their occurrence on a quaking or floating scraw of vegetation.

Two distinct variants of this vegetation type were observed during the classification of the relevé data. The first was a Transition mire rich fen variant (TMR) characterised by the growth of *Carex diandra* (relevé table no. 8 to 26), where pH values tended to range between 6 and 7.1.

The second was a Transition mire poor fen variant (TMP) which was characterised by a lack of *Carex diandra*, and an increased occurrence of *Carex curta*, *Carex rostrata inter alia*. (relevé table no. 27-40). pH in this TMP variant ranged from 5.5 to 6.8 demonstrating slightly more acidic conditions.

Transition mire – rich fen variant (TMR)

Nineteen relevés (table numbers 8 to 26) show a species composition which allows these relevés to be assigned to the Transition mire rich fen variant community, identified during the MFS, which includes species characteristic of the Caricetalia davallianae.

Species commonly occurring on this Transition mire rich fen variant included: *Calliergonella cuspidata, Hydrocotyle vulgaris, Galium palustre, Agrostis stolonifera, Carex rostrata, Caltha palustris, Equisetum fluviatile, Potentilla palustris, Cardamine pratensis, Menyanthes trifoliata, Juncus effusus* and *Angelica sylvestris.*

Species which differentiated this Transition mire rich fen variant from the poor fen variant included: *Carex diandra, Filipendula ulmaria, Holcus lanatus, Calliergon giganteum, Equisetum palustre, Lychnis flos-cucli, Rumex acetosa* and *Plagiomnium rostratum*.

This variant of transition mire was recorded from 15 of the 42 sites surveyed in detail (see Table 5.4).

Transition mire – poor fen variant (TMP)

Fourteen relevés (table numbers 27 to 40) show a species composition which allows these to be assigned to the Transition mire poor fen variant community, identified during the MFS, which includes species characteristic of the Caricetalia nigrae.

Species commonly occurring on this Transition mire poor fen variant included: *Hydrocotyle vulgaris, Galium palustre, Agrostis stolonifera, Carex rostrata, Equisetum fluviatile, Potentilla palustris, Cardamine pratensis, Menyanthes trifoliata,* and *Eriophorum angustifolium.*

Species which differentiated this Transition mire poor fen variant from the rich fen variant included: the increased abundance of *Carex curta, Calliergon stramineum, Ranunculus flammula,*

Veronica scutellata and *Lemna minor.* The TMP variant also shows a reduced occurrence or complete absence of *Carex diandra, Filipendula ulmaria, Plagiomnium rostratum, Rumex acetosa, Holcus lanatus, Lychnis flos-cucli, Equisetum palustre, Calliergonella cuspidata, Angelica sylvestris,* and *Calliergon giganteum*.

Four relevés assigned to this group (table no. 37 to 40) lack both the differential species associated with the TMR and TMP community, and contain only the commonly occurring species for TMP listed above.

This variant of transition mire was recorded from 9 of the 42 sites surveyed in detail (see Table 5.4).

5.3.4 Poor fen (relevé table no. 41 to 52)

Twelve relevés (table numbers 41 to 52) show a species composition which allows these to be assigned to Poor fen habitat which includes species characteristic of the Caricetalia nigrae to Scheuchzerietalia palustris.

pH of water samples collected from these sites ranged from 4.2 to 6.8 representing the prevailing acid conditions (with 10 of the 12 relevés having a pH below 5.8).

Species commonly occurring on Poor fen sites included: *Carex rostrata, Menyanthes trifoliata, Equisetum fluviatile, Potentilla palustris, Juncus articulatus, Eriophorum angustifolium, Carex nigra* and *Succisa pratensis.*

Species which differentiated Poor fen from the other fen types recorded during the MFS included: *Sphagnum fallax, S. palustre, S. subsecundum, S. squarrosum, Polytrichum commune, Aulacomnium palustre, Carex echinata, Crepis paludosa, Carex limosa, Molinia caerulea, Potentilla erecta* and *Anthoxanthum odoratum.*

This fen type occurred most commonly in regenerating cutaway bog areas, where remnant peatland communities occurred, in low lying cutover bog hollows between peat hags, or on flushed areas on blanket bog. A feature of all of the relevés assigned to this group was there occurrence on a firmer peat substrate which did not form of a quaking or floating scraw of vegetation.

Poor fen was recorded from 9 of the 42 sites surveyed during the MFS (see Table 5.4).

5.3.5 Revised Fen Classification Scheme based on the Results of the MFS

Table 5.3 below shows the revision of the fen classification scheme proposed for the National Fen Survey after taking account of the results of the Monaghan Fen Survey.

This scheme suggests that two variants of Transition mire should be identified, based on the floristic difference noted between relevé groups. Due to the small sample size from the MFS, the restricted geographic scope of the survey, and lack of further national data on the occurrence of this, and other Transition mire community type(s), the current classification is considered to be provisional, and subject to revision in the future.

Table 5.3. Revised classification for the main fen types recognised as part of the Monaghan Fen Survey, and their relationship to other classification schemes, phytosociological classification, together with details of key species and habitat features.

NPWS Fen Survey Habitats Classification Scheme	**EU Habitats Directive Habitat;** CORINE Habitat; **Fossitt Habitat Scheme**	**Phytosociological Classification**	**Key Species**	**Habitat Examples**	**Site Examples**
Transition Mire – Rich type	**7140 Transition mires and quaking bogs;** 545 Transition mires; **PF3 Transition mire and quaking bog**	Caricetalia davallianae	*C. diandra, C. viridula, Agrostis stolonifera, Menyanthes trifoliata, Potentilla palustris, Pedicularis palustris, Calliergon spp., Scorpidium spp.*	Quaking areas on secondary fen areas of cutover and cutaway bogs	Monaghan
Transition Mire – Poor type	**7140 Transition mires and quaking bogs;** 545 Transition mires; **PF3 Transition mire and quaking bog**	Scheuchzerietalia palustris to Caricetalia nigrae	*Carex limosa, C. lasiocarpa, Eriophorum angustifolium, E. gracile, Agrostis stolonifera, Molinia caerulea, Menyanthes trifoliata, Potentilla palustris, Pedicularis palustris, Sphagnum spp., Calliergon spp.*	Quaking areas on blanket and raised bogs; bog laggs; secondary fen areas of cutover and cutaway bogs	Monaghan
Alkaline fen	**7230 Alkaline fens;** 542 Rich Fens Caricion davallianae & 5421 Black bog rush fens & 5422 Fens not Schoenus dominated; **PF1 Rich fens and flushes**	Caricetalia davallianae	*Schoenus nigricans, Homalothecium nitens, Carex viridula, C. nigra, C. dioica, C. panicea, Juncus subnodulosus, Molinia caerulea, Hydrocotyle vulgaris, Ranunculus flammula, Mentha aquatica, Galium palustre, Parnassia palustris, Pinguicula vulgaris*	Topogenous fens in valleys or depressions ; within transition mire and tall reed beds; calcium rich flush areas in blanket bogs; dune slack areas; wet hollows in machair	Pollardstown fen, Kildare

Table 5.3. (cont.) Revised classification for the main fen types recognised as part of the Monaghan Fen Survey, and their relationship to other classification schemes, phytosociological classification, together with details of key species and habitat features.

NPWS Fen Survey Habitats Classification Scheme	EU Habitats Directive Habitat; CORINE Habitat; Fossitt Habitat Scheme	Phytosociological Classification	Key Species	Habitat Examples	Site Examples
Cladium Fen	**7210 *Calcareous fens with Cladium mariscus and species of the Caricion davallianae;** 533 Fen Sedge Beds; 5331 Fen Cladium Beds; **PF1 Rich fen and flush**	Magnocaricion - Cladietum marisci to Caricetalia davallianae	*Cladium mariscus* and species of Alkaline fens (see above)	Fen beds of the emergent plant zones of lakes; Cladium stands in blanket bog flushes and fens. Excludes mono-dominant stands of *Cladium*	Pollardstown Fen, Kildare; East Burren complex, Clare
Poor Fen	**Habitats Directive – NA;** 544 Acidic fens; **PF2 Poor fen and flush**	Caricetalia nigrae	*Hammarbya paludosa, Juncus effusus, Carex rostrata, C. nigra, C. curta, Sphagnum recurvum, S. teres, Calliergon stramineum*	Poor fen flushes in blanket bog; soligenous depressions among grassland, cutover bogs and heath	Carrigower Bog, Wicklow; Liffey Head flush, Wicklow
Petrifying Spring with Tufa	**7220 * Petrifying springs with tufa formation (Cratoneurion);** 5412 Hard Water Springs Cratoneurion; **FP1 Calcareous Springs**	Cratoneurion	*Saxifraga aizoides, Carex dioica, C. pulicaris, C. flacca, C. nigra, Pinguicula vulgaris, Equisetum palustre*	Calcium rich spring areas in fens, woodland, sea cliffs, esker ridges, limestone areas, blanket bogs	Pollardstown fen, Kildare; Knocksink Wood, Wicklow; Bellacorick Iron Flush
Non-Calcareous Spring	**Habitats Directive – NA;** 541 Springs Montio-Cardaminetea & 5411 Soft Water springs Montio-Cardaminetea; **FP2 Non-Calcareous Springs**	Montio-Cardaminetea	*Saxifraga hirculus, Sphagnum auriculatum, Calliergon sarmentosum, Polytrichum commune, Juncus bulbosus, Viola palustris, Ranunculus flammula,* Hydrocotyle vulgaris	Cold springs, commonly dominated by bryophytes within blanket bog complexes, clay and rock cliffs poor in lime	Glenamoy Bog Complex, Mayo

5.4 Extent of Fen Habitats in County Monaghan

Following the survey of the 42 sites examined in detail as part of the Monaghan Fen Survey a total of 24 sites were found to contain fen habitats.

Appendix 3B shows the fen habitat types believed to occur on the sites surveyed, prior to the present survey and those actually observed following the present phase of the Monaghan Fen Survey.

In total 22 sites were found to contain Transition mire; two sites contained Alkaline fen, two sites contained Cladium fen and seven sites held Poor fen communities.

The total area of fen recorded on sites during the Monaghan Fen Survey amounted to 95.6 ha. Appendix 3 shows the total fen area found on each site during the Monaghan Fen Survey. A detailed breakdown by site, of the area of each individual fen type, together with all other non-fen habitat areas recorded on sites surveyed is presented in Appendix 14. These data were obtained following the preparation of the habitat maps produced for each of the sites surveyed.

Table 5.4 shows a summary breakdown of the respective areas of each fen type recorded in County Monaghan during this survey. The individual site reports in Appendix 1 (see Volume II of this report) list the area of each fen type found on each site during the present survey.

The results in Appendix 3 show that although the original area of fen in Monaghan was estimated to be a minimum of 190 ha (based on data in Foss 2007), results from the current survey found that only 95.6 ha of fen vegetation occur on known fen sites in Monaghan.

Fens are therefore much rarer in the county than previously thought.

The discrepancy in the expected and fen area actually recorded from the current survey can in part be explained by the fact that previous surveys had misidentified certain wetland areas and classified these as fens. In many cases these "fens" were found to contain extensive marsh, reed and other wetland habitats (using the habitat classification scheme of Fossitt 2000) rather than fen habitats. In other cases the area of fen estimated at sites was found to be too high, with fen habitats occurring as relatively small restricted areas, among other wetland habitats.

Table 5.4. The number of sites with fen communities and the total extent of each fen type found on sites during the Monaghan Fen Survey 2007.

Fen Habitat Type	**No. of sites**	**Area in ha**
Transition Mire	22	76.2
TM Rich variant	*15*	*nd*
TM Poor variant	*9*	*nd*
Alkaline Fen	1	1.5
Cladium Fen	2	1.1
Poor Fen	7	16.8
Total		95.6

** nd: not determined*

5.5 Environmental Conditions of Fens in County Monaghan

In total 61 water samples were taken during the field survey, 50 of which were taken from relevé locations. Of the 42 fen sites surveyed in detail, water samples were taken from 26. The original result – sheet issued by the EPA is included in the appropriate site folder. A full table of hydrochemistry results is presented in Appendix 8 along with the associated water sample number, site name and relevé code.

Unfortunately, due to misplacement of samples, nutrient analysis was not determined on 14 of the water samples, although stable metal parameters were determined on all samples.

The range and mean values of each chemical parameter is presented in Table 5.5 along with values for peat depth and water table depth. It can be seen that there is wide variation in the water chemistry recorded from the full suite of sites.

Water chemistry of sites varies considerable between sites (see Table 5.5), with some sites displaying acid, nutrient poor conditions while other sites are characterised by alkaline mineral rich conditions. The water chemistry reflects the source of water feeding the system which in turn is dependant on the hydrogeology of the areas.

Table 5.5. Ranges of hydrochemical variables, peat depth and water table depth (n=50).

Variable	Units	Mean	Minimum	Maximum
pH	pH Units	6.52	4.50	8.20
Alkalinity	mg/l CaCO3	99.30	<12	324.00
Conductivity	µS/cm@25°C	250.44	44.00	630.00
Calcium (Ca)	mg/l CaCO3	35.21	<5	104.98
Magnesium (Mg)	mg/l	3.43	0.97	10.92
Sulphate (S)	mg/l SO4	9.72	<1	93.30
Potassium (k)	mg/l	2.47	0.97	11.24
Sodium (Na)	mg/l	7.53	<5	19.04
Iron (Fe)	µg/l	2154.54	67.10	54616.50
Manganese (Mn)	µg/l	772.27	4.10	11358.60
Copper (Cu)	µg/l	2.93	<1	20.20
Zinc (Zn)	µg/l	11.71	<1	263.10
Ammonia (NH3)	mg/l N	0.22	<0.03	1.49
Total Oxidised Nitrogen (TON)	mg/l N	0.11	<0.05	2.12
Total Phosphorus (TP)	mg/l P	0.28	<0.01	1.23
Ortho-Phosphate (OP)	mg/lP	0.04	<0.02	0.25
Water Table Depth	cm	-3.98	-20	10
Peat Depth	cm	>200	30	>200

Table 5.6 shows the mean concentrations of water chemistry parameters recorded within different fen types as classified by the Monaghan Fen Survey 2007. As expected, it is clear that poor fens are characterised by nutrient poor, acid conditions.

Following a one-way ANOVA statistical test (and Tukey post-hoc test), significant differences ($p<0.05$) in mean pH, Ca concentration, Alkalinity, Electrical Conductivity, Magnesium concentration and Sulphate concentration are evident between the different fen types (see Table 5.6), although in the case of Sulphate no differences between groups were shown in the Tukey post-hoc test. Significant differences occur between alkaline fens and poor fens for all of these

parameters. There appears to be an increasing gradient from acid calcium poor water in the poor fens increasing to less acid conditions in the transition mires to more alkaline calcium rich conditions in the alkaline fens.

Although significant differences were not found between the TMR and TMP vegetation types, it is clear that differences are consistent with water samples from TMR being more alkaline and calcium rich than the TMP sites (see Table 5.6), thus supporting the occurrence of two different variants as revealed in the vegetation data analysis.

Table 5.6. Mean values (+/- Standard Error of the Mean) of hydrochemical variables recorded from different fen types.

Variable	**Units**	**Alkaline Fen (& Cladium Fen) (n=6)**	**Transition Mire (Rich) (n=18)**	**Transition Mire (Poor) (n=12)**	**Poor Fen (n=12)**	**Marsh (n=2)**
pH	pH Units	**7.6 (0.3)a**	**6.6 (0.1)b**	**6.5 (0.2)b**	**5.6 (0.3)c**	6.8 (0.1)
Alkalinity	mg/l CaCO3	**187.8 (40.1)a**	**117.2 (19)ab**	**52.8 (12.9)b**	**49.6 (19.5)b**	147 (70)
Conductivity	µS/cm @25°C	**438.3 (53.6)a**	**283.8 (33.6)ab**	**196.3 (38.2)bc**	**123.4 (34.6)c**	275.5 (117.5)
Calcium (Ca)	mg/l CaCO3	**75.4 (6.9)a**	**42.1 (7.2)b**	**19.4 (5.4)bc**	**13.6 (6.2)c**	44.5 (22)
Magnesium (Mg)	mg/l	**5.7 (1.1)a**	**3.7 (0.4)ab**	**2.8 (0.3)b**	**2.0 (0.6)b**	3.6 (0.9)
Sulphate (S)	Mg/l SO4	**24.3 (10.8)**	**6.0 (0.9)**	**15.9 (7.8)**	**3.0 (1)**	2.4 (0.3)
Potassium (k)	mg/l	3.7 (1.6)	2.7 (0.4)	2.7 (0.9)	2.1 (0.5)	1.41 (0.4)
Sodium (Na)	mg/l	7.6 (0.8)	8.0 (0.6)	7.1 (0.6)	7.0 (1.2)	5.7 (0.7)
Iron (Fe)	µg/l	3884.4 (3744.5)	928.2 (279.5)	691.6 (167.1)	5770.9 (4453.3)	3524.9 (3212.6)
Manganese (Mn)	µg/l	1574.4 (1459.5)	660.3 (216.8)	1675.7 (1015)	107.5 (25.4)	350.7 (253.2)
Copper (Cu)	µg/l	2.7 (1.7)	2.7 (0.4)	4.9 (1.6)	2.8 (0.7)	1.65 (0.7)
Zinc (Zn)	µg/l	44.7 (43.7)	5.5 (3.3)	13.8 (5.6)	11.4 (3.2)	10.1 (9.1)
Ammonia (NH3)	mg/l N	0.21 (0.11)	0.25 (0.05)	0.25 (0.11)	0.11 (0.03)	0.04
Total Oxidised Nitrogen (TON)	mg/l N	0.05	0.06 (0.01)	0.05	0.05	0.05
Total Phosphorus (TP)	mg/l P	0.24 (0.18)	0.25 (0.03)	0.30 (0.08)	0.32 (0.1)	0.21 (0.14)
Ortho-Phosphate (OP)	mg/lP	0.03	0.07 (0.02)	0.03 (0.01)	0.02	0.04 (0.02)
Water Table Depth	cm	-15 (3.1)	-1.9 (1.3)	-1.3 (1.5)	-5 (2.3)	0 (5)
Peat Depth	cm	>200	>200	>200	>200	>200
Species Richness		21 (3.5)	19.11 (0.9)	15.4 (1.4)	17.5 (2)	13.5 (1.5)

***Bold text**: significant differences between the mean values of different fen types following ANOVA (p<0.05). Different letters indicate significant differences between groups (e.g. for example in the case of pH, alkaline fen (a) is significantly different from all other groups; whereas Transition mire Rich (b) is not significantly different from Transition mire Poor which is also (b)). Marsh samples were excluded from analysis as there were only 2 samples. Peat depth was also excluded. n = sample size.*

Transition mires are characterised by the near neutral water chemistry and intermediate mineral enrichment. This implies that they are dependant on groundwater that is not calcareous in nature.

There is little variation found in nutrient (Total Phosphorous, Ortho-phosphate and Total Organic Nitrogen) levels within or between the different fen types.

The results of the DCA analysis are presented in Figure 5.3, with relevés (Figure 5.3a) and species plotted (Figure 5.3b) on a two dimensional ordination diagram. In general, those relevés that occur closest to each other on the ordination diagram are most similar in species composition. Bi-plot arrows indicate those environmental variables that are most important in determining species composition. The arrow length is proportional to the importance and the direction indicates the axis along which the variable increases.

Figure 5.3a confirms that the groups revealed by Twinspan releve analysis are also evident as clusters in the DCA ordination thus supporting the classification of fen types. Axis 1 accounts for 42% of the variation in the species data and is negatively correlated with pH, Alkalinity, Calcium and Magnesium concentration and Water Table height (see Figure 5.3 and Table 5.7). Axis 2 accounts for 27% of the variation in species data and is positively correlated with Electrical Conductivity, pH, Alkalinity and Magnesium but negatively correlated with Water Table depth (see Figure 5.3 and Table 5.7).

The importance of base-richness as a primary determinant of the composition of mire vegetation has long been recognised, as reflected in the gradient bog > poor fen > rich fen (Wheeler et al. 1995). This gradient is apparent in the classification of fen types undertaken during the current study as is evident from Figure 5.3 and Table 5.6.

The availability of nutrients such as N, P and K is undoubtedly of key importance to plant growth and vegetation composition in fens, but general relationships are often difficult to establish (Wheeler et al. 1995). Wheeler et al (1995) suggested that this may be due to the fact that simple measurement of N and P concentrations in fen waters does not adequately represent the availability of these nutrients, or because different nutrients are limiting in different situations. 'Eutrophication' of fens (i.e. enrichment with N, P or K) is widely regarded as an important cause of vegetation change (loss of species richness in particular) within fens in NW Europe, though its influence has often been more inferred than demonstrated (Wheeler et al 1995; Verhoeven et al. 1983). Methods used to reduce fertility of enrichment of fens are outlined by Bakker & Olff (1995).

In summary the results of the hydrochemical analysis confirms that Alkaline Fen sites are dependant on a continual supply of oligotrophic Calcium rich groundwater. In contrast, vegetation that occurs on Transition Mires is dependant on less mineral rich groundwater, with a circum-neutral pH. There is little published data on hydrochemical characteristics of fen types in Ireland. Dowding (1990) reported that Pollardstown Fen (an alkaline fen habitat) had conductivity ranging from 484 to 635µS/cm, which is comparable with the range recorded for alkaline fens in this study. Calcium (122 - 125mg/l) and Magnesium (8.5 – 9.1mg/l) concentrations recorded at Pollardstown were somewhat higher while Total Phosphorus (0.04 – 0.08mg/l) and Ammonia (0.06 – 0.09 mg/l) concentrations recorded were somewhat lower than those recorded from Alkaline Fens in the current study (Dowding 1990). Brooks et al. (2004) give a range of various parameters characteristic of Alkaline Fen vegetation in the UK which is comparable with the results of the current study.

Total Oxidised Nitrogen (Nitrates and Nitrites) concentrations were relatively low being below the lowest detection level of 0.05mg/l at most sites; with the only exceptions being a sample from each of Nafarty Fen (2.12mg/l), Dunaree (0.41mg/l) and Rafinny Lough (0.13mg/l).

The highest water tables were recorded from Transition mires indicating that the vegetation within these habitats require a high year-round water table as previously reported by Curtis et al (2006). In contrast, Alkaline Fens surveyed during the current study had lower water table, indicating that they may withstand water levels below the ground surface, as has been reported previously by Curtis et al (2006) and Brooks et al (2004) who reported a range of summer water levels from -34 to + 5 cm which is comparable to those recorded from the current study. The current study provides useful baseline data on the nutrient status of fen surface waters against which future monitoring can be compared. Unfortunately because of the lack of knowledge and data, it is not possible at present to draw many conclusions regarding the nutrient status of fens in the current study.

(see Appendix 8 for Hydrochemistry data)

Table 5.7. Eigenvalues of axes and Pearson correlation coefficients of environmental variables with axis 1, 2 and 3 of DCA.

	AXIS 1	**AXIS 2**	**AXIS 3**
Eigenvalue	0.420	0.267	0.195
Water Table	**-.299**	**-.522**	.072
Electrical Conductivity	**-.393**	**.558**	-.230
pH	**-.409**	**.525**	-.310
Alkalinity	**-.298**	**.592**	-.107
Calcium	**-.309**	**.620**	-.173
Magnesium	**-.239**	**.488**	-.182
Sulphate	-.028	.164	-.150
Total Phosphorus	.032	-.047	.096
Potassium	-.158	.043	-.077
Sodium	-.185	.028	-.036
Iron	.185	.152	.287
Manganese	-.236	.037	-.018
Copper	-.113	-.006	.009
Zinc	.101	.120	.100

Bold text: *indicates those that are displayed on Figure 5.3 (Pearson correlation >0.2)*

5.6 Ranking of Sites and Conservation Recommendations

Following the detailed survey of sites in County Monaghan each site was evaluated for its conservation value based on a set of 15 criteria (see Chapter 4 for details). Each of these criteria was scored in relation to each site on a four point scale and score totals for each site were calculated (see Appendix 9). Those sites which scored highest are deemed to have a greater ecological value. These site scores allowed ranking of sites into a series of categories from International importance to sites with a Low Local conservation value (see Chapter 4 for details).

Of the 42 sites surveyed in detail during the Fen Survey, site scores ranged from 3 to 67. The possible maximum that a site could score was 75.

Table 5.6 shows the number of sites in each conservation category following the ranking scheme adopted in the Monaghan Fen Survey 2007 (see Chapter 4 for details). This evaluation is based primarily on features of the site, the habitats present and overall damage and threats faced by the site (see Appendix 1 for individual site reports). Due to absence of data it takes only minimal account of general species values of the site (e.g. birds, mammals, insects, fish populations etc.). The addition of such values, based on future species surveys and information, may change the overall ranking of certain sites.

Table 5.6. The number sites and their conservation ranking following the Monaghan Fen Survey 2007.

Site Conservation Status	Ranking Code	No. of sites
International Value	A	3
National Value	B	16
County value	C	8
High local value	C+	4
Moderate local value	D	6
Low local value	E	5

5.6.1 Internationally important sites (A)

The three internationally important sites, Moylan Turlough (2531), Eshbrack Bog (1603) and the Kilroosky Lough Cluster (1786) contain habitat types which are rare or uncommon in a European context, namey Turlough, Blanket Bog and Hard Water Oligotrophic lakes. These sites have primarily been ranked as of international conservation value, meriting Special Areas of Conservation (SAC) designation by NPWS, because of the presence of these habitat types.

Only one site, the Kilroosky Lough Cluster has been given this designation to date. This is in fact the only SAC presently listed for County Monaghan.

Fen habitats, which only occur at Eshbrack Bog (Poor fen and Transition mire) and Kilroosky Loughs Cluster (Alkaline fen and *Cladium* fen), although of ecological interest, and in the case of *Cladium* fen which a priority habitat under the EU Habitats Directive, tend to form only a small percentage of the overall site area. These fen habitats do, however, add considerable interest to the overall ecological variation present within these sites.

5.6.2 Nationally important sites (B)

The 16 nationally important sites (B rating) contain habitat types which are rare or uncommon in Ireland, and merit designation under the NHA system. Based on thr results of the current study, these are now being proposed by the authors for inclusion in the NHA designation process being undertaken by the NPWS.

Of these sites, nine are already listed for designation by NPWS namely: Killyvilly Lough (1839), Lisabuck Lough (1835), Lisarilly Bog (1781), Lislannan Bog (1840), Lough Smiley (1607),

Mullaghmore Lake (South) (1785), Mullaglassan Lough (1837), Rafinny Lough (1606) and Rosefield Lake and Woodland (1784).

The remaining seven sites have no formal conservation designation, namely Aghnamullen Fen (2904), Cornaglare (MFS-01), Crinkill Lough (MFS-07), Drum Lough (MFS-02), Drumgallan Bog (2732), Killycooly Lough (MFS-08) and Killyneill Fen (2755).

With the exception of Drum Lough, Lisabuck Lough, Mullaghmore Lake (South) and Rosefield Lake and Woodland, which are primarily sites with a lake and associated non-fen wetland interest, the remaining sites being proposed for designation as NHA's contain significant fen element within the sites, and is the main reasons the sites are being proposed for NHA designation.

5.6.3 County Conservation Value (C)

Of the 8 sites considered to be of County conservation value, the MFS found that most are relatively extensive and contain good examples of fen habitat, and / or other habitat types.

In the case of Annagheane Lough (1836) and Drumcor Lough (1841) these sites have already been designated as NHA's by the NPWS. We recommend that this conservation designation should be maintained.

In the case of Coravilla-Rakeen Fen (2901), Crumlin Lough (MFS-04), Greaghlas Fen (2897), Lisinisky Marsh (2911), Morgans Lough (MFS-05) and Priestfield Lough (2614) the MFS found that these sites merit conservation due to their County conservation value, although at present they have no formal conservation designation.

Effective conservation of these sites will require listing of these sites in the Monaghan County development plan and Local Area Plans. The occurrence of Priestfield Lough, within the Rossmore Forest Park, managed as an amenity woodland area by Coillte Teoranta may also afford protection to this site. Should a local designation such as Local Biodiversity Area (LBA) be implemented as recommended by Anonymous (2005) come into being these sites should be given such as designation.

With the exception of Drumcor Lough, Greaghglas and Priestfield Lough which are primarily sites with a lake and associated non-fen wetland interest, limited areas of fen communties are an element within these sites, and are one the reasons the sites are being proposed for High local value designation.

5.6.4 High Local Value (C+)

Of the four high local value sites some have extensive water bodies but other wetland habitats generally tend to be poorly developed.

In the case of all four sites, Aghacloghan (2902), Ardkirk Fen (MFS-03), Bocks Upper (MFS-06), and Sheetrim Fen (2892) these sites merit conservation due to their High local conservation value, although at present they have no formal conservation designation.

Effective conservation of these sites will require listing of these sites in the Monaghan County development plan and Local Area Plans. Should a local designation such as Local Biodiversity Area (LBA) be implemented as recommended by Anonymous (2005) come into being these sites should be given such as designation.

Aghacloghan and Bocks Upper in particular, contain reasonably good examples of fen communities, while the remaining two sites have no fen habitats.

5.6.5 Moderate Local Value (D)

The six sites which are of Moderate local value (D rating) are all either very small or have been heavily modified by drainage or other impacts.

Only one of these sites Lisquigy (2896) was found to contain any significant fen communities. Fens were absent on the remaining sites.

Effective conservation of these sites will require listing of these sites in the Monaghan County Development Plan and Local Area Plans. Should a local designation such as Local Biodiversity Area

(LBA) be implemented as recommended by Anonymous (2005) come into being these sites should be given such as designation.

5.6.6 Low Local Value (E)

Five site were considered to have a low local rating (E rating), following the MFS survey, as they have been extensively modified and retain only minimal local wildlife value.

Three of these sites, which were proposed for NHA designation in the past, are now considered to be so altered, that de-designation is recommended (see Section 5.8 below).

Should conservation of the Low local value sites be considered as an option for these sites, they will require listing in the Monaghan County Development Plan and Local Area Plans. Should a local designation such as Local Biodiversity Area (LBA) be implemented as recommended by Anonymous (2005) come into being these sites should be given such as designation.

5.6.7 Future Conservation and Protection of Sites

The future conservation of the fen and wetland sites proposed above depends on a number of factors including conservation designations, ownership, legal status, planning controls, habitat management and protection of water sources, which are effectively controlled or under the remit of either the NPWS and Monaghan County Council.

Future conservation of the areas surveyed and found to be of conservation value in County Monaghan will require:

Designation: Sites found to be of SAC or NHA conservation value and status should be appropriately designated by the NPWS.

The SAC and NHA sites, as well as sites of County, High and Moderate local conservation value should be protected, and need to be listed in the County Council Development Plan and other related area plans. A local nature conservation designation similar to the SLNCI (Sites of Local Nature Conservation Value) designation in Northern Ireland would be useful in ensuring the conservation of these sites. Such a designation (Local Biodiversity Areas (LBA's)) has been recently proposed by a report commissioned by the Heritage Council (Anonymous 2005).

The Planning & Development Act 2000 requires Local Authorities to prepare Local Area Plans (LAPs) for towns and villages within their functional areas which satisfy specific criteria. The LAPs go through various public consultation stages before final adoption. The LAP sets out a framework to ensure that development occurs in a planned and sustainable (environmental, economic and social) manner over the plan's six-year lifetime. Fens identified as of county conservation value should be included in such LAPs.

Planning control: Control of damaging developments under the Planning Acts is the most immediate way in which conservation of the most important sites can be achieved, and should be implemented by the County Council, particularly in relation to the issue of landfill and dumping onto fen sites.

Management: Agricultural management, such as grazing and control of fertiliser run-off on surrounding lands, may be important in the conservation of certain sites. For example, light grazing of wet grassland or fen by certain livestock can prevent scrub encroachment. The Rural Environment Protection Scheme (REPS) may offer a mechanism to help conserve and manage these areas. Drainage needs to be restricted, and afforestation of sites should not be permitted as both these activities would seriously impact on the conservation value of fen and other wetland habitats.

Pollution control: Control of water pollution is a key factor in the conservation of fen sites. This depends on regular monitoring and prevention of nutrient enrichment at source whether this is from individual sewage treatment systems, agricultural run-off or other sources. Wetlands assist in purifying waters (both surface and groundwater) that pass through them.

Dumping and infilling control: Dumping and infilling was found to be a major damaging activity during MFS affecting 20 of those sites surveyed (see section 5.9 below). Further dumping and infilling of wetland sites should be strictly prohibited with a severe penalty imposed for such an offence. This should be a real deterrent for potential offenders in the future. In cases where

infilling has already taken place, if there is evidence of indirect effects on water quality due to the polluting nature of the infill, then the fill should be removed.

On wetland sites, where the fill is inert and the impact is loss of habitat, then consideration on whether the removal of fill is justified should be based on the quality of the wetland habitat. Where costs are prohibitive, then some other form of compensation for loss of habitat such as wetland enlargement of the remaining wetland area should be required.

This area is effectively controlled and under the remit of Monaghan County Council.

Control of invasive species: Removal of invasive species such as *Rhododendron ponticum* should be considered, as well as selective scrub removal on sites. The latter may be achieved by introducing a suitable grazing regime. Appropriate management regimes should be established with advice from a qualified ecologist and scientific personel from NPWS.

Provision of Public information: The provision of information on the conservation value of wetland and fen sites in particular is fundamental to the future local support for retention and enhancement of wetland sites. Such an information programme should be introduced on sites recommended for conservation and local protection; especially those that are located in close proximity to populated areas and easily accessible sites.

The programmes might include on site signposting to advertise the nature conservation value of areas (a feature loacking on all of the sites surveyed during the MFS); a public information leaflet on the value of wetlands (emphasising both economic and biodiversity values); and information displays or ehibitions that could tour county locations to raise public awareness of wetland value.

On site interpretation facilities would need to be vandal proof and be maintained on a regular basis.

The public information leaflet on wetland conservation could be prepared and distributed by the Heritage Office of Monaghan County Council. Some of the key information contained in this fen survey report and other sources could be used to make this as informative as possible. This would help to increase public understanding and support for wetland conservation measures.

The use of sites for recreational purposes should be explored, as this land-use when managed correctly can be beneficial to wetland conservation by building an appreciation of the beauty and value of fens and other wetlands.

5.7 Cross Border Conservation Issues

On five of the sites surveyed in detail during the Monaghan Fen Survey 2007, which contained a lake and habitat component which cross the international border with Northern Ireland, discontinuities in conservation designations on either side of the border were noted (see Table 5.7 below) which resulted in inadequate protection of sites.

Unless these discrepancies in conservation designations are resolved by the National Parks and Wildlife Service (ROI) and the Environment and Heritage Service (NI) it is difficult to see how the long term protection of these sites can be assured. Effective long term conservation and protection of these cross-border sites can only be achieved by ensuring the protection and proper management of the entire hydrological unit that constitutes these sites.

This issue relating to cross border sites occurred in the Republic of Ireland within the Kilroosky Lough Cluster SAC, Eshbrack Bog NHA, Drumgallan Bog (an undesignated site in the ROI), Killyvilly Lough NHA and Lislannan Bog NHA, and are illustrated in Figures 5.3 A to E below.

Appendix 11 illustrates the names of the sites on either side of the border and their relevant site codes, details the miss matched conservation designations or complete lack of them on either side of the border, and makes recommendations to resolve the discrepancies in conservation designations, so as to ensure favourable conservation status and long-term protection for these important cross border sites.

Table 5.7. The location of sites with mismatched cross border conservation designations with respective site names and codes in Republic of Ireland and Northern Ireland.

Site Code ROI	Site Name and Conservation Status ROI	Site Code NI	Site Name and Conservation Status NI
001603	ESHBRACK BOG, NHA	UK0016622	SLIEVE BEAGH, SAC
001786	KILROOSKY LOUGH CLUSTER, SAC	SAC009	MAGHERAVEELY MARL LOUGHS, SAC
001839	KILLYVILLY LOUGH, NHA	SAC009	MAGHERAVEELY MARL LOUGHS, SAC
002732	DRUMGALLAN BOG, Undesignated	ASSI182	DRUMCARN, ASSI
001840	LISLANNAN BOG, NHA	None	None

** NHA – Natural Heritage Area*
** SAC – Special Area of Conservation*
** ASSI – Area of Special Scientific Interest*

5.8 Change in Conservation Value of Sites

Three sites surveyed during the current Monaghan Fen Survey 2007, which had an existing conservation designation prior to the survey, were found to have been seriously affected by drainage activities, resulting in habitat deterioration and loss of most if not all of their conservation value.

The sites in question were Allagesh Lough (1780); Killyhoman Marsh (1782) and Nafarty Fen (2077), (see Appendix 1 for site descriptions and Appendix 2 for illustration the damage which has been caused to these sites).

In the case of the first two sites, Allagesh Lough (1780); Killyhoman Marsh (1782), extensive drainage works, carried out over a decade ago, have contributed to a significant drop in the water table which has resulted in a deterioration or loss in the conservation worthy wetland and possibly former fen habitats previously recorded on these sites. In the case of Allagesh, the site is now dominated by a *Phalaris arundinacea* marsh and areas of wet grassland, which have only a low conservation value. Extensive drainage works on Killyhoman have completely dried out the site which has been invaded and overgrown by a dense Birch (*Betula pubescens*) scrub community.

In the case of Nafarty fen, which has been used extensively as a water supply for the town of Carrickmacross, water abstraction and the construction of various water collection structures has significantly altered the naturalness of the site.

It is the opinion of the survey team that these sites should be de-listed as NHAs, although they still retain a lower conservation value. Allagesh Lough (1780) and Killyhoman Marsh (1782) were both rated as of Low local conservation value (ranking E), while Nafarty Fen (2077) was rated as of Moderate local conservation value (ranking D) (see Appendix 9 for further information on site conservation evaluation).

5.9 Threats and Damage to Fens in County Monaghan

The majority, if not all, the fen and wetland sites surveyed in County Monaghan have been subject to some degree of damage or modification from their natural state in the past. This feature has been observed on other Irish peatland types, most noteably raised bogs (Cross 1990; Fernandez *et al* 2005; Derwin *et al* 2002; Foss *et al* 2001), which are surrounded by agricultural land, where reclamation and drainage works are an on-going agricultural management tool which affects the hydrological condition of adjacent wetlands.

The Monaghan Fen Survey (MFS) also found that 36 of the 42 sites surveyed are threatened with further damage which will continue to reduce their value for biodiversity value (see Table 5.7). Details of the past damage and current threat to each individual site surveyed as part of the MFS can be viewed on the "Site Threats" layout in the NPWS Fen Survey database which accompanies this report, or in the full site description for each site in Appendix 2.

The major sources of damage and threat were as follows:

5.9.1 Drainage

Drainage has visibly affected the greatest number of sites and has generally led to drying out and reduction in the wetland area on sites. In certain cases this has also been associated with land reclamation.

At least 20 of the wetlands have suffered from drainage, while 18 are threatened or likely to be affected by this activity in the future. Some of the sites may have been drained as long ago as the nineteenth century, while others have been recently drained and the effects are evident in the vegetation and habitat change occurring on these sites today. Four sites (see section 5.8 above) have in fact been so negatively affected by drainage works over the last decade in particular, that their continuing conservation value is questionable.

5.9.2 Land reclamation, infilling and domestic refuse dumping

Land reclamation often follows drainage work, although infilling of wetlands can take place independently of drainage.

During the course of the Monaghan Fen Survey 2007 it became apparent that, on many of the sites surveyed, and on wetlands within the county in general, infilling with building waste and soil is a serious problem which is affecting the conservation status of sites. Infilling of wetlands which are an important source of biodiversity within the County is not compatible with the long term protection of their biodiversity value.

Of the 42 sites surveyed in detail during the course of this survey 20 were found to be affected by this activity (13 have been affected by this activity in the past; while 16 sites are threatened by on-going infill activities). This represents 47% of the sites surveyed during the MFS. More worrying is that 6 of the sites on which current dumping activities were noted have been designated as Natural Heritage Areas (NHA). These infill and dumping activities are not compatible with the long term survival and protection of these conservation worthy areas. There may also be a wider indirect impact on the water quality of the wetland if the fill contains toxic or polluting substances, especially where infilling is accompanied by the dumping of household refuse. This type of damage is very costly to reverse.

Appendix 10 lists the sites where such dumping and infilling was noted (in some cases associated with the dumping of domestic refuse), and assesses the severity of these activities.

It would also appear that most of this infilling is occurring illegally on sites, though at one or two sites planning notices were observed which might indicate that these activities had been sanctioned by the County Council. If the Council is serious in its efforts to protect biodiversity at the County level it must take action to halt this illegal infilling of wetlands. The Council might also consider an education and sign posting programme, at least at the NHAs and other designated sites, to make people aware of the damage they are causing when they infill wildlife sites in the County.

5.9.3 Afforestation

Planting of trees on wetland soil is generally accompanied by drainage. Conifer plantations have been established on the immediate margins or on a number of wetlands in the County (Bocks Upper, Kilroosky Lough Cluster, Drumcor Lough, Aghacloghan, Eshbrack, Graffagh and Corinshigo,) while broad-leaved tree planting has been undertaken on the margin of Coravilla - Rakeen. Consideration should be given to the likely future impacts of these woodlands, and their removal should be considered.

A number of other wetlands have various types of wet woodland present, in particular on marginal areas. In some cases this wet woodland development may be due mainly to natural colonisation by Willow species and Alder, however the spread of such woodland areas over a site may also be an indication of hydrological conditions that favour the spread of woodland at the expense of fen communities. It may be necessary to monitor the changing status of wet woodland areas, and where these threaten the long term survival of open fen areas, some degree of scrub removal or a suitable grazing regime to halt the woodland spread may be need to be considered in relation to the future management of these sites.

5.9.4 Pollution

Water pollution and its effects on fens may be a difficult problem to identify and resolve in wetland habitats. Nutrient enrichment from inflow sources or run-off from neighbouring agricultural land may be a problem. These nutrient sources need to be carefully monitored to ensure that they are not adding key nutrients to the wetland system which might cause vegetation changes.

Although significant changes in water chemistry, caused by water pollution has been cited (Curtis *et al* 2006) as a factor affecting site vulnerability, studies are lacking on the physio-chemical requirements of most fen habitat types in Ireland. The current study should go some way towards filling this information gap.

Buffering capacity is considered to be high for Transition mire and Alkaline fens (due to nature of the organic peat substrate), but not accurately known. Phosphorus is the limiting nutrient to growth in most calcareous fen habitats (Doyle & Ó Críodáin 2003)) while Nitrogen has been shown to be the limiting nutrient in many poor fens (Koerselman and Verhoeven 1995). Elevated levels lead of phosphorus leads to vigorous growth of grasses over other species, resulting in the loss of fen species diversity. The role of increased nitrogen levels in the species composition of Transition mire and Alkaline fen is unclear.

Transition mire is characteristic of more nutrient poor and less alkaline conditions, it may be assumed that changes in either of these water parameters (Nitrogen, Phosphorus) will result in unfavourable conditions for long term survival of the habitat.

During the course of the Monaghan Fen Survey, water samples were often collected from stands of vegetation located near the centre of the sites. In these samples little evidence of elevetated nutrient or polluting levels were detected, although 5 sites were identified where changes in vegetation were noted and ascribed to the effects of pollution, while a further 10 sites were considered to be potentially under threat from water pollution.

These results may indicate that sites were not being polluted, or that the marginal or inflow pollution sources were not detected at the sample locations chosen possibly due to internal cycling of nutrients and complex biochemical processes. Further research is required to ascertain the likely future effects of pollution on the various fen habitats as noted in Monaghan.

A common feature of Monaghan fens is the unusually small catchment of many systems which often comprises no more than the surrounding drumlins. These sites may provide ideal opportunities for controlling the input of nutrients from surrounding land-uses. The predominant land-use however on the surrounding drumlins is intensive agriculture and the boundary between this land and the fen is usually abrupt.

Such a programme might be implemented as part of the Water Framework Directive (2000/60/E). Efforts to protect water dependent habitats, which include Alkaline Fen, Transition Mire, and Calcareous Fens with *Cladium mariscus* are being taken within each River Basin District. This is critical as far as protection of the water supplies for these groundwater dependant systems are concerned.

All SACs and, in future, NHAs in which these fen habitats are a qualifying interests will be listed in the Register of Protected Areas drawn up for each River Basin District.

The Water Framework Directive requires that an integrated monitoring programme be established within each river basin district. These monitoring programmes will in many cases be extensions or modifications of existing programmes and will enable collection of the physical, chemical and biological data necessary to assess the status of surface and groundwater bodies in each river basin district.

Where water quality or supply issues are, or have the potential to, impact adversely on sites, this will have to be dealt with through the Programme of Measures associated with each River Basin District Management Plan.

5.9.5 Invasive species

The invasion of alien plants into wetland habitats is also a difficult problem to resolve as these species are generally vigorous and may be quite resistant to most control measures. At Killyneill Fen (Site 2755) a small area of the woodland contains stands of *Rhododendron ponticum.* This plant can also invade open peat areas so is a threat to the entire wetland. Its removal is recommended as part of any management plan that is developed for the site.

5.9.6 Other Impacts

In addition to the main threats listed above, a number of other impacts were noted at some of the site visited during the MFS. The impacts of these activities is likely to have some affect on the wetlands on which they occur, and should perhaps be quantified and addressed in any management plans developed for these sites.

These other potential impacts included small to medium scale water abstraction schemes for local use, noted at Nafarty Fen, Crinkill Lough and Rafinny Lough.

Where sites allowed a degree of visitor access (most notably for fishing activities) littering and trampling damage were noted in some cases, espcially along routes leading to fishing stands (Kilroosky Lough Cluster).

Low evidence of shooting was recorded at a number of sites. The main impact resulting from this activity is on the wildfowl populations that utilise the wetlands especially in winter. Shooting should be prohibited in all those sites that are known to be utilised by significant numbers of wildfowl or threatened bird species. Shooting is not compatible with the conservation objectives of NHA's and SAC's and therefore should be prohibited in these areas.

Table 5.7. The number sites damaged and threatened by various activities as revealed during the Monaghan Fen Survey 2007.

Type of Activity	No. of sites damaged by this activity	No. of sites threatened by this activity
Drainage	20	18
Infilling/Dumping	13	16
Afforestation	7	1
Water Pollution	5	10
Invasive species	1	6

5.10 Potential Fens Sites requiring future Survey in County Monaghan

Due to the abundance of wetland sites in County Monaghan it was not possible in the context of this survey to visit all sites within the County. In total 69 sites were examined during the 2007 Monaghan Fen Field Survey.

During the course of the survey, a number of additional sites were discovered as part of the field survey and associated examination of air photographs. In addition some extra sites were submitted for survey consideration by third parties, in particular Lord Tennison and Alan Hill, the BSBI County Recorder for Monaghan. A list of the additional wetland sites, which it was not possible to survey, but which may contain a fen interest are referred to in Appendix 4 & 5.

As a means of estimating number and area of other potential wetland areas in the county a GIS based desktop survey was carried out. From this analysis of four square grids (5 X 5 km) within the county (see Figure 5.8), where quaternary soil deposits were compared with the habitat types that can be identified from air photographs, it would appear that there may be a considerable number of additional wetland areas remaining in Monaghan worthy of survey.

Table 5.8 presents the results of this desk-top exercise to estimate the percentage of wetland habitat remaining in the county. Figure 5.4 shows the location of the sample areas of the survey. The results of this survey shows that of the original area of raised bog in the county approximately 21% remains as wetland habitat. Most of the raised bog areas (estimated 58%) have been drained and is now under improved pasture, the remainder comprising wet grassland and woodland habitats (estimated 21%).

This survey indicates that although 80% of raised bogs have lost all wetland interest, there is likely to be a large number (approximately 500) that contain wetland habitat which may comprise some fen vegetation. This confirms that it is unlikely that the current MFS 2007 has surveyed all fens in the county and that there are likely to be a number of sites that have yet to be surveyed. However, during this exercise, of the 173 units surveyed with remote sensing techniques, very few appeared likely to have any significant areas of fen, many of the sites appeared to have reed and marsh vegetation types although a field survey would be the only way to confirm this.

Table 5.8 Desktop habitat survey of cutover raised bogs from four sample blocks (5 X 5 km) throughout county Monaghan (sources: Meehan 2004 and Ordnance Survey of Ireland Colour Aerial Photographs).

Survey Area	Total Area of Blocks (ha)	Number of Cutover Bog Units	Total Area of Bog Units (ha)	Number and (percentage) of Units Now Containing Wetland	Estimate Area in ha and (percentage) of Wetland Remaining
Eastern	2500	68	803.1 (32%)	19 (28%)	144 (18%)
Northern	2500	29	114.8 (5%)	3 (10%)	6.8 (6%)
Southern	2500	46	100.2 (4%)	9 (20%)	36.4 (36%)
Western	2500	30	456.9 (18%)	7 (23%)	126.3 (28%)
Total	**10000**	**173**	**1475 (15%)**	**38 (22%)**	**314 (21%)**
County	**129356**	**2267**	**12246 (9.5%)**	**499 (22%)[1]**	**2572 (21%)[2]**

[1] Assuming that 22% of bog units throughout the county now contain wetland units as recorded in the sample blocks surveyed in detail.
[2] Assuming that 21% of wetland units throughout the county now contain wetland as recorded in the sample blocks surveyed in detail.

Expert opinion would suggest that the known sites recommended for survey, as well potential fen sites that might be identified following a detailed air GIS based desk survey, be examined as part

of a follow up survey of fen sites in Monaghan, using the survey methodology developed and reported on in this report.

5.11 Methodological Considerations for the forthcoming National Fen Survey

A number of points have emerged from the Monaghan Fen Survey which might be considered in the planning and implementation of future surveys forming part of the National Fen Survey. These are detailed below.

The Monaghan Fen Survey project developed a detailed site survey system for fens, which could be used on the forthcoming National Fen Survey. This incorporates the following main elements:

- background research on known or potential fen sites, using previous report and survey data; accessing expert data sources; and using various GIS data sources;
- identification of additional potential sites made by examination of air photographic data and during field survey period;
- field survey system designed and tested;
- digital data storage, analysis and presentation system developed and tested;
- conservation evaluation and ranking system of sites for the NFS created.

Based on the results of the MFS it is likely that a significant number of sites presently considered to contain fens at the national level, may not in fact contain this habitat. The area of fen identified within these sites is also likely to be over estimated at present. To obtain accurate information on the scale, and geographic distribution of the Irish fen resource it is essential that additional county fen surveys are undertaken without delay.

From an analysis of the GIS maps, it is likely that a significant number of additional potential fens exist in Monaghan (and by extension nationally) than were identified in advance and during the course of the present survey (see section 5.10 above). Although many of the larger, more well known sites appear to have been surveyed, it is likely that numerous smaller sites still exist which may have a conservation value and should be considered for survey.

It is possible that a longer period spent on GIS air photograph analysis would have yielded additional (though smaller) sites for survey consideration in Monaghan. However, a larger site survey list would also require additional field survey time and resources to survey properly. The MFS has shown that only by examining sites on the ground is it possible to be sure that the site contains fen vegetation, and of which type. These details cannot be identified with certainty from GIS data sources alone. A decision to undertake a detailed GIS habitat study, of each county in the context of each fen survey (or for the entire country as part of the NFS), would have significant manpower implications. For example, in the case of the MFS, a representative sample of four 5km squares were surveyed. This took approximately 10 man hours to complete (excluding the development of the GIS), on this basis a GIS survey of the entire county as carried out in the MFS would have taken approximately 144 man hours to complete (based on 58 X 5km squares).

In terms of the detailed fen survey of sites, the time required to prepared for, and undertake the detailed field survey of fen sites is equivalent to time needed to prepare final site reports and maps; analyse relevé data; undertake water chemistry data analysis; present results and prepared the overall survey report etc.

It is suggested that a simplified first round national fen survey scheme needs to be developed and tested, which would allow a larger number of sites to be assessed in brief, before the detailed fen survey work is undertaken. This might include:

- a more detailed GIS air photographic evaluation of potential fen site locations within each county
- followed by drive by survey and quick field examination to identify the best candidate fen sites requiring detailed survey; and make a simple site record of the main habitats present
- this initial reconnaissance survey could be followed by a detailed fen survey on the smaller number of sites identified as highly likely to contain fen habitats. The detailed survey would collect of relevé data, produce habitat and site maps, analyse site hydrochemistry, conduct evaluation and conservation ranking of site and produce the full digital site report.

One of the requirements of the MFS was to prepare a duplicate set of site folders containing maps, site description and final habitat information, for NPWS and Monaghan County Council. Although preparation of one copy of site folders, for the Natural Heritage Area archive system in NPWS is an essential requirement – the MFS survey team question the necessity to duplicate all paper records

for the County Council (or other third party), especially as a complete digital record of the sites is already included within the report format designed for the MFS. This project requirement should be dropped from future county surveys where NPWS undertakes the survey in partnership with a third parties.

Within the context of the MFS, for sites which were identified as of national or international conservation value (i.e. NHA or SAC level), a requirement of the project was the completion of a NPWS Natural Heritage Area data form. The current version of this NHA form is somewhat out of date. Prior to the survey of additional sites as part of the NFS this data form should be up-dated to reflect current habitat classification schemes, site threats and damage recording schemes, habitat area estimation inter alia. One option in this regard might be to incorporate this form and the associated data fields required into the NPWS Fen Survey database, which would allow digital entry and storage of results, and final output.

During the MFS water samples were collected from the majority of sites surveyed in detail, and which contain fen habitats. The results obtained from this hydrochemical analysis proved useful and supplied valuable data on the environmental factors occurring on the fen sites and in relation to the community types recorded there. Full analysis of water samples as undertaken during the MFS, if applied to the NFS would have significant cost implications.

Should resources limit the number of water samples that could be analysed in future, perhaps restricting water sample collection to the key fen community types recognised during future surveys, would provide adequate detailed hydrochemistry data.

Provision of a portable pH meter and electrical conductivity meter, to future survey teams should be considered, and would give adequate information on water chemistry as part of the general survey.

One other equipment requirement for future surveys, which the NPWS should consider providing surveyors with is a hand help Global Positioning System (GPS) device. GPS was found to be useful in some larger sites (Eshbrack) but in general due to the small and accessible nature of most of those sites surveyed in Monaghan was of limited value, having a good aerial photograph at an appropriate scale and with a grid overlain proved more useful in most situations. GPS would be especially useful in accurately locating small areas of fen within large sites (e.g. blanket bog areas) where accurate positioning can be difficult due to lack of useful local topographic features or where significant changes in local features has occurred due to habitat drainage, infill or fluctuating water levels.

6. Conclusions

6.1 Monaghan Fen Survey

This survey set out to examine 30 known sites in County Monaghan and assess their fen interest, and locate additional sites. Following the completion of the field survey, a total of 42 sites (with 69 sub compartments) had been examined in detail together with 14 sites examined in brief.

The results of the Monaghan Fen Survey, for the 30 sites which had been proposed for survey, indicates that the extent of fens was over estimated (Foss 2007) in the county in terms of both the number of sites believed to contain fen and the estimate of fen habitat extent on sites.

However, due to habitat conditions within the county (based on an analysis of GIS quaternary deposits information, present day habitats on these areas, and local topographical conditions), additional fen sites are likely to occur. In addition a number of sites have been identified, though not surveyed, which would indicate that additional un-surveyed fen sites occur within the county.

A follow up survey of fen habitats within the county is required to ascertain the final distribution and extent of fens in county Monaghan.

At present only 96.5 ha of fen have been identified in county Monaghan making the habitat rare within a county context. Measures to ensure the long term protection, conservation and management have been proposed for those sites identified as of conservation importance at county level or higher. The protection and long term biodiversity protection within these sites will require actions by both the County Council and the National Parks and Wildlife Service.

6.2 National Fen Survey

A methodology for the detailed survey of fen sites has been developed and trailed during the course of the Monaghan Fen Survey.

This methodology allows the creation of a full digital record of the sites surveyed to include various site maps (GIS air photograph, 6 inch map etc) and a final site habitat map, photographic site record, and a description and account of the site and habitat particulars, together with phytosociological, environmental and hydrochemical data on the fen communities present.

This survey methodology is ideal for the detailed survey of sites with a known fen interest as part of a National Survey of Fens.

However, due to the volume of "potential" fen sites to be examined on a national scale, and the likelihood of the discovery of additional fen sites, it is suggested that a less intensive, more rapid preliminary survey approach may be more resource efficient, in short listing actual fen sites for detailed survey. This approach is supported by the high number (40%) of sites that were listed as "possible" fen sites in Monaghan – but which were subsequently found not to include any significant fen areas, following their detailed survey.

A structure for the on-going survey of Irish fens might then consist of:

- more detailed GIS examination of air photography to shortlist possible fen sites
- greater efforts made to contact local specialists seeking site information
- a rapid field assessment system to identify fen sites and exclude those site with other related wetland habitats including marsh; wet woodland; and reed bed communities

Only following the completion of the various County shortlists would a detailed Fen Survey be undertaken on sites identified as the potential location for fen communities.

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8. Appendices

In the report appendices which follow, the PDF layouts (produced in general from Excel files) have been formatted and reduced to allow printing at A4 page size. The original Excel appendix spreadsheets from which these were PDF's were produced are included on the CD rom included with this report.

Contents – Report Appendices Volume I

Contents – Report Appendices Volume II

Contents – Report Appendices Volume III

Monaghan Fen Survey 2007

Appendix 3A. List of fens in County Monaghan surveyed in detail with site source, survey status and conservation designation prior to survey on the Monaghan Fen Survey 2007.

Totals			69			1,919			
Site Code	**Site Name**	**Site Source**	**Number of discrete sub sites for survey**	**Date Monaghan Fen Survey Completed**	**Survey Status prior to Monaghan Fen Survey**	**Estimated total site area**	**Grid Reference**	**Existing Conservation Designations**	**MFS Ranking after Survey**
002900	AGHABOY TOWNLAND FEN	Original NPWS FEN Study List	1	31 May 2007	No NHA survey	7.3	H 626 350	Undesignated site	D
002902	AGHACLOGHAN FEN	Original NPWS FEN Study List	1	24 May 2007	No NHA survey	5.1	H 802 089	Undesignated site	C+
002904	AGHNAMULLEN FEN	Original NPWS FEN Study List	1	23 May 2007	No NHA survey	8.2	H 684 172	Undesignated site	B
001780	ALLAGESH LOUGH	Finn/Lackey Report	1	9 June 2007	NPWS Ranger Survey only	5.5	H 590 346	Undesignated site	E
001836	ANNAGHEANE LOUGH NHA	Finn/Lackey Report	2	30 May 2007	NHA Survey completed	12.3	H 469 181	cNHA pNHA	C
MFS-03	ARDKIRK FEN	Heritage Officer 2007	1	5 June 2007	No NHA survey	8.4	H 872 144	Undesignated site	C+
MFS-06	BOCKS UPPER	Air Photo/survey discovery	1	8 June 2007	No NHA survey	11.1	H 794 091	Undesignated site	C+
002901	CORAVILLA - RAKEEN FEN	Original NPWS FEN Study List	1	23 May 2007	No NHA survey	12.9	H 648 241	Undesignated site	C
MFS-01	CORNAGLARE	Air Photo/survey discovery	1	28 May 2007	No NHA survey	18.8	H 648 300	Undesignated site	B
MFS-07	CRINKILL LOUGH	BSBI Alan Hill Site	1	10 June 2006	No NHA survey	22.1	H 767 195	Undesignated site	B
MFS-04	CRUMLIN LOUGH	Air Photo/survey discovery	1	28 May 2007	No NHA survey	5.1	H 642 330	Undesignated site	C
MFS-02	DRUM LOUGH	Heritage Officer 2007	3	28 May 2007	No NHA survey	42.7	H 561 183	Undesignated site	B
001841	DRUMCOR LOUGH NHA	Finn/Lackey Report	2	30 May 2007	Unsurveyed	32.7	H 472 171	cNHA pNHA	C
002732	DRUMGALLAN BOG	Original NPWS FEN Study List	1	27 May 2007	No NHA survey	34.3	H 810 283	cNHA	B
002903	DUNAREE FEN	Original NPWS FEN Study List	1	24 May 2007	No NHA survey	3.2	H 794 104	Undesignated site	E
001603	ESHBRACK BOG NHA	Original NPWS FEN Study List	10	6 June 2007	NHA Survey completed	1183	H 550 430	NHA pNHA	A
002898	GRAFFAGH AND CORINSHIGO FEN	Original NPWS FEN Study List	2	11 June 2006	No NHA survey	75.7	H 590 331	Undesignated site	D
002897	GREAGHGLAS FEN	Original NPWS FEN Study List	1	22 May 2007	No NHA survey	8.9	H 701 307	Undesignated site	C
MFS-08	KILLYCOOLY LOUGH	BSBI Alan Hill Site	1	11 June 2006	No NHA survey	6.4	H 794 091	Undesignated site	B
001782	KILLYHOMAN MARSH NHA	Original NPWS FEN Study List	1		NHA Survey completed	6.1	H 630 523	pNHA cNHA	E
002755	KILLYNEILL FEN	Original NPWS FEN Study List	4	25 May 2007	No NHA survey	80.9	H 730 354	Undesignated site	B
001839	KILLYVILLY LOUGH NHA	Original NPWS FEN Study List	1	9 June 2007	NHA Survey completed	3.1	H 551 334	cNHA pNHA	B
002899	KILNACLAY FEN	Original NPWS FEN Study List	2	28 May 2007	No NHA survey	7.7	H 632 303	Undesignated site	D
001786	KILROOSKY LOUGH CLUSTER SAC	Original NPWS FEN Study List	5	29 May 2007	NHA Survey completed	58	H 490 275	cSAC pNHA	A
001835	LISABUCK LOUGH NHA	Finn/Lackey Report	2	30 May 2007	NHA Survey completed	17	H 503 230	cNHA pNHA	B
001781	LISARILLY BOG NHA	Original NPWS FEN Study List	1	28 May 2007	NPWS Ranger Survey only	9.9	H 581 269	cNHA pNHA	B
002911	LISINISKY MARSH	Original NPWS FEN Study List	1	8 June 2007	No NHA survey	22.4	H 706 096	Undesignated site	C
001840	LISLANNAN BOG NHA	Original NPWS FEN Study List	2	29 May 2007	No NHA survey	14.9	H 548 303	cNHA pNHA	B
002893	LISNALEE FEN	Original NPWS FEN Study List	1	22 May 2007	No NHA survey	8.6	H 690 281	Undesignated site	E
002896	LISQUIGNY (CORLONGFORD) FEN	Original NPWS FEN Study List	1	25 May 2007	No NHA survey	15.7	H 732 267	Undesignated site	D

Monaghan Fen Survey 2007

Appendix 3A. List of fens in County Monaghan surveyed in detail with site source, survey status and conservation designation prior to survey on the Monaghan Fen Survey 2007.

Totals			69			1,919			
Site Code	**Site Name**	**Site Source**	**Number of discrete sub sites for survey**	**Date Monaghan Fen Survey Completed**	**Survey Status prior to Monaghan Fen Survey**	**Estimated total site area**	**Grid Reference**	**Existing Conservation Designations**	**MFS Ranking after Survey**
001607	LOUGH SMILEY NHA	Original NPWS FEN Study List	4	27 May 2007	NHA Survey completed	75.7	H 82 21	cNHA pNHA	B
MFS-05	MORGANS LOUGH	Air Photo/survey discovery	1	29 May 2007	No NHA survey	5.1	H 502 279	Undesignated site	C
002531	MOYLAN LOUGH	Original NPWS FEN Study List	1	24 May 2007	No NHA survey	12.8	H 854 088	cNHA	A
001785	MULLAGHMORE LAKE (SOUTH) NHA	Original NPWS FEN Study List	1	31 May 2007	NPWS Ranger Survey only	16.1	H 624 381	pNHA cNHA	B
001837	MULLAGLASSAN LOUGH NHA	Original NPWS FEN Study List	1	9 June 2007	NHA Survey completed	5.8	H 573 327	pNHA cNHA	B
002077	NAFARTY FEN NHA	Original NPWS FEN Study List	1	5 June 2007	NPWS Ranger Survey only	3.6	H 837 045	cNHA pNHA	D
002614	PRIESTFIELD LOUGH	Original NPWS FEN Study List	1	31 May 2007	No NHA survey	7.2	H 650 310	ASI cNHA	C
001606	RAFINNY LOUGH NHA	Original NPWS FEN Study List	1	23 May 2007	NPWS Ranger Survey only	5.2	H 618 263	cNHA pNHA	B
001784	ROSEFIELD LAKE AND WOODLAND NHA	Original NPWS FEN Study List	1	31 May 2007	NPWS Ranger Survey only	16.8	H 632 337	cNHA pNHA	B
002892	SHEETRIM FEN	Original NPWS FEN Study List	1	22 May 2007	No NHA survey	6.3	H 679 315	Undesignated site	C+
002894	TIRAGARVAN FEN	Original NPWS FEN Study List	1	5 June 2007	No NHA survey	8.3	H 819 048	Undesignated site	D
002895	TOSSY CROSS FEN	Original NPWS FEN Study List	1	24 May 2007	No NHA survey	8.1	H 769 154	Undesignated site	E

Monaghan Fen Survey 2007

Appendix 3B. List of fens in County Monaghan surveyed in detail in 2007 with predicted fen types and area, and fen types and total area confirmed following the Monaghan Fen Survey.

					Total Fen Area:	**190**	**Total Fen Area:**	**95.58**	
Site Code	**Site Name**	**Estimated total site area**	**Grid Reference**	**Predicted Fen type(s) present**	**Estimated Fen Area**	**Confirmed Fen type(s) after Monaghan Fen Survey 2007**	**Fen Area after MFS**	**MFS Ranking after Survey**
002900	AGHABOY TOWNLAND FEN	7.3	H 620 350	Poor fen PF2	4	No fen on site	0	D
002902	AGHACLOGHAN	5.1	H 807 087	Poor fen PF2	0	Transition Mire 7140 PF3 Poor fen PF2	1.15	C+
002904	AGHNAMULLEN	8.2	H 682 172	Poor fen PF2	0	Transition Mire 7140 PF3	2.14	B
001780	ALLAGESH LOUGH NHA	5.5	H 590 346	No fen predicted	n/a	No fen on site	0	E
001836	ANNAGHEANE LOUGH NHA	12.3	H 469 181	No fen predicted	n/a	Transition Mire 7140 PF3	0.21	C
MFS-03	ARDKIRK FEN	8.4	H 872 144	New site - no predicted fen type	n/a	No fen on site	0	C+
MFS-06	BOCKS UPPER	11.1	H 794 091	New site - no predicted fen type	n/a	Transition Mire 7140 PF3	4.15	C+
002901	CORAVILLA - RAKEEN	12.9	H 660 245	Poor fen PF2 Transition Mire 7140 PF3	30	Transition Mire 7140 PF3	3.94	C
MFS-01	CORNAGLARE	18.8	H 648 300	New site - no predicted fen type	n/a	Transition Mire 7140 PF3	1.05	B
MFS-07	CRINKILL LOUGH	22.1	H 767 195	New site - no predicted fen type	n/a	Transition Mire 7140 PF3 Poor fen PF2	3.59	B
MFS-04	CRUMLIN LOUGH	5.1	H 642 330	New site - no predicted fen type	n/a	Transition Mire 7140 PF3	1.93	C
MFS-02	DRUM LOUGH	42.7	H 561 183	New site - no predicted fen type	n/a	No fen on site	0	B
001841	DRUMCOR LOUGH NHA	32.7	H 472 171	No fen predicted	n/a	No fen on site	0	C
002732	DRUMGALLAN BOG	34.3	H 813 283	Transition Mire 7140 PF3	20	Transition Mire 7140 PF3	11.88	B
002903	DUNAREE	3.2	H 795 105	Poor fen PF2	0	Transition Mire 7140 PF3	0.48	E
001603	ESHBRACK BOG NHA	1183	H 550 430	Transition Mire 7140 PF3 Poor fen PF2	39.3	Alkaline fen 7230 PF1 Transition Mire 7140 PF3 Poor fen PF2	4.1	A
002898	GRAFFAGH AND CORINSHIGO	75.7	H 595 338	Transition Mire 7140 PF3 Poor fen PF2	15	Site survey incomplete	n/a	D
002897	GREAGHGLAS	8.9	H 705 307	Poor fen PF2	0	No fen on site	0	C
MFS-08	KILLYCOOLY LOUGH	6.4	H 794 091	New site - no predicted fen type	n/a	Transition Mire 7140 PF3	1.5	B
001782	KILLYHOMAN MARSH NHA	6.1	H 630 523	Transition Mire 7140 PF3	0	No fen on site	0	E
002755	KILLYNEILL FEN	80.9	H 730 354	Transition Mire 7140 PF3 Poor fen PF2	40	Transition Mire 7140 PF3 Poor fen PF2	31.45	B
001839	KILLYVILLY LOUGH NHA	3.1	H 551 334	Cladium fen 7210 PF1	0.4	Cladium fen 7210 PF1	0.24	B
002899	KILNACLAY FEN	7.7	H 635 305	Poor fen PF2	3	No fen on site	0	D
001786	KILROOSKY LOUGH CLUSTER SAC	58	H 490 275	Alkaline fen 7230 PF1 Cladium fen 7210 PF1 Transition Mire 7140 PF3	10	Alkaline fen 7230 PF1 Cladium fen 7210 PF1 Transition Mire 7140 PF3	1.27	A
001835	LISABUCK LOUGH NHA	17	H 503 230	No fen predicted	n/a	No fen on site	0	B
001781	LISARILLY BOG NHA	9.9	H 582 268	Transition Mire 7140 PF3	1	Poor fen PF2	1.48	B
002911	LISINISKY MARSH	22.4	H 706 096	Transition Mire 7140 PF3	0	Transition Mire 7140 PF3	4.23	C
001840	LISLANNAN BOG NHA	14.9	H 549 303	Transition Mire 7140 PF3	7	Transition Mire 7140 PF3	5.48	B
002893	LISNALEE	8.6	H 689 277	Poor fen PF2	0	Transition Mire 7140 PF3 Poor fen PF2	2.27	E
002896	LISQUIGNY (CORLONGFORD) FEN	15.7	H 732 267	Poor fen PF2	0	Transition Mire 7140 PF3	2.68	D
001607	LOUGH SMILEY NHA	75.7	H 82 21	Poor fen PF2	1.5	Transition Mire 7140 PF3	5.91	B
MFS-05	MORGANS LOUGH	5.1	H 502 279	New site - no predicted fen type	n/a	Transition Mire 7140 PF3	2.93	C
002531	MOYLAN LOUGH	12.8	H 855 085	Petrifying Spring 7220 FP1	0.1	No fen on site	0	A

Monaghan Fen Survey 2007

Appendix 3B. List of fens in County Monaghan surveyed in detail in 2007 with predicted fen types and area, and fen types and total area confirmed following the Monaghan Fen Survey.

					Total Fen Area: **190**		**Total Fen Area:** **95.58**	
Site Code	**Site Name**	**Estimated total site area**	**Grid Reference**	**Predicted Fen type(s) present**	**Estimated Fen Area**	**Confirmed Fen type(s) after Monaghan Fen Survey 2007**	**Fen Area after MFS**	**MFS Ranking after Survey**
001785	MULLAGHMORE LAKE (SOUTH) NHA	16.1	H 624 381	Transition Mire 7140 PF3	0	No fen on site	0	B
001837	MULLAGLASSAN LOUGH NHA	5.8	H 573 327	Alkaline fen 7230 PF1	0.5	Transition Mire 7140 PF3	0.44	B
002077	NAFARTY FEN NHA	3.6	H 833 045	Alkaline fen 7230 PF1	3	No fen present	0	D
002614	PRIESTFIELD LOUGH	7.2	H 650 310	Transition Mire 7140 PF3	1.5	No fen present	0	C
001606	RAFINNY LOUGH NHA	5.2	H 620 265	Poor fen PF2	0.5	Transition Mire 7140 PF3	1.08	B
001784	ROSEFIELD LAKE AND WOODLAND NHA	16.8	H 633 337	Cladium fen 7210 PF1	0.2	No fen present	0	B
002892	SHEETRIM	6.3	H 679 315	Poor fen PF2 Transition Mire 7140 PF3	11	No fen present	0	C+
002894	TIRAGARVAN	8.3	H 815 045	Alkaline fen 7230 PF1 Poor fen PF2	0	No fen present	0	D
002895	TOSSY CROSS	8.1	H 769 154	Transition Mire 7140 PF3	2	No fen present	0	E

Monaghan Fen Survey 2007

Appendix 4. List of sites in County Monaghan surveyed in brief in 2007 to assess their potential fen interest.

Site Name	Grid Reference	Date Site Surveyed	Site comments/habitat notes	Conservation Designations
AGHABOY LAKE	H 590 346	9 June 2007	Small inter drumlin lake with fringing *Typha latifolia* edge with emergent *Nuphar lutea*. Edge of lake heavily grazed and grading into wet pasture and then improved grassland. On northern side of the lake a relatively large flat marginal zone is dominated by wet *Juncus effusus* rich grassland. Some infill has been dumped on north-eastern shore. No fen zone present around lake.	Undesignated site
DRUMSNAT LOUGH	H 611 308	9 June 2007	Step sided inter drumlin lake site with fringing *Phragmites australis, Schoenoplectus lacustris* with *Sparganium erectum*. *Nuphar lutea* emergent in lake. Willow scrub at eastern end. Lake edge has well developed recreational fishing stands (10 or more in number). No fen interest at the site.	None known
KILCORRAN LOUGH	H 560 334	9 June 2007	Large inter drumlin lake which is used as a water supply. Recently constructed large pump house at the north-western end of lake. Areas of eroding bare soil along the north-western shore. In other parts of the lake there is a narrow band of fringing reed vegetation with *Phragmites australis, Iris pseudacorus* and *Schoenoplectus lacustris*. Willow scrub fringes in parts. No fen zone present around lake.	NHA
DRUMBERAGH	H 802 098	8 June 2007	Cutover bog area with regenerating wetland community to the east of the road dominated by *Equisetum fluviatile* and *Typha latifolia* marsh. No fen interest observed.	None known
SHANKILL LOUGH	H 729 086	8 June 2007	Small inter drumlin Lough surrounded by a wide dense stand of *Phragmites australis* which leaves only a small central area of open water, forming a near perfect circle. No fen interest observed.	None known
LOUGH BANE	H 739 095	8 June 2007	Inter drumlin lake site with *Typha latifolia* along lakeshore fringe. Area of wet Alder woodland occurs at the south western end of the lake leading down to lake from road. No fen interest observed.	None known
CORRACHARRA	H 715 092	8 June 2007	Regenerating wetland community on cutover bog dominated by wet scrub woodland with *Salix cinerea* and *Salix aurita* with extensive *Filipendula ulmaria* and *Rubus fruticosus* cover. No fen interest observed.	None known
LAUREL LOUGH	H 463 180	May 2007	Small inter-drumlin lake surrounded by improved grassland. No scraw vegetation was recorded and only a narrow band of emergent reed vegetation exists along the lake shore.	None known

Monaghan Fen Survey 2007

Appendix 4. List of sites in County Monaghan surveyed in brief in 2007 to assess their potential fen interest.

Site Name	Grid Reference	Date Site Surveyed	Site comments/habitat notes	Conservation Designations
CORCONNELLY LOUGH	H 505 217	30 May 2007	Relatively large inter-drumlin lake surrounded by improved agricultural grassland which extends down to the lake shore, there was no scraw recorded along the lake shore. Douglas et al 1983 listed the site as a reservoir and a lake with scraw.	None known
CARRAGHMORE FEN	H 736 078	8 June 2007	Extensive area (approx. 4.1 ha) of quaking transition mire to the East of the road. The site contains some remnants of the original raised bog vegetation and wet Willow scrub areas. **Site worthy of more detailed future fen survey.**	None known
CORLOUGHAROE LOUGH	H 567 222		Inter-drumlin lake on eastern side of the road. The open water is dominated by the floating macrophyte *Nuphar lutea*. The site is surround by improved agricultural grassland which extends right down to the lake shore on all sides. There is no fen interest at the site.	None known
EMY LOUGH	H 69 44	11 June 2007	Large inter drumlin lake site with emergent *Eleocharis palustris* and many areas of the shore going directly into improved pasture. Other sections of lake wooded with Alder and *Salix* spp. There is no fen interest at the site.	None known
KILLY LOUGH	H 63 42	11 June 2007	Inter drumlin lake with marsh area at the southern end, which was being infilled with soil and building rubble on the day of survey. Possibly for future use as car park. Eastern side of lake has steep sided drumlin edge, with only a narrow band of *Typha latifolia* and emergent *Equisetum fluviatile* zone. A number of areas have a rocky shore grading directly into pasture. At northern end of lake there is an extensive reed bed zone with scrub woodland further from the lake. There is no fen interest at the site.	None known
DERNAHAMSHA	H 575 348	11 June 2007	Reed fringed lake with central area of open water. Large *Typha latifolia* reed zone which grades into extensive marsh zone to the west. There is no fen interest at the site.	None known

Appendix 5. List of sites worthy of survey submitted by Alan Hill (BSBI County Recorder) to the Monaghan Fen Survey 2007

Site Name	Grid Ref N	Grid ref E	10 km Grid Square	Site Interest	Survey Comments
Annagheane Lough	246800	318000	H41	*Stratoites aloides*	Surveyed on MFS 2007
Drumaveale Lough	247300	319600	H41	*Hydrochaeris morsus ranae*	
Clonoony Lough	244700	321700	H42		
Corvahan	245700	324100	H42		
Clonkeen Lough (south side)	250000	324000	H52	*Parnassia palustris*	
Aghafin Lough	252300	329300	H52		
East of Aghafin Lough	253800	329500	H52	*Epipactis palustris*	
Roosky Lough	257163	326786	H52		
Annagose Lough	258100	325700	H52		
Colonkirk Bog	251700	329700	H52		
Bishops Lough	252600	326300	H52		
Creevaghy Bog/Fen	252500	328000	H52		
Lough Ooney	255800	329600	H52		
Rathkeevan Lough	253700	330200	H53		
Drumgoost Lough	257500	333700	H53		
Mont Louise Lough	258600	333600	H53		Surveyed on MFS 2007, under Graffagh & Corinshigo
Aghaboy Lake	259200	335100	H53	*Parnassia palustris*	Fen Assessment Undertaken MFS 2007
Dartry	260600	318000	H61	*Carex elongata*	
Corravoo Lough	265400	318300	H61		
Faltagh	263600	323100	H62		
Kiltubrid Lough	264700	329700	H62	*Hypericum elodes*	Surveyed on MFS 2007, under Cornaglare
Drumsnat Lough	261100	330800	H63		Fen Assessment Undertaken MFS 2007
Annayalty	261900	334100	H63		
Killy Lough	263000	342000	H64		Fen Assessment Undertaken MFS 2007
Killycooly Lough	269700	345000	H64		Surveyed on MFS 2007
Drumcunnion Lough	270700	309400	H70		Surveyed on MFS 2007, under Lisinisky
Corlea (North of road)	277200	302200	H70	*Hypericum elodes*	
Black Lough	269671	311639	H61	*Typha latifolia*	Within Black & Derrygoony Loughs NHA 1596; reference to possible transition mire in NHA description. Possibly confused with site below by Hill
Black Lough	270800	310300	H71		Within Loughbawn House Loughs NHA 1595;no reference to fen in NHA description
Shantonagh Lough	275600	310900	H71	*Salix repens*	
Crinkill Lough	276700	319500	H71	Alkaline fen/acid fen	Surveyed on MFS 2007
Killyboley Lough	272400	339400	H73		
Sillis Lough	273400	339700	H73		
Drumganny Lough	288700	308500	H80		
Lough Aphuca	283100	305900	H80		
Drumharrif Lough	285300	310700	H81		
Muckno Mill Lough	284200	322600	H92		
Carrickashane Lough	280300	324200	H82		
Mount Matthews	294000	308400	H90		
Rahans Lough	283100	297800	H89	*Stellaria palustris*	

Appendix 6: Monaghan Fen Survey 2007 Vegetation Classification Table

Table 6A: Relevé data sorted and classified according to the Braun Blanquet approach to vegetation classification.

Table 6B: Relevé data sorted and arranged according to TWINSPAN.

Table 6B: Synoptic table for relevé data collected during the Monaghan Fen Survey.

Table 6D: Species name abbreviations with full Latin and English names. Species Latin nomenclature for vascular plants and bryophytes, were made using Webb, Scannell & Doogue (1996); Watson (1981); Smith (1980); Jermy et al (1982), while nomenclature for species follows that provided National Biodiversity Network Gateway website at http://www.searchnbn.net. Species English nomenclature follows Scannell & Synnott (1987).

Monaghan Fen Survey 2007
Appendix 6A: Relevé Table

Relevé Table No.	2	3	4	1	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
Habitat type	CF	CF	CF	AF	AF	AF	AF	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	TM	PF	PF	PF	PF	PF	PF	PF	PF	PF	PF	PF	PF	MSH	MSH
pH	8.07	8.03	N/A	6.46	7.8	8.1	7.1	6.9	6.76	7.1	7.0	7.1	6.85	6.63	6.75	6.3	6.0	6.3	6.34	6.4	6.3	6.9	6.4	6.2	6,0	6.94	5.90	6.27	6.38	N/A	6.23	6.28	6.43	6.0	6.2	5.52	N/A	6.15	6.3	6.84	6.81	6.4	5.05	5.34	4.53	4.72	4.7	4.22	5.8	4.85	4.95	4.41	6.83	6.7
Water depth	-20	-20	-20	-10	-10	-15	0	0	-10	-15	0	0	-15	0	0	0	0	0	0	5	0	0	0	0	0	0	0	-10	0	0	0	0	0	0	10	-5	0	0	0	-10	-20	-10	-5	0	-5	-20	0	0	0	0	-5	5	-10	0
Soil type	M	P	PM	P	PM	PM	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P/M	P	P	P	P	P	P	P	P	P	P
Peat depth cm	60	>200	>200	>200	>200	>200	>200	>200	>200	40	>200	>200	>200	>200	>200	>200	200	>200	80	>200	>200	>200	120	>200	>200	>200	>200	N/A	>200	>200	>200	>200	>200	>200	100	>200	>200	>200	>200	>200	>200	>200	>200	100	30	40	>200	>200	180	>200	>200	>200	40	>200
Total cover %	250	255	195	240	230	175	170	260	270	205	205	230	280	250	245	290	255	245	200	185	280	200	190	225	205	270	220	220	195	175	160	205	110	210	170	200	230	280	175	210	200	255	215	195	175	215	130	220	175	180	190	210	130	165
Trees %	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35
Shrub %	0	5	0	0	0	0	0	0	0	0	0	5	5	0	0	15	5	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0
Herb/Grass/Sedge %	90	100	90	100	100	70	60	110	80	100	100	95	100	100	90	95	80	95	100	100	95	100	70	100	90	100	100	100	100	95	110	100	100	70	100	90	30	80	95	60	50	80	80	85	70	100	70	90	75	70	70	40	100	95
Bryophytes %	70	70	100	100	80	100	100	70	100	100	100	100	80	100	100	95	100	100	80	25	90	100	90	25	50	100	35	60	60	50	20	60	5	70	0	100	0	0	5	60	100	100	100	80	100	45	20	100	100	100	100	100	0	5
Algal %	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	30	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	5
Bare Peat/Soil %	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	5	0	0	0	0	0	0	0	0	0	0	20	0	0	0	10	0	0	0	0	0	0
Litter%	90	80	5	40	50	5	5	80	90	5	5	30	95	50	55	80	70	45	5	10	90	0	30	100	60	70	75	60	35	0	20	30	0	70	0	10	0	100	75	90	50	65	30	0	5	70	0	20	0	10	20	20	30	0
Open Water %	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	5	0	5	15	50	5	0	0	0	0	0	10	0	0	5	10	15	0	0	70	0	100	70	0	0	0	0	0	10	0	0	30	10	0	0	0	50	0	25
Height Herb layer cm	100	100	70	100	60	70	45	50	50	50	50	50	45	45	80	50	45	60	60	40	40	40	50	55	45	45	45	70	50	40	50	50	50	35	50	70	50	50	50	60	60	45	50	60	55	50	50	60	35	30	40	50	100	60
Size (meters squared)	4	4	2	2	4	4	4	1	4	4	4	4	4	4	1	4	4	4	2	4	4	4	1	4	4	2	1	2	4	1	2	4	2	4	4	2	4	4	4	4	2	4	4	1	2	2	1	2	4	1	1	4	2	9
Water Sample number	W1	W2	N/A	W8	W3	W5	W4	W2	W1	W1	W2	W1	W1	W1	W3	W1	W1	W1	W1	W1	W2	W1	W2	W1	na	W2	W1	W2	W7	N/A	W1	W2	W1	W1	W2	W5	na	W1	W1	W1	W2	W1	W4	W3	W2	W2	W1	W2	W6	W9	W4	W1	W1
Twinspan Order	53	54	4	52	2	3	26	5	19	20	25	11	12	14	15	22	24	17	18	16	23	10	21	8	28	13	29	30	31	32	33	34	36	40	27	39	41	42	37	35	6	7	38	50	43	44	46	48	51	45	47	49	1	9

	Site name		Killyvilly	Kilrooskey	Kilrooskey	Eshbrack	Kilrooskey	Kilrooskey	Kilrooskey	Aghnamullen	Mullaglassan	Killycooly	Lislannan	Lislannan	Morgans	Killyneill	Killyneill	Aghacloghan	Aghnamullen	Bocks	Lisinisky	Cornaglare	Rafinny	Lisnalee	Lisquigny	Lisquigny	Drumgallan	Smiley	Smiley	Lisinisky	Eshbrack	Eshbrack	Crumlin	Crumlin	Crinkill	Dunaree	Drumgallan	Eshbrack	Drumgallan	Drumgallan	Coravilla-R	Annagheane	Killyneill	Lisarilly	Killyneill	Eshbrack	Crinkill	Crinkill	Eshbrack	Eshbrack	Lisnalee	Eshbrack	Eshbrack	Eshbrack	Nafarty	Greaghglas
	Spp. Per relevé		22	13	23	37	21	17	16	16	18	23	23	22	18	19	17	19	20	21	29	23	13	18	16	12	20	17	18	27	15	19	11	19	18	12	11	17	7	13	13	11	26	18	14	30	16	19	12	12	18	20	22	4	12	15
	Relevé Number	No. Occurrences	1839-R1	1786-R1-KILL	1786-R2-SUM	1603(6)-R1	1786-R2-KILL	1786-R1-SUM	1786-R1-DUMM	2904-R2	1837-R1	MFS08-R1	1840-R2	1840-R1	MFS05-R1	2755-R1	2755-R3	2902-R1	2904-R1	MFS06-R1	2911-R1	MFS01-R1	1606-R1	2893-R1	2896-R2	2896-R1	2732-R3	1607-R2	1607-R1	2911-R2	1603(9)-R1	1603(9)-R2	MFS04-R1	MFS04-R2	MFS07-R1	2903-R1	2732-R4	1603(2)-R1	2732-R1	2732-R2	2901-R1	1836-R1	2755-R2	1781-R1	2755-R4	1603(4)-R1	MFS07-R2	MFS07-R3	1603(5)-R2	1603(5)-R1	2893-R2	1603(2)-R2	1603(6)-R2	1603(4A)-R1	2077-R1	2897-R1
Number	Species full name																																																								
	Alkaline Fen - Caricetalia davallianae																																																						
43	Cladium mariscus	3	2	3	3																																																		
122	Phragmites australis	12	2	1		3	1	1			+	1									2										1																						1	2		3		
30	Carex panicea	14	1	1	+	+	2	1		2			1									1																																1				
35	Carex viridula ssp. oedocarpa	8			2	2	2	2		+											+											1												+											
188	Campylium stellatum	8	1		+	+		+												1								1					+			+																		
203	Hylocomium splendens	3	1			2																																					1												
32	Carex pulicaris	3	+	1		+																																																
193	Ctenidium molluscum	5	3			+	+																					+																+										
098	Luzula multiflora	3	1			1																																					+											
15	Briza media	2	1	+																																																		
42	Cirsium palustre	4		+		+						+																																	+										
197	Drepanocladus revolvens	4			4	1		5	+																																													
120	Pedicularis palustris	4			1		2															+																																
25	Carex flacca	3	1		1		2																																															
	Transition mire - Caricetalia davallianae																																																						
21	Carex diandra	17				2	1	1		4	4		2	1	1	4	4	3	2	4	2																						+	+	2														
73	Filipendula ulmaria	13		+	+		1					+	2	1					2	2	1					+	2																													3	3
238	Plagiomnium rostratum	8							+				2		+		2			1							1	+																		+										
146	Rumex acetosa	11											1		2	1	1				+				+		1											2						1			2					1				
81	Holcus lanatus	19				+						2	+	1	+	+	+			1	1	2		2		2	1		2						+									1		+			1					1
099	Lychnis flos-cuculi	9				1						2	1	2		2	2								1			+															1												
63	Equisetum palustre	7			+						+		1			2	+																											+							1				
184	Calliergon giganteum	9								2								+	+	2		2	1		1		1	1																												
	Transition mire - Caricetalia nigrae																																																						
20	Carex curta	18																2	3	1	1	1	1				2	3	2	+	4	3		1		2		2										1				1		
185	Calliergon stramineum	14	1																	1				+					3	4	1	2	2	1	3		2				1			2										2
141	Ranunculus flammula	13					1													1	1			1			+		2	1	2			1										+		+	1								
177	Veronica scutellata	7				+						+									1								+	+					+		+																	
92	Lemna minor	5																								+						2	1	1		4																		

	Relevé Number	No. Occurrences	1839-R1	1786-R1-KILL	1786-R2-SUM	1603(6)-R1	1786-R2-KILL	1786-R1-SUM	1786-R1-DUMM	2904-R2	1837-R1	MFS08-R1	1840-R2	1840-R1	MFS05-R1	2755-R1	2755-R3	2902-R1	2904-R1	MFS06-R1	2911-R1	MFS01-R1	1606-R1	2893-R1	2896-R2	2896-R1	2732-R3	1607-R2
Transition mire - General Species																												
186	Calliergonella cuspidata	34	2	3	2	2	4	1	5	2	5	5	5	5	5	5	5	4	4	4	5	3	5	4	4	2	3	5
82	Hydrocotyle vulgaris	24			2		2	2	+	2	+	+				2	+	1	1	2	2	2			3		2	+
74	Galium palustre	32				+	1		2	1	1	1	2		2	1	1		1	1	2	+		2	1	1	+	1
2	Agrostis stolonifera	28			1		2	1	1			2	+	2	2	1				1	1		2	2	2	4	+	2
33	Carex rostrata	39			+	2			3	2	2	1	3	2	1		+	2		1		+	3	1	+	1	1	+
167	Typha latifolia	13							1					1	2			+						1	1	1		
103	Mentha aquatica	9			2			1	2			2				1	+	1				2						
18	Caltha palustris	16				1					1	1		+	+		1		+		1	+	+				1	
59	Epilobium palustre	9									+		1	+							+		1					
150	Salix cinerea ssp oleifolia	10		+			+							+	+			1	1								1	
Poor Fen - Caricetalia nigrae to Scheuchzerietalia																												
221	Sphagnum fallax	8																										
105	Molinia caerulea	11	3	2						3									2			+						
139	Potentilla erecta	8	1			+																						
008	Anthoxanthum odoratum	13				+								1				+										1
228	Sphagnum subsecundum	6																										
222	Sphagnum palustre	7				1																						
130	Polytrichum commune	7				+																						
24	Carex echinata	7																				1						
260	Crepis paludosa	4				2																						
127	Polygala serpyllifolia	2																										
28	Carex limosa	4				+																						
090	Juncus effusus	10														+			+					+		+		
226	Sphagnum squarrosum	5																2										
241	Sphagnum capillifolium	2																										
227	Sphagnum subnitens	2																										
181	Aulacomnium palustre	7																										
219	Sphagnum cuspidatum	2																										
Companion Species																												
62	Equisetum fluviatile	42				2			1	1	1	1	1	2	1	+	1		2	2	3	1	2	2	2	2	2	
140	Potentilla palustris	38					1			1	1	1		2	1	1	1	1	3	3	2	1	2	2	1	1	2	2
19	Cardamine pratensis	32			+	+	1		1		1		1	1	2	1	1	1	1	1	1		1	2	1	2	+	1
104	Menyanthes trifoliata	31			2	+	2	+		+	2	1		1	+	3	2	2	1	3	3	3						
088	Juncus articulatus	19				1				2		1	1							1	1	1	1		+		1	
007	Angelica sylvestris	19	+		+	+		+	+					1	2	1		+			+			+	+	1		1
066	Eriophorum angustifolium	20			+		1	+					+							1	+	2					3	
29	Carex nigra	19		1	1			2		3	1	2	1						2				1					1
163	Succisa pratensis	18	2	2		+							+						1		+	+	1					+
182	Brachythecium rivulare	13											+			1	1	+		1					1		+	
213	Rhytidiadelphus squarrosus	11				2							+	1	1			1						+				
40	Cicuta virosa	8						+	+	+									+		1	1						
179	Viola palustris	7																										
211	Scleropodium purum	6				2										1												
149	Salix aurita	5				+								+										+				
212	Rhizomnium punctatum	3										+							+								1	
45	Dactylorhiza maculata	3												+								+						
54	Eleocharis palustris	3																+										
58	Epilobium obscurum	3																										+
72	Festuca rubra	4									+				+									1				
106	Myosotis laxa	3																			1							
137	Potamogeton polygonifolius	3																				+						
138	Potamogeton natans	3																										
239	Dactylorhiza spp.	3	+													+												
183	Bryum pseudotriquetrum	2																			1							
199	Eurhynchium praelongum	2																									+	
12	Betula pubescens	3					+							+														
23	Carex disticha	3									1	2																
41	Cirsium dissectum	3					1		+									+										
49	Drosera rotundifolia	2																										
57	Epilobium hirsutum	3							1			1																
65	Erica tetralix	2																										
096	Lotus uliginosus	2																						+				
097	Luzula campestris	2																										
100	Lycopus europaeus	2																	+									
142	Ranunculus lingua	2									+																	

	Relevé Number	1607-R1	2911-R2	1603(9)-R1	1603(9)-R2	MFS04-R1	MFS04-R2	MFS07-R1	2903-R1	2732-R4	1603(2)-R1	2732-R1	2732-R2	2901-R1	1836-R1	2755-R2	1781-R1	2755-R4	1603(4)-R1	MFS07-R2	MFS07-R3	1603(5)-R2	1603(5)-R1	2893-R2	1603(2)-R2	1603(6)-R2	1603(4A)-R1	2077-R1	2897-R1
Transition mire - General Species																													
186	Calliergonella cuspidata	1	1				2								3	1	1	3	2										
82	Hydrocotyle vulgaris	2	2			+	1			+			+												2				
74	Galium palustre	+	2	1	2	3	2	3	+				+	3	1	+													1
2	Agrostis stolonifera	+	3	+		2	+	3						2	3						1							1	2
33	Carex rostrata		+	1	2	2	2	3	2	4	3	1	4	4	1	1	1	2					+	2		+	3		
167	Typha latifolia		+	1		+	1								1	1													
103	Mentha aquatica							1																					
18	Caltha palustris		1	1	2			+						1															
59	Epilobium palustre		+					+	+																				1
150	Salix cinerea ssp oleifolia						+								+														1
Poor Fen - Caricetalia nigrae to Scheuchzerietalia																													
221	Sphagnum fallax										4							2		4	3		5	2	2		3		
105	Molinia caerulea															2				2	1		+		+	1			
139	Potentilla erecta															+			1	1	1			+	1				
008	Anthoxanthum odoratum										1							2	3			+	1	1	+	+		1	
228	Sphagnum subsecundum	1			1														+			1			4	2			
222	Sphagnum palustre															2				1	1		1	2		5			
130	Polytrichum commune										+					1				1	1			1		1			
24	Carex echinata				1														1	1	1		1			1			
260	Crepis paludosa																		2			+			+				
127	Polygala serpyllifolia																				+					+			
28	Carex limosa																1								2	2			
090	Juncus effusus		2	2															+	+	4			1					
226	Sphagnum squarrosum															+		+						1		1			
241	Sphagnum capillifolium																5			1									
227	Sphagnum subnitens																+	2											
181	Aulacomnium palustre								+							2	2	2			1				+	1			
219	Sphagnum cuspidatum																									+	3		
Companion Species																													
62	Equisetum fluviatile	1	2	2	1	2	3	1	1	2	2	1	1	3	3	+		1	+				+	1	2	2		+	3
140	Potentilla palustris	2	1	2	3		2		1	2	3		2	1	1	1	1	2				2	2	1	1				1
19	Cardamine pratensis	+	1		1	+		1		+	+			2		+			1			1							1
104	Menyanthes trifoliata		2			4	3			1	3	3	2	2			+	2				3	4		2	2	2		
088	Juncus articulatus		2		3										1		+			3	1	1	2			+			
007	Angelica sylvestris		1											+		1								1					1
066	Eriophorum angustifolium	2	+		+		+		2			+	+				+	3		1			+			+			
29	Carex nigra	4	+		2														+	+	+	3	3						1
163	Succisa pratensis										2					2	2	+	+		2	+			2	2			
182	Brachythecium rivulare		1			1	1							+					+					+					
213	Rhytidiadelphus squarrosus								2							1			2					3					1
40	Cicuta virosa						1	1																					
179	Viola palustris			+	1						1								+		2			+	1				
211	Scleropodium purum										+					3	+		2										
149	Salix aurita																2												1
212	Rhizomnium punctatum																												
45	Dactylorhiza maculata																									1			
54	Eleocharis palustris			+				2																					
58	Epilobium obscurum													+										1					
72	Festuca rubra																											+	
106	Myosotis laxa		+					2																					
137	Potamogeton polygonifolius				+																				1				
138	Potamogeton natans						1			+			+																
239	Dactylorhiza spp.																+												
183	Bryum pseudotriquetrum												+																
199	Eurhynchium praelongum																				+								
12	Betula pubescens																												2
23	Carex disticha																											3	
41	Cirsium dissectum																												
49	Drosera rotundifolia																1								+				
57	Epilobium hirsutum																											1	
65	Erica tetralix															1		+											
096	Lotus uliginosus													+															
097	Luzula campestris																		1		+								
100	Lycopus europaeus		1																										
142	Ranunculus lingua						2																						

	Relevé Number	No. Occurrences	1839-R1	1786-R1-KILL	1786-R2-SUM	1603(6)-R1	1786-R2-KILL	1786-R1-SUM	1786-R1-DUMM	2904-R2	1837-R1	MFS08-R1	1840-R2	1840-R1	MFS05-R1	2755-R1	2755-R3	2902-R1	2904-R1	MFS06-R1	2911-R1	MFS01-R1	1606-R1	2893-R1	2896-R2	2896-R1	2732-R3	1607-R2	1607-R1	2911-R2	1603(9)-R1	1603(9)-R2	MFS04-R1	MFS04-R2	MFS07-R1	2903-R1	2732-R4	1603(2)-R1	2732-R1	2732-R2	2901-R1	1836-R1	2755-R2	1781-R1	2755-R4	1603(4)-R1	MFS07-R2	MFS07-R3	1603(5)-R2	1603(5)-R1	2893-R2	1603(2)-R2	1603(6)-R2	1603(4A)-R1	2077-R1	2897-R1
162	Stellaria uliginosa	2																			+									+																										
170	Utricularia minor	2																																					2	+																
234	Chara spp	2																																					5	3																
235	Juncus conglomeratus	2																									+													+																
262	Pleurozium schreberi	2				1																																																		
263	Ranunculus repens	2																																							+					1										
264	Lophocolea bidentata	2				+																																								+										
265	Cephaloziella spp.	2				+																																									+									
180	Aneura pinguis	1				+																																																		
191	Climacium dendroides	1											+																																											
216	Scorpidium scorpioides	2								2																													+																	
217	Sphagnum fimbriatum	1																																																	+					
223	Sphagnum papillosum	1																																													1									
1	Agrostis canina	2																																		+		2																		
3	Alisma plantago aquatica	1																																	+																					
4	Alnus glutinosa	2		+	+																																																			
009	Apium inundatum	1																																	+																					
17	Calluna vulgaris	1																																									+													
34	Carex viridula ssp. brachyrhyncl	1	1																																																					
37	Centaurea nigra	1																									1																													
46	Dactylorhiza majalis	3					+	+	+																																															
069	Eriophorum vaginatum	1																																													1									
83	Hypericum elodes	1																				1																																		
84	Hypericum tetrapterum	1										+																																												
087	Juncus acutiflorus	1																																												4										
089	Juncus bulbosus	1																																													1									
101	Lysimachia nemorum	1																																												+										
107	Myosotis scorpioides	1																																												+										
112	Narthecium ossifragum	1																																									+													
118	Osmunda regalis	1																											+																											
119	Parnassia palustris	1	1																																																					
121	Phalaris arundinacea	1																																	1																					
123	Pinguicula vulgaris	1	1																																																					
124	Plantago lanceolata	1	+																																																					
126	Poa trivialis	1																						1																																
131	Potamogeton berchtoldii	1																																			+																			
157	Senecio aquaticus	1																												+																										
172	Vaccinium oxycoccus	1																																																		2			
178	Vicia cracca	1	+																																																					
233	Algae	1																																						2																
240	Geranium robertianum	1																																									+													
236	Hypnum cupressiforme var. resu	1																																			+																			
252	Ranunculus acris	1																																												1										
257	Marchantia polymorpha	1																			1																																			
258	Mylia anomala	1																			+																																			
237	Solidago virgaurea	1									1																																													
261	Riccardia pinguis	1																																																		+				
266	Drepanocladus uncinatus	1																														2																								
267	Myosotis secunda	1																														+																								
268	Potentilla anserine	1										1																																												
269	Trifolium repens	1											+																																											
208	Philonotis calcarea	2			+			+																																																
31	Carex paniculata	1			+																																																			
48	Deschampsia caespitosa	1																																																					1	
173	Valeriana officinalis	1			+																																																			
246	Arrhenatherum elatius	1																																																					1	
247	Carex acutiformis	1																																																					1	
248	Lathyrus montanus	1																																																					1	
259	Scapania undulata	1																																				+																		

Monaghan Fen Survey 2007

Appendix 6B. Releve table as sorted and ordered by Twinspan

		ALK FEN				TRANSITION MIRES?? RICH -------- POOR																																				POOR FEN									CLADIUM			
MFS CODE	2077-R1	1786-R2-KILL	1786-R1-SUM	1786-R1-SUM	2904-R2	2755-R2	1781-R1	2896-R1	2897-R1	2893-R1	1840-R1	MFS05-R1	1607-R2	2755-R1	2755-R3	MFS01-R1	MFS06-R1	2911-R1	1837-R1	MFS08-R1	2896-R2	2902-R1	1606-R1	2904-R1	1840-R2	1786-R1-DUMM	2732-R4	2732-R3	1607-R1	2911-R2	1603(9)-R1	1603(9)-R2	MFS04-R1	MFS04-R2	1836-R1	MFS07-R1	2901-R1	2755-R4	1603(2)-R1	2903-R1	2732-R1	2732-R2	MFS07-R2	MFS07-R3	1603(2)-R2	1603(5)-R2	1603(6)-R2	1603(5)-R1	1603(4A)-R1	1603(4)-R1	2893-R2	1603(6)-R1	1839-R1	1786-R1-KILL	
TWSPN NO	13	51	53	54	43	8	12	36	44	45	47	49	6	7	9	11	14	15	18	19	37	38	40	42	48	52	3	4	5	16	28	29	30	31	32	33	41	10	20	39	1	2	34	35	21	25	27	24	23	22	46	26	17	50	
6 Call str	-	-	-	-	-	-	-	-	2	+	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	3	4	1	2	2	1	1	-	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-	1	-	0
27 Sphag su	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100
29 Agros ca	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100
31 Alisma p	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100
35 Apium in	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100
54 Cent nig	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100
63 Eleoch p	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	+	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100
77 Hype elo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100
83 Lemna mi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	4	-	-	-	-	2	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100
96 Osmunda	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100
99 Phalar a	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100
105 Potamo b	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100
107 Potamo n	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	1	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	100
115 Senecio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100
119 Utric mi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	+	-	-	-	-	-	-	-	-	-	-	-	-	100
125 Algae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	100
126 Chara sp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	3	-	-	-	-	-	-	-	-	-	-	-	-	100
130 Juncus c	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	100
131 Hyp cup	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100
139 Scapania	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100
145 Drep unc	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100
146 Myostis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100
93 Myosot l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	101
111 Ranunc l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	101
17 Rhizo pu	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	+	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	110
84 Lotus ul	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	110
88 Lycopus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	110
116 Stellar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	110
69 Erica te	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	111
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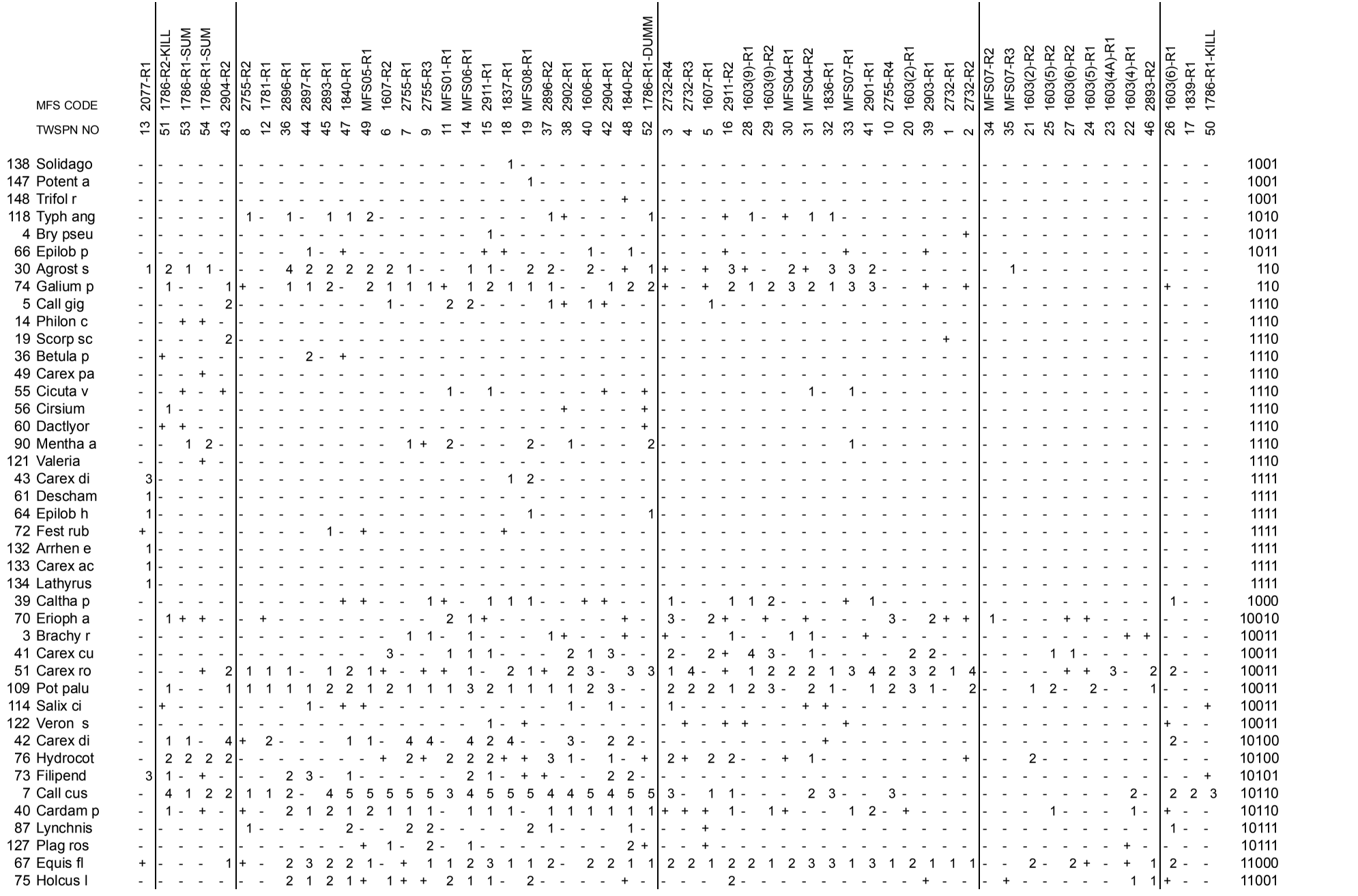
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36 Betula p
49 Carex pa
55 Cicuta v
56 Cirsium
60 Dactlyor
90 Mentha a
121 Valeria
43 Carex di
61 Descham
64 Epilob h
72 Fest rub
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133 Carex ac
134 Lathyrus
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3 Brachy r
41 Carex cu
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109 Pot palu
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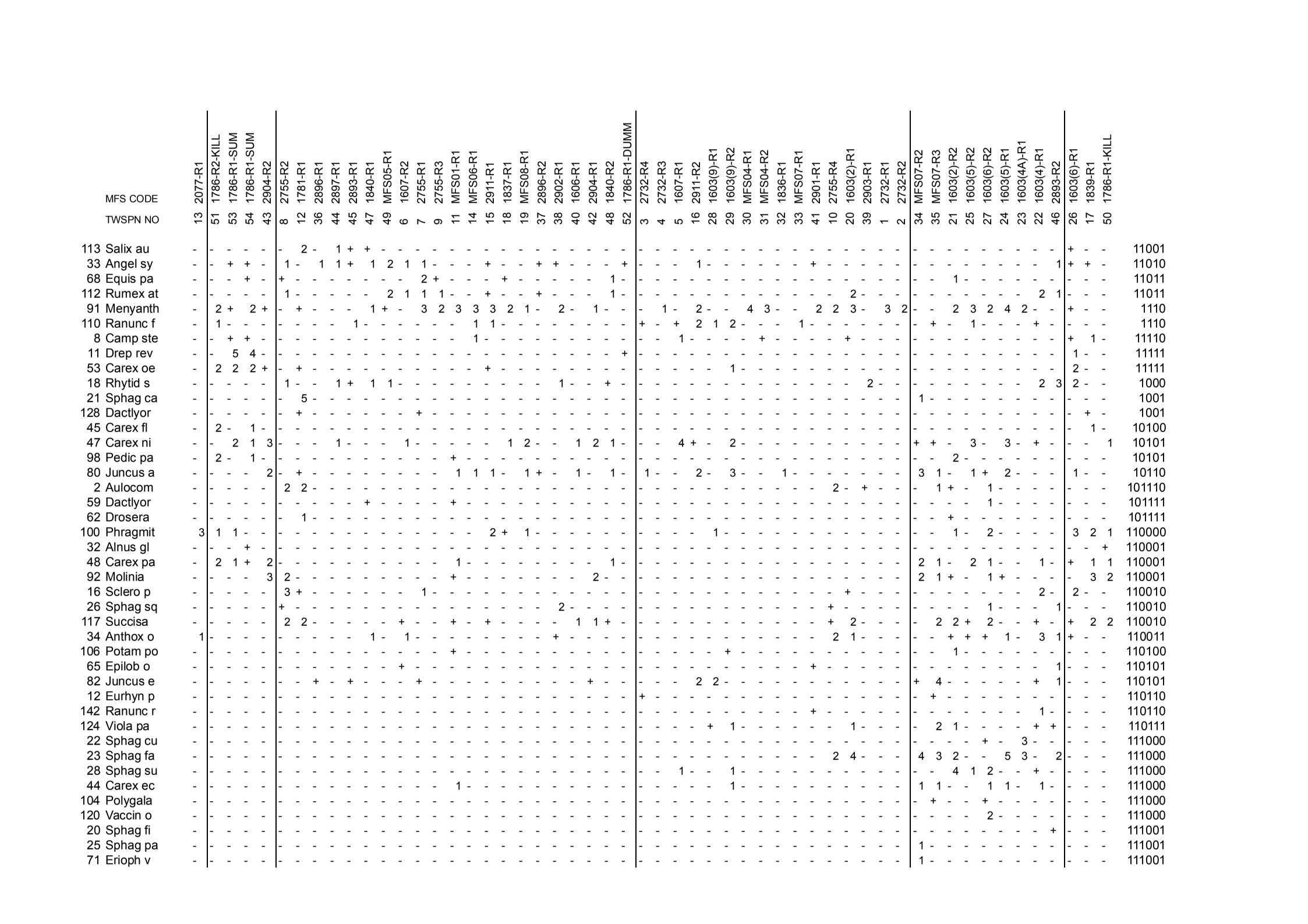
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110 Ranunc f 1110
8 Camp ste 11110
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12 Eurhyn p 110110
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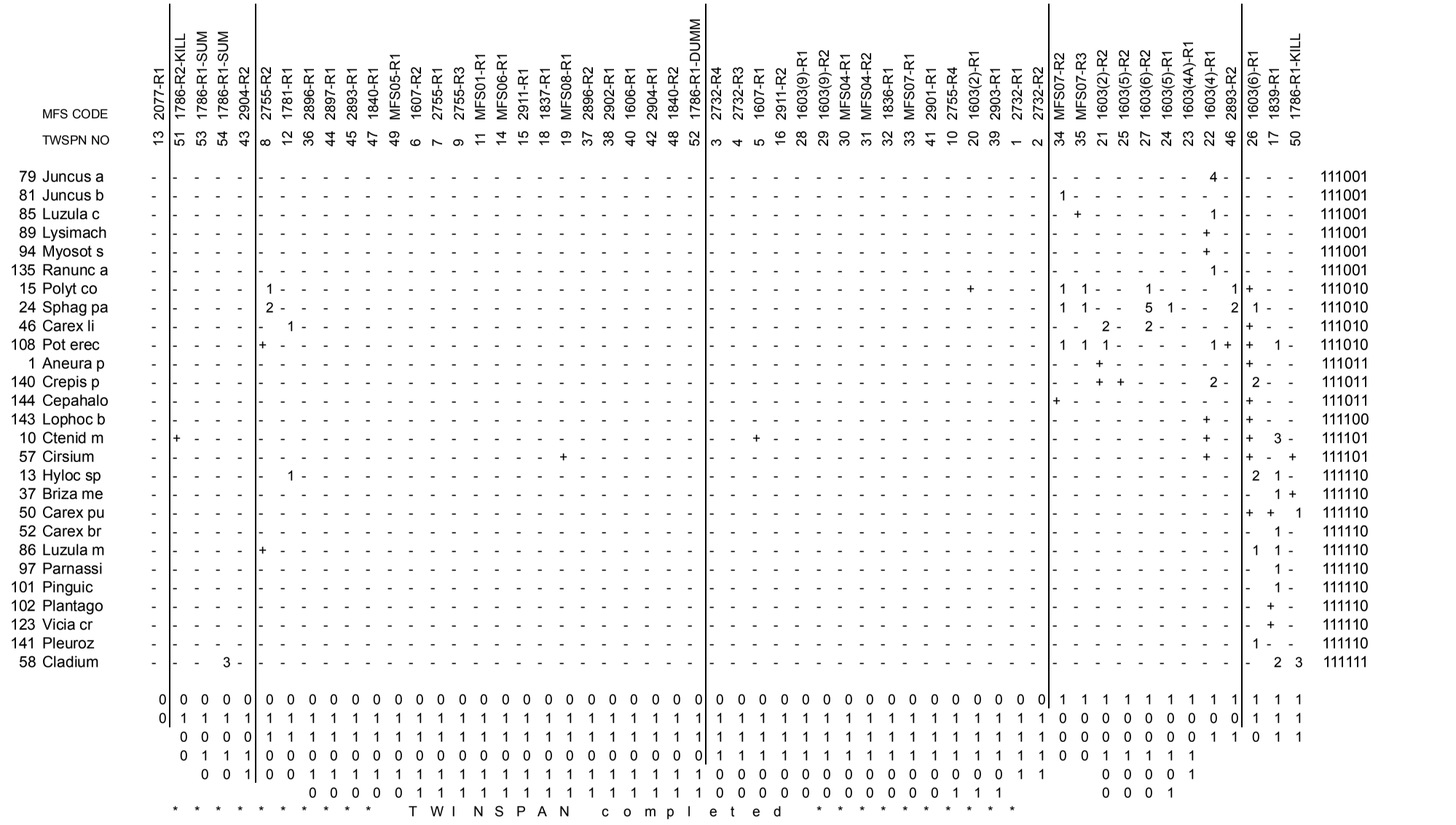
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9 2755-R3
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14 MFS06-R1
15 2911-R1
18 1837-R1
19 MFS08-R1
37 2896-R2
38 2902-R1
40 1606-R1
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48 1840-R2
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31 MFS04-R2
32 1836-R1
33 MFS07-R1
41 2901-R1
10 2755-R4
20 1603(2)-R1
39 2903-R1
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101 Pinguic 111110
102 Plantago 111110
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TWINSPAN completed

Monaghan Fen Survey 2007

Appendix 6C: Synoptic Table of Relevé

Constancy values (species occurence within a group of relevés expressed as a percentage) I= 1-20%; II=21-40%; III=41-60%; IV=61=80%; V=81-100. Range of cover abundance in releve in brackets, and that of environmental and releve factors shown (format x : y).

* pH is field based measured soon after collecting sample.

		Alkaline Fen	Transition Mire (Rich)	Transition Mire (Poor)	Poor Fen	Marsh
No. of Relevés in Group		**7**	**19**	**14**	**12**	**2**
Total Species Richness		**70**	**78**	**73**	**78**	**24**
pH*		**6.5 : 8.1**	**6 : 7.1**	**5.5 : 6.8**	**4.2 : 6.8**	**6.7 : 6.8**
Water depth		**-20 : 0**	**-15 : 5**	**-10 : 10**	**-20 : 5**	**-10 : 0**
Soil type		**M : P**	**P**	**P**	**P : PM**	**P**
Peat depth cm		**60 : >200**	**40 : >200**	**100 : >200**	**30 : >200**	**40 : >200**
Total cover %		**100**	**100**	**100**	**100**	**100**
Trees %		**0**	**0**	**0**	**0**	**0 : 35**
Shrub %		**0 : 5**	**0 : 15**	**0**	**0 : 10**	**0**
Herb/Grass/Sedge %		**60 : 100**	**70 : 100**	**30 : 100**	**40 : 100**	**95 : 100**
Bryophytes %		**70 : 100**	**25 : 100**	**0 : 100**	**20 : 100**	**0 : 5**
Algal %		**0**	**0**	**0 : 100**	**0 : 5**	**0 : 5**
Bare Peat/Soil %		**0**	**0**	**0 : 25**	**0 : 20**	**0**
Litter%		**5 : 90**	**0 : 100**	**0 : 100**	**0 : 70**	**0 : 30**
Open Water %		**0 : 5**	**0 : 50**	**0 : 100**	**0 : 50**	**0 : 25**
Height Herb layer cm		**45 : 100**	**40 : 80**	**40 : 70**	**30 : 60**	**60 : 100**
Average No. Species per relevé		**20**	**19**	**15**	**18**	**14**
Species per relevé range		**13 : 28**	**12 : 29**	**7 : 27**	**4 : 29**	**12 : 15**
Alkaline Fen - Caricetalia davallianae						
122	Phragmites australis	IV (1-3)	I (+-2)	I (1)	I (1-2)	III (3)
30	Carex panicea	V (+-2)	I (1-2)		III (1-2)	
35	Carex viridula ssp. oedocarpa	III (2)	I (+)	I (1)	I (+)	
188	Campylium stellatum	III (+-1)	I (1)	II (+-1)		
43	Cladium mariscus	III (2-3)				
203	Hylocomium splendens	II (1-2)			I (1)	
32	Carex pulicaris	III (+-1)				
193	Ctenidium molluscum	III (+-3)		I (+)	I (+)	
098	Luzula multiflora	II (1)			I (+)	
15	Briza media	II (+-1)				
42	Cirsium palustre	II (+)	I (+)		I (+)	
197	Drepanocladus revolvens	III (+-5)				
120	Pedicularis palustris	II (1-2)	I (+)		I (2)	
25	Carex flacca	III (1-2)				
Transition mire - Caricetalia davallianae						
21	Carex diandra	III (1-2)	III (1-4)	I (+)	I (+-2)	
73	Filipendula ulmaria	III (+-1)	III (+-2)			V(3)
238	Plagiomnium rostratum	I (+)	II (+-2)	I (+)	I (+)	
146	Rumex acetosa		II +-2)	I (2)	(1-2)	
81	Holcus lanatus	I (+)	IV (+-2)	I (+-2)	II (+-1)	III (1)
099	Lychnis flos-cuculi	I (1)	II (1-2)	I (+)	I (1)	
63	Equisetum palustre	I (+)	II (+-2)		I (+-1)	
184	Calliergon giganteum		III (+-2)	I (1)		
Transition mire - Caricetalia nigrae						
20	Carex curta		III (1-3)	III (+-4)	I (1)	
185	Calliergon stramineum	I (1)	I (+-1)	IV (1-4)	I (2)	III (2)
141	Ranunculus flammula	I (1)	II (+-1)	II (+-2)	II (+-1)	
177	Veronica scutellata	I (+)	I (+-1)	II (+)		
92	Lemna minor		I (+)	II (1-4)		
Transition mire - General Species						
186	Calliergonella cuspidata	V (1-5)	V (2-5)	II (1-3)	II (1-3)	
82	Hydrocotyle vulgaris	III (+-2)	IV (+-3)	III (+-2)	I (2)	
74	Galium palustre	III (+-2)	V (+-2)	IV (+-3)	I (+)	III (1)
2	Agrostis stolonifera	III (1-2)	IV (+-4)	III (+-3)	I (1)	V (1-2)
33	Carex rostrata	III (+-3)	V (+-3)	V (+-4)	III (+-3)	
167	Typha latifolia	I (1)	II (+-2)	II (+-1)	I (1)	
103	Mentha aquatica	III (1-2)	II (+-2)	I (1)		
18	Caltha palustris	I (1)	III (+-1)	II (+-2)		
59	Epilobium palustre		II (+-1)	II (+)		III (1)
150	Salix cinerea ssp oleifolia	II (+)	II (+-1)	I (+)		III (1)
Poor Fen - Caricetalia nigrae to Scheuchzerietalia						
221	Sphagnum fallax			I (4)	III (2-5)	
105	Molinia caerulea	II (2-3)	I (+-3)		III (+-2)	
139	Potentilla erecta	II (+-1)			III (+-1)	

		Alkaline Fen	Transition Mire (Rich)	Transition Mire (Poor)	Poor Fen	Marsh
008	Anthoxanthum odoratum	I (+)	I (+-1)	I (1)	III (+-3)	III (1)
228	Sphagnum subsecundum			I (1)	II (+-4)	
222	Sphagnum palustre	I (1)			III (1-5)	
130	Polytrichum commune	I (+)		I (+)	III (1)	
24	Carex echinata		I (1)	I (1)	III (1)	
260	Crepis paludosa	I (2)			II (+-2)	
127	Polygala serpyllifolia				I (+)	
28	Carex limosa	I (+)			II (1-2)	
090	Juncus effusus		II (+)	I (2)	II (+-4)	
226	Sphagnum squarrosum		I (2)		II (+-1)	
241	Sphagnum capillifolium				I (1-5)	
227	Sphagnum subnitens				I (+-2)	
181	Aulacomnium palustre			I (+)	III (+-2)	
219	Sphagnum cuspidatum				I (+-3)	
Companion Species						
62	Equisetum fluviatile	II (1-2)	V (+-3)	V (1-3)	III (+-2)	V (+-3)
140	Potentilla palustris	I (1)	V (1-3)	IV (1-3)	III (1-2)	III (1)
19	Cardamine pratensis	III (+-1)	V (+-2)	III (+-2)	II (+-1)	III (1)
104	Menyanthes trifoliata	III (+-2)	IV (+-3)	III (1-4)	III (+-4)	
088	Juncus articulatus	I (1)	III +-2)	II (1-3)	III (+-3)	
007	Angelica sylvestris	IV (+)	III (+-2)	I (+-1)	I (+-1)	III (1)
066	Eriophorum angustifolium	III (+-1)	II (+-3)	III (+-2)	III (+-3)	
29	Carex nigra	III (1-2)	II (1-3)	II (+-4)	III (+-3)	III (1)
163	Succisa pratensis	III (+-2)	II (+-1)	I (2)	IV(+-2)	
182	Brachythecium rivulare		II (+-1)	II (+-1)	I (+)	
213	Rhytidiadelphus squarrosus	I (2)	II (+-1)	I (2)	II (1-3)	III (1)
40	Cicuta virosa	II (+)	II (+-1)	I (1)		
179	Viola palustris			II (+-1)	II (+-2)	
211	Scleropodium purum	I (2)	I (1)	I (+)	II (+-3)	
149	Salix aurita	I (+)	I (+)		I (2)	III (1)
212	Rhizomnium punctatum		I (+-1)			
45	Dactylorhiza maculata		I (+)		I (1)	
54	Eleocharis palustris		I (+)	I (+-2)		
58	Epilobium obscurum		I (+)	I (+)	I (1)	
72	Festuca rubra		I (+-1)			III (+)
106	Myosotis laxa		I (1)	I (+-2)		
137	Potamogeton polygonifolius		I (+)	I (+)	I (1)	
138	Potamogeton natans			II (+-1)		
239	Dactylorhiza spp.	I (+)	I (+)		I (+)	
183	Bryum pseudotriquetrum		I (1)	I (+)		
199	Eurhynchium praelongum		I (+)		I (+)	
12	Betula pubescens	I (+)	I (+)			III (2)
23	Carex disticha		I (1-2)			III (3)
41	Cirsium dissectum	II (+-1)	I (+)			
49	Drosera rotundifolia				I (+-1)	
57	Epilobium hirsutum	I (1)	I (1)			III (1)
65	Erica tetralix				I (+-1)	
096	Lotus uliginosus		I (+)	I (+)		
097	Luzula campestris				I (+-1)	
100	Lycopus europaeus		I (+)	I (1)		
142	Ranunculus lingua		I (+)	I (2)		
162	Stellaria uliginosa		I (+)	I (+)		
170	Utricularia minor			I (+-2)		
234	Chara spp			I (3-5)		
235	Juncus conglomeratus		I (+)	I (+)		
262	Pleurozium schreberi	I (1)				
263	Ranunculus repens			I (+)	I (1)	
264	Lophocolea bidentata	I (+)			I (+)	
265	Cephaloziella spp.	I (+)			I (+)	
180	Aneura pinguis	I (+)				
191	Climacium dendroides		I (+)			
216	Scorpidium scorpioides		I (2)	I (+)		
217	Sphagnum fimbriatum				I (+)	
223	Sphagnum papillosum				I (1)	
1	Agrostis canina			I (+-2)		
3	Alisma plantago aquatica			I (+)		
4	Alnus glutinosa	II (+)				
009	Apium inundatum			I (+)		
17	Calluna vulgaris				I (+)	
34	Carex viridula ssp. brachyrhyncha	I (1)				
37	Centaurea nigra		I (1)			
46	Dactylorhiza majalis	III (+)				
069	Eriophorum vaginatum				I (1)	
83	Hypericum elodes		I (1)			
84	Hypericum tetrapterum		I (+)			
087	Juncus acutiflorus				I (4)	
089	Juncus bulbosus				I (1)	

		Alkaline Fen	Transition Mire (Rich)	Transition Mire (Poor)	Poor Fen	Marsh
101	Lysimachia nemorum				I (+)	
107	Myosotis scorpioides				I (+)	
112	Narthecium ossifragum				I (+)	
118	Osmunda regalis			I (+)		
119	Parnassia palustris	I (1)				
121	Phalaris arundinacea			I (1)		
123	Pinguicula vulgaris	I (1)				
124	Plantago lanceolata	I (+)				
126	Poa trivialis		I (1)			
131	Potamogeton berchtoldii			I (+)		
157	Senecio aquaticus			I (+)		
172	Vaccinium oxycoccus				I (2)	
178	Vicia cracca	I (+)				
233	Algae			I (2)		
240	Geranium robertianum				I (+)	
236	Hypnum cupressiforme var. resupinatum			I (+)		
252	Ranunculus acris				I (1)	
257	Marchantia polymorpha		I (1)			
258	Mylia anomala		I (+)			
237	Solidago virgaurea		I (1)			
261	Riccardia pinguis				I (+)	
266	Drepanocladus uncinatus			I (2)		
267	Myosotis secunda			I (+)		
268	Potentilla anserine		I (1)			
269	Trifolium repens		I (+)			
208	Philonotis calcarea	II (+)				
31	Carex paniculata	I (+)				
48	Deschampsia caespitosa					III (1)
173	Valeriana officinalis	I (+)				
246	Arrhenatherum elatius					III (1)
247	Carex acutiformis					III (1)
248	Lathyrus montanus					III (1)
259	Scapania undulata			I (+)		

Monaghan Fen Survey 2007

Appendix 6D. Species abbreviations with full Latin and English names

Species Code	Abbreviation	Species full name	English Names	Latin Synonyms
001	Agros can	Agrostis canina	Velvet Bent	
002	Agrost stol	Agrostis stolonifera	Creeping Bent Grass	
233	Algae	Algae	Algae	
003	Alisma pl aq	Alisma plantago aquatica	Water-plantain	
004	Alnus glut	Alnus glutinosa	Alder	
005	Alop genic	Alopecurus geniculatus	Marsh Foxtail	
006	Anag tenella	Anagallis tenella	Bog Pimpernel	
180	Aneura ping	Aneura pinguis	Liverwort	Riccardia pinguis
007	Angel sylv	Angelica sylvestris	Angelica	
008	Anthox od	Anthoxanthum odoratum	Sweet Vernal Grass	
009	Apium inunda	Apium inundatum	Lesser Marshwort	
010	Apium nodi	Apium nodiflorum	Fool's Water Cress	
246	Arrhen elatius	Arrhenatherum elatius	False Oat-grass	
242	Athyrium f-f	Athyrium filix-femina	Lady Fern	
181	Aulocom pal	Aulacomnium palustre	Moss	
011	Berula erec	Berula erecta	Lesser Water-parsnip	
012	Betula pub	Betula pubescens	Birch	
013	Bidens cer	Bidens cerua	Nodding bur-marigold	
014	Bidens tripar	Bidens tripartia	Trifid bur-marigold	
182	Brachy riv	Brachythecium rivulare	Moss	
015	Briza med	Briza media	Quaking Grass	
183	Bry pseudo	Bryum pseudotriquetrum	Moss	
186	Call cusp	Calliergonella cuspidata	Spear Moss	Calliergon or Arcocladium cuspidatum
184	Call gig	Calliergon giganteum	Moss	Acrocladium giganteum
185	Call stram	Calliergon stramineum	Moss	
016	Callitrich stag	Callitriche stagnalis	Common water-starwort	
017	Calluna vul	Calluna vulgaris	Ling Heather	
018	Caltha pal	Caltha palustris	Marsh Marigold, Kingcup	
187	Calyp muell	Calypogeia muelleriana	Liverwort	Calypogeia muellerana
188	Camp stell	Campylium stellatum	Moss	
019	Cardam pra	Cardamine pratensis	Lady's Smock	
247	Carex acutifor	Carex acutiformis	Lesser Pond Sedge	
034	Carex brach	Carex viridula ssp. brachyrhyncha	Long-stalked Yellow Sedge	Carex lepidocarpa
020	Carex curta	Carex curta	White Sedge	
021	Carex diand	Carex diandra	Lesser Tussock Sedge	
022	Carex dioic	Carex dioica	Dioecious Sedge	
023	Carex disti	Carex disticha	Brown Sedge	
024	Carex echin	Carex echinata	Star Sedge	
025	Carex flac	Carex flacca	Glaucous Sedge	
026	Carex hos	Carex hostiana	Tawny Sedge	
027	Carex lasio	Carex lasiocarpa	Slender Sedge	
028	Carex limosa	Carex limosa	Bog Sedge	
029	Carex nigra	Carex nigra	Common Sedge	
035	Carex oed	Carex viridula ssp. oedocarpa	Common Yellow Sedge	Carex demissa
031	Carex pancl	Carex paniculata	Greater Tussock Sedge	
030	Carex panic	Carex panicea	Carnation Sedge	
032	Carex pulica	Carex pulicaris	Flea Sedge	
033	Carex ros	Carex rostrata	Bottle Sedge	
036	Carex virid	Carex viridula ssp. viridula	Small-fruited Yellow Sedge	C. serotina/C. oederi
037	Cent nigra	Centaurea nigra	Blackheads	
265	Cepahaloz spp	Cephaloziella spp.	Liverwort	
038	Cerast font	Cerastium fontanum	Common mouse-ear	
039	Chara spp	Chara spp	Stoneowrt	
040	Cicuta viro	Cicuta virosa	Cowbane	
189	Cinc font	Cinclidotus fontinaloides	Moss	
041	Cirsium dis	Cirsium dissectum	Meadow Thistle, Fen Thistle	
042	Cirsium pal	Cirsium palustre	Marsh Thistle	
043	Cladium mar	Cladium mariscus	Saw Sedge	
190	Cladop fluit	Cladopodiella fluitans	Liverwort	Cephalozia fluitans
191	Clim dend	Climacium dendroides	Moss	
192	Craton filicin	Cratoneuron filicinum	Moss	Amblystegium filicinum
260	Crepis palud	Crepis paludosa	Marsh Hawk's-beard	
193	Ctenid moll	Ctenidium molluscum	Moss	
044	Dactlyor incar	Dactylorhiza incarnata	Marsh Orchid	
045	Dactlyor macul	Dactylorhiza maculata	Heath Spotted-orchid	
046	Dactlyor maj	Dactylorhiza majalis	Broad-leaved Marsh-orchid	
047	Dactyl glom	Dactylus glomerata	Cock's-foot	
048	Descham caes	Deschampsia caespitosa	Tufted hair-grass	
194	Dicran scop	Dicranum scoparium	Moss	
195	Drep cosson	Drepanocladus cossonii	Moss	Drepanocladus intermedius
197	Drep revolv	Drepanocladus revolvens	Moss	
266	Drep uncinat	Drepanocladus uncinatus	Moss	

Monaghan Fen Survey 2007

Appendix 6D. Species abbreviations with full Latin and English names

Species Code	Abbreviation	Species full name	English Names	Latin Synonyms
049	Drosera rot	Drosera rotundifolia	Round-leaved Sundew	
050	Dryopt affin	Dryopteris affinis	Scaly male-fern	
051	Dryopt carth	Dryopteris carthusiana	Narrow buckler-fern	
052	Dryopt fx-ma	Dryopteris felix-mas	Male-fern	
053	Eleoch mult	Eleocharis multicaulis	Many stalked Spike-rush	
054	Eleoch pal	Eleocharis palustris	Common Spike-rush	
055	Eleoch quin	Eleocharis quinqueflora	Few-flowered Spike-rush	
056	Elodea can	Elodea canadensis	Canadian Water-weed	
057	Epilob hirs	Epilobium hirsutum	Great Willowherb	
058	Epilob obscur	Epilobium obscurum	Short-fruited Willowherb	
059	Epilob palu	Epilobium palustre	Marsh Willowherb	
060	Epilob parvi	Epilobium parviflorum	Hoary Willowherb	
061	Epipactis pal	Epipactis palustris	Marsh Helleborine	
062	Equis fluv	Equisetum fluviatile	Water Horsetail	
063	Equis pal	Equisetum palustre	Marsh Horsetail	
064	Equis varie	Equisetum variegatum	Variegated Horsetail	
065	Erica tet	Erica tetralix	Cross-leaved Heath	
066	Erioph ang	Eriophorum angustifolium	Many-headed Bog Cotton	
067	Erioph grac	Eriophorum gracile	Slender Cotton Grass	
068	Erioph lat	Eriophorum latifolium	Broad-leaved Cotton Grass	
069	Erioph vag	Eriophorum vaginatum	Single-headed Bog Cotton	
198	Euclad vertic	Eucladium verticillatum	Moss	
070	Eupat cann	Eupatorium cannabinum	Hemp Agrimony	
199	Eurhyn prae	Eurhynchium praelongum	Moss	
071	Fest arund	Festuca arundinacea	Tall fescue	
072	Fest rub	Festuca rubra	Red Fescue	
073	Filipend ulm	Filipendula ulmaria	Meadowsweet	
200	Fiss adian	Fissidens adianthoides	Moss	
201	Font anti	Fontinalis antipyretica	Moss	
249	Fraxinus excel	Fraxinus excelsior	Ash	
074	Galium pal	Galium palustre	Common Marsh-bedstraw	
075	Galium sax	Galium saxatile	Heath Bedstraw	
076	Galium ulig	Galium uliginosum	Fen Bedstraw	
240	Ger robert	Geranium robertianum	Herb Robert	
077	Glyceria fluit	Glyceria fluitans	Float sweet-grass	
078	Glyceria not	Glyceria notata	Sweet-grass	
202	Hamat verni	Hamatocaulis vernicosus	Moss	Drepanocladus vernicosus
079	Hamm paludo	Hammarbya palusdosa	Bog Orchid	
080	Hippuris	Hippuris vulgaris	Mare's-tail	
081	Holcus lan	Holcus lanatus	Yorhshire Fog	
082	Hydrocot vul	Hydrocotyle vulgaris	Marsh Pennywort	
203	Hyloc splend	Hylocomium splendens	Red Feather Moss	
236	Hyp cup v res	Hypnum cupressiforme var. resupinatum	Moss	
083	Hyperic elod	Hypericum elodes	Marsh St John's-Wort	
084	Hyperic tetrap	Hypericum tetrapterum	Square stalked St John's-Wort	
085	Hypoch rad	Hypochoeris radicata	Cat's Ear	
086	Iris psuedo	Iris pseudacorus	Flag Iris	
087	Juncus acuti	Juncus acutiflorus	Sharp-flowered Rush	
088	Juncus artic	Juncus articulatus	Jointed Rush	
089	Juncus bulb	Juncus bulbosus	Bulbous Rush	
235	Juncus cong	Juncus conglomeratus	Compact Rush	
090	Juncus eff	Juncus effusus	Soft Rush	
091	Juncus subn	Juncus subnodulosus	Blunt-flowered Rush	
248	Lathyrus mon	Lathyrus montanus	Bitter-vetch	
092	Lemna min	Lemna minor	Common Duckweed	
093	Lemna tri	Lemna trisulca	Ivy-leaved Duckweed	
094	Leont autum	Leontodon autumnalis	Autumn Hawkbit	
095	Littor unifl	Littorella uniflora	Shoreweed	
264	Lophoc bident	Lophocolea bidentata	Liverwort	
096	Lotus ulig	Lotus uliginosus	Greater Bird-foot-trefoil	
097	Luzula camp	Luzula campestris	Field wood-rush	
098	Luzula mult	Luzula multiflora	Heath wood-rush	
100	Lycopus eu	Lycopus europaeus	Gipsywort	
099	Lynchnis flos	Lychnis flos-cuculi	Ragged Robin	
101	Lysimach nem	Lysimachia nemorum	Yellow Pimpernel	
102	Lythrum sal	Lythrum salicaria	Purple Loosestrife	
257	Marchant poly	Marchantia polymorpha	Liverwort	
103	Mentha aq	Mentha aquatica	Water Mint	
104	Menyanthes	Menyanthes trifoliata	Bog Bean	
105	Molinia	Molinia caerulea	Purple Moor Grass	
258	Mylia anom	Mylia anomala	Liverwort	
106	Myosot laxa	Myosotis laxa	Tufted forget-me-not	

Monaghan Fen Survey 2007

Appendix 6D. Species abbreviations with full Latin and English names

Species Code	Abbreviation	Species full name	English Names	Latin Synonyms
107	Myosot scor	Myosotis scorpioides	Water forget-me-not	
267	Myostis secund	Myosotis secunda	Creeping forget-me-not	
108	Myrica gale	Myrica gale	Bog Myrtle	
109	Myrioph alter	Myriophyllum alterniflorum	Alternate water-milfoil	
110	Myrioph spic	Myriophyllum spicatum	Spiked water-milfoil	
111	Nardus stricta	Nardus stricta	Mat-grass	
112	Narth ossi	Narthecium ossifragum	Bog Asphodel, Brittle Bones	
113	Nastur off	Nasturtium officinale	Water-cress	
114	Nuphar lut	Nuphar lutea	Yellow water lily	
115	Nymph alba	Nymphaea alba	White water lily	
116	Oenanth aq	Oenanthe aquatica	Fine-leaved water-dropwort	
117	Oenanth croc	Oenanthe crocata	Hemlock water-dropwort	
118	Osmunda	Osmunda regalis	Royal Fern	
205	Palust co v co	Palustriella commutata var commutata	Moss	Cratoneuron commutatum var commutatum
206	Palust co v fa	Palustriella commutata var falcata	Moss	Cratoneuron commutatum var falcata
204	Palust comm	Palustriella commutata	Moss	Cratoneuron commutatum
119	Parnassia pal	Parnassia palustris	Grass of Parnassus	
120	Pedic palust	Pedicularis palustris	Marsh Lousewort	
207	Pellia epi	Pellia epiphylla	Lousewort	
121	Phalar arund	Phalaris arundinacea	Reed Canary-grass	
208	Philon calc	Philonotis calcarea	Moss	
251	Phleum prat	Phleum pratense	Timothy	
122	Phragmites	Phragmites australis	Common Reed	
256	Picea spp	Picea sp	Spruce	
123	Pinguic vul	Pinguicula vulgaris	Butterwort	
255	Pinus syl	Pinus sylvestris	Scots Pine	
238	Plag rost	Plagiomnium rostratum	Moss	
209	Plagio aff	Plagiomnium affine	Moss	Mnium affine
210	Plagio ellip	Plagiomnium ellipticum	Moss	
124	Plantago lan	Plantago lanceolata	Plantain	
262	Pleuroz schreb	Pleurozium schreberi	Moss	
125	Poa prat	Poa pratensis	Smooth meadow-grass	
126	Poa triv	Poa trivialis	Rough meadow-grass	
127	Polygala serp	Polygala serpyllifolia	Milkwort	
128	Polygo amph	Polygonum amphibium	Amphibious bistort	
129	Polygo hydro	Polygonum hydropiper	Water-pepper	
130	Polyt comm	Polytrichum commune	Common Hair-moss	
139	Pot erecta	Potentilla erecta	Tormentil	
140	Pot palust	Potentilla palustris	Marsh cinquefoil	
137	Potam poly	Potamogeton polygonifolius	Bog Pondweed	
131	Potamo berch	Potamogeton berchtoldii	Small Pondweed	
132	Potamo color	Potamogeton coloratus	Fen Pondweed	
133	Potamo crisp	Potamogeton crispus	Curled Pondweed	
134	Potamo lucen	Potamogeton lucens	Shining Pondweed	
138	Potamo natan	Potamogeton natans	Broad-leaved Pondweed	
135	Potamo obtus	Potamogeton obtusifolius	Blunt-leaved Pondweed	
136	Potamo perfol	Potamogeton perfoliatus	Perfoliate Pondweed	
268	Potent anser	Potentilla anserine	Silverweed	
245	Pterid aquil	Pteridium aquilinum	Bracken	
252	Ranunc acris	Ranunculus acris	Meadow Buttercup	
141	Ranunc flam	Ranunculus flammula	Lesser Spearwort	
142	Ranunc ling	Ranunculus lingua	Greater Spearwort	
263	Ranunc rep	Ranunculus repens	Creeping Buttercup	
212	Rhizo punc	Rhizomnium punctatum	Moss	Mnium punctatum
143	Rhynch alba	Rhynchospora alba	White beak-sedge	
213	Rhytid squar	Rhytidiadelphus squarrosus	Moss	
214	Rhytid triq	Rhytidiadelphus triquetrus	Moss	
261	Riccardia ping	Riccardia pinguis	Liverwort	
144	Rorrip amph	Rorippa amphibia	Great yellow-cress	
145	Rorrip palus	Rorippa palustris	Marsh yellow-cress	
244	Rubus frut agg	Rubus fructicosus agg	Bramble; Blackberry	
146	Rumex atosa	Rumex acetosa	Common Sorrel	
147	Rumex cong	Rumex conglomeratus	Clustered Dock	
148	Rumex hydro	Rumex hydrolapathum	Water Dock	
149	Salix aur	Salix aurita	Eared Willow	
150	Salix cin	Salix cinerea ssp oleifolia	Grey Willow	Salix cinerea var. atrocinerea
151	Salix frag	Salix fragilis	Crack Willow	
152	Salix rep	Salix repens	Creeping Willow	
153	Salix vim	Salix viminalis	Osier	
154	Saxifrag aizo	Saxifraga aizoides	Yellow Mountain Saxifrage	
259	Scapania undu	Scapania undulata	Liverwort	
155	Schoeno lac	Schoenoplectus lacustris	Common club-rush	Scirpus lacustris

Monaghan Fen Survey 2007

Appendix 6D. Species abbreviations with full Latin and English names

Species Code	Abbreviation	Species full name	English Names	Latin Synonyms
156	Schoenus	Schoenus nigricans	Black Bog Rush	
211	Sclero pur	Scleropodium purum	Moss	Pseudoscleropodium purum
216	Scorp scorp	Scorpidium scorpioides	Moss	
157	Senecio aq	Senecio aquaticus	Marsh Ragwort	
237	Solidago vir	Solidago virgaurea	Goldenrod	
158	Sparg erec	Sparganium erectum	Branched Bur-reed	
159	Sparg min	Sparganium minimum	Least Bur-reed	
218	Sphag angust	Sphagnum angustifolium	Bog Moss	Sphagnum recurvum var. tenue
241	Sphag cap	Sphagnum capillifolium	Bog Moss	
219	Sphag cusp	Sphagnum cuspidatum	Bog Moss	
220	Sphag dent	Sphagnum denticulatum	Bog Moss	Sphagnum auricultaum var auriculatum
221	Sphag fallax	Sphagnum fallax	Bog Moss	Sphagnum apiculatum Sphagnum recurvum var. mucronatum
217	Sphag fimb	Sphagnum fimbriatum	Bog Moss	
222	Sphag pal	Sphagnum palustre	Bog Moss	
223	Sphag papil	Sphagnum papillosum	Bog Moss	
224	Sphag recurv	Sphagnum recurvum	Bog Moss	
225	Sphag ripar	Sphagnum riparium	Bog Moss	
226	Sphag squarr	Sphagnum squarrosum	Bog Moss	
227	Sphag subnit	Sphagnum subnitens	Bog Moss	
228	Sphag subsec	Sphagnum subsecundum	Bog Moss	
229	Sphag teres	Sphagnum teres	Bog Moss	
160	Stellar gram	Stellaria graminea	Lesser Stichwort	
161	Stellar pal	Stellaria palustris	Marsh Stichwort	
162	Stellar ulig	Stellaria uliginosa	Bog Stichwort	
163	Succisa prat	Succisa pratensis	Devils Bit Scabious	
164	Thelyp pal	Thelpteris palustris	Marsh Fern	
230	Thuid tamar	Thuidium tamariscinum	Moss	
231	Toment nit	Tomentypnum nitens	Moss	Homalothecium nitens
269	Trifol repens	Trifolium repens	White Clover	
165	Trigloc pal	Triglochin palustris	Arrow Grass	
166	Typh ang	Typha angustifolia	Lesser Bulrush	
167	Typha lat	Typha latifolia	Reed mace, Bulrush	
243	Ulex europ	Ulex europaeus	Gorse	
250	Urtica dioica	Urtica dioica	Nettle	
168	Utric austral	Utricularia australis	Bladderwort	
169	Utric inter	Utricularia intermedia	Intermediate Bladderwort	
170	Utric minor	Utricularia minor	Lesser Bladderwort	
171	Utric vulg	Utricularia vulgaris	Greater Bladderwort	
172	Vaccin oxy	Vaccinium oxycoccus	Cranberry	
173	Valeria offic	Valeriana officinalis	Wild Valerian	
174	Veron an-aq	Veronica anagallis-aquatica	Blue water-speedwell	
175	Veron becca	Veronica beccabunga	Brooklime	
176	Veron caten	Veronica catenata	Pink water-speedwell	
177	Veron scutel	Veronica scutellata	Marsh speedwell	
178	Vicia cracca	Vicia cracca	Tufted Vetch	
253	Vicia sepium	Vicia sepium	Bush vetch	
179	Viola pal	Viola palustris	Marsh Violet	
232	Wanrst exan	Warnstorfia exannulata	Moss	Drepanocladus exannulatus var rotea; Drepanocladus exannulatus
234	*Vacant*			
270	*Vacant*			
254	*Vacant*			

Appendix 7: Monaghan Fen Survey 2007 Relevé Card

Sample of relevé card used on the Monaghan Fen Survey 2007.

Species nomenclature for species follows that provided National Biodiversity Network Gateway website at http://www.searchnbn.net.

Species abbreviations with full Latin and English species names, where there are available, are listed in Appendix 6D.

NPWS Fen Survey Relevé Card

Site/Location		**Relevé Size m²**		**Altitude (m)**			
Site Code		**Relevé Code**		**Slope**			
County	**Monaghan**			**Aspect**			
Date		**Water Sample Code**					
National Grid Ref		**Water Depth (cm)**		**pH**			
Discovery Grid Ref							
Discovery Map No.			**Peat**	**Peat/Min**	**Min**		
Recorder(s)		**Soil type**					
Photo Nos.		**Peat Depth (cm)**					

	Cover %	**Height (cm)**
Total Cover		
Tree		
Shrub		
Herbs/Grass/Sedge		
Bryophytes		
Litter		
Bare Peat/Soil		
Algal		
Open Water		

Vegetation description

(Other habitat: _____)

Fen Habitat: ❑ **7140 Transition Mire** ❑ **7210 Cladium fen** ❑ **7230 Alkaline fen**
❑ **7220 Petrifying springs** ❑ **Poor fen** ❑ **Non-calcareous springs**

Drainage Features Comments

Observations/Comments

Cover scale:	+ a few	1 <5%	2 5-25%	3 26-50%	4 51-75%	5 >75%

	Aneura ping	*180*		*Sphag ripar*	*225*		Cirsium dis	041		Juncus bulb	089		Potamo perfol	136
	Aulocom pal	*181*		*Sphag squarr*	*226*		Cirsium pal	042		Juncus cong	235		Potamo poly	138
	Brachy riv	*182*		*Sphag subnit*	*227*		Cladium mar	043		Juncus eff	090		Pot erecta	139
	Bry pseudo	*183*		*Sphag subsec*	*228*		Dactlyor incar	044		Juncus subn	091		Pot palust	140
	Call gig	*184*		*Thuid tamar*	*230*		Dactlyor macu	045		Lemna min	092		Ranunc flam	141
	Call stram	*185*		*Toment nit*	*231*		Dactlyor maj	046		Lemna tri	093		Ranunc ling	142
	Call cusp	*186*		Agros can	001		Dactyl glom	047		Leont autum	094		Rhynch alba	143
	Calyp muell	*187*		Agrost stol	002		Descha caes	048		Littor unifl	095		Rorrip amph	144
	Camp stell	*188*		Alisma pl aq	003		Drosera rot	049		Lotus ulig	096		Rorrip palus	145
	Cinc font	*189*		Alnus glut	004		Dryopt affin	050		Luzula camp	097		Rumex atosa	146
	Cladop fluit	*190*		Alop genic	005		Dryopt carth	051		Luzula mult	098		Rumex cong	147
	Clim dend	*191*		Anag tenella	006		Dryopt fx-ma	052		Lynchnis flos	099		Rumex hydro	148
	Craton filicin	*192*		Angel sylv	007		Eleoch mult	053		Lycopus eu	100		Salix aur	149
	Ctenid moll	*193*		Anthox od	008		Eleoch pal	054		Lysimac nem	101		Salix cin	150
	Dicran scop	*194*		Apium inunda	009		Eleoch quin	055		Lythrum sal	102		Salix frag	151
	Drep cosson	*195*		Apium nodi	010		Elodea can	056		Mentha aq	103		Salix rep	152
	Drep revolv	*197*		Berula erec	011		Epilob hirs	057		Menyanthes	104		Salix vim	153
	Euclad vertic	*198*		Betula pub	012		Epilob obscur	058		Molinia	105		Saxifrag aizo	154
	Eurhyn prae	*199*		Bidens cer	013		Epilob palu	059		Myosot laxa	106		Schoeno lac	155
	Fiss adian	*200*		Bidens tripar	014		Epilob parvi	060		Myosot secu	267		Schoenus	156
	Font anti	*201*		Briza med	015		Epipactis pal	061		Myosot scor	107		Senecio aq	157
	Hamat verni	*202*		Callitrich stag	016		Equis fluv	062		Myrica gale	108		Sparg erec	158
	Hyloc splend	*203*		Calluna vul	017		Equis pal	063		Myrioph alter	109		Sparg min	159
	Palust comm	*204*		Caltha pal	018		Equis varie	064		Myrioph spic	110		Stellar gram	160
	Palust c v c	*205*		Cardam pra	019		Erica tet	065		Narth ossi	112		Stellar pal	161
	Palust co v fa	*206*		Carex curta	020		Erioph ang	066		Nastur off	113		Stellar ulig	162
	Pellia epi	*207*		Carex diand	021		Erioph lat	068		Nuphar lut	114		Succisa prat	163
	Philon calc	*208*		Carex dioic	022		Erioph vag	069		Nymph alba	115		Thelyp pal	164
	Plagio aff	*209*		Carex disti	023		Eupat cann	070		Oenanth aq	116		Trigloc pal	165
	Plagio ellip	*210*		Carex echin	024		Fest arund	071		Oenanth croc	117		Typh ang	166
	Pleur schre	*262*		Carex flac	025		Fest rub	072		Parnassia pal	119		Typha latif	167
	Polyt comm	*130*		Carex hos	026		Filipend ulm	073		Pedic palust	120		Utric austral	168
	Scleropo pur	*211*		Carex lasio	027		Galium pal	074		Phalar arund	121		Utric inter	169
	Rhizo punc	*212*		Carex limosa	028		Galium sax	075		Phragmites	122		Utric minor	170
	Rhytid squar	*213*		Carex nigra	029		Galium ulig	076		Pinguic vul	123		Utric vulg	171
	Rhytid triq	*214*		Carex panic	030		Glyceria fluit	077		Plantago lan	124		Vaccin oxy	172
	Scorp scorp	*216*		Carex pancl	031		Glyceria not	078		Poa prat	125		Valeria offic	173
	Sphag fimb	*217*		Carex pulica	032		Hippuris	080		Poa triv	126		Veron an-aq	174
	Sphag angus	*218*		Carex ros	033		Holcus lan	081		Polygala serp	127		Veron becca	175
	Sphag capil	*241*		Carex brach	034		Hydrocot vul	082		Polygo amph	128		Veron caten	176
	Sphag cusp	*219*		Carex oed	035		Hyperic elod	083		Polygo hydro	129		Veron scutel	177
	Sphag dent	*220*		Carex virid	036		Hyperic tetrap	084		Potamo berc	131		Vicia cracca	178
	Sphag fallax	*221*		Cent nigra	037		Hypoch rad	085		Potamo color	132		Viola pal	179
	Sphag pal	*222*		Cerast font	038		Iris psuedo	086		Potamo crisp	133		Algae	233
	Sphag papil	*223*		Chara spp	039		Juncus acuti	087		Potamo lucen	134			
	Sphag recurv	*224*		Cicuta viro	040		Juncus artic	088		Potamo obtus	135			

Monaghan Fen Survey 2007

Appendix 8. Hydrochemistry data from water samples taken on sites during the Monaghan Fen Survey 2007.

EPA Sample Code	Site Name	Releve Code Number	Species Richness	Water Table Depth (cm)	Peat Depth (cm)	Fen Type	Ammonia	Total Oxidised Nitrogen	Total Phosphorus	Ortho-Phosphate	Electrical Conductivity	pH	Alkalinity	Sulphate	Calcium	Magnesium	Potassium	Sodium	Iron	Manganese	Copper	Zinc
							mg/l N	mg/l N	mg/l P	mg/l P	µS/cm @25C		mg/l CaCO3	mg/l SO4	mg/l Ca	mg/l	mg/l	mg/l	µg/l	µg/l	µg/l	µg/l
1603_5	ESHBRACK BOG	1603(2)-R1	17	-5	>200	TMP	0.08	<0.05	<0.010	<0.02	48	5.7	<12	1	<5.00	0.99	<1	<5.00	702.6	18	<1	2.4
1603_6	ESHBRACK BOG	1603(2)-R2	20	0	>200	PF	0.05	<0.05	0.073	<0.02	50	5.2	<12	1.2	<5.00	0.97	<1	<5.00	1950.8	34.9	<1	5.7
1603_3	ESHBRACK BOG	1603(4)-R1	30	0	100	PF	0.12	<0.05	0.104	0.03	57	6.4	<12	2	6.21	1.78	<1	<5.00	54616.5	230.5	7.6	31.2
1603_4	ESHBRACK BOG	1603(4A)-R1	4	5	>200	PF	0.04	<0.05	0.181	<0.02	47	4.5	<12	<1.0	<5.00	<1	<1	<5.00	1143.2	17.1	<1	8.1
1603_1	ESHBRACK BOG	1603(5)-R1	12	0	>200	PF	0.06	<0.05	0.021	<0.02	127	7.6	<12	1.6	<5.00	<1	<1	<5.00	1768.6	58.2	<1	8.2
1603_2	ESHBRACK BOG	1603(5)-R2	12	0	>200	PF	0.05	<0.05	0.024	<0.02	44	5.1	<12	1.2	<5.00	<1	<1	<5.00	1802.6	110.6	<1	5.3
1603_8	ESHBRACK BOG	1603(6)-R1	37	-10	>200	AF	0.78	<0.05	1.13	0.04	248	6.6	25	75.8	65.3	10.92	5.21	6.49	22606.8	8867.1	11.2	263.1
1603_9	ESHBRACK BOG	1603(6)-R2	22	-5	>200	PF	0.2	<0.05	0.213	0.02	59	5	141	13.5	<5.00	1.22	2.98	<5.00	699.3	18	2.2	9.3
1603_7	ESHBRACK BOG	1603(9)-R1	15	0	>200	TMP	<0.03	<0.05	0.043	<0.02	87	6.5	20	3.2	8.24	1.64	<1	5.13	1785.4	105.3	2.6	1.9
1606_1	RAFINNY LOUGH	1606-R1	13	0	>200	TMR	0.04	0.13	0.153	0.02	194	7	55	8	19.38	2.45	4.23	7.38	94.8	18.7	3.3	<1
1607_1	LOUGH SMILEY	1607-R1	18	0	N/A	TMP			0.475		122	5.3	15	14.7	10.52	2.63	0.97	8.57	819.8	192	8.6	36.8
1607_2	LOUGH SMILEY	1607-R2	17	0	>200	TMR			0.137		141	6.1	40	7.3	14.11	2.74	3.57	6.64	143.6	226.9	<1	11.8
1781_1	LISARILLY BOG	1781-R1	18	-10	>200	PF			0.08		239	6.6	98	4	37.17	3.04	<1	6.13	169.8	242.7	<1	<1
1786_4	KILROOSKY LOUGH CL.	1786-R1-Dum	16	0	>200	AF	0.11		0.186	0.03	630	7.1	324	1.6	104.98	5.02	10.82	11.42	142.3	371	<1	<1
1786_2	KILROOSKY LOUGH CL.	1786-R1-Kill	13	-20	>200	AF	0.09		0.022	<0.02	382	8.1	172	14.8	61	4.28	1	6.94	90.7	51.3	<1	<1
1786_5	KILROOSKY LOUGH CL.	1786-R1-Sum	17	-15	>200	AF	0.11		<0.010	<0.02	465	8.2	220	12.4	79.95	3.68	1.36	6.4	135.6	19.1	<1	<1
1786_3	KILROOSKY LOUGH CL.	1786-R2-Kill	21	-10	>200	AF	0.1		<0.010	0.02	386	7.8	162	15	61.44	4.91	0.98	7.03	115.1	40.1	<1	<1
1836_1	ANNAGHEANE LOUGH	1836-R1	11	-10	>200	TMP	0.11	<0.05	0.923	<0.02	487	7	126	93.3	71.39	5.01	11.24	9.97	256.8	224.7	3.9	2.1
1837_1	MULLAGLASSAN LOUGH	1837-R1	18	-10	>200	TMR	0.63	<0.05	0.502	0.02	315	6.7	152	5.5	59.88	1.34	7.86	<5.00	2829.2	410.2	4.1	14.9
1839_1	KILLYVILLY LOUGH	1839-R1	22	-20	60	AF	0.08	<0.05	0.069	<0.02	519	8	224	26.4	79.53	5.13	2.72	7.35	215.9	97.6	<1	<1
1840_1	LISLANNAN BOG	1840-R1	22	0	>200	TMR	0.12		0.143	0.06	381	7.2	178	1.7	68.75	3.1	1.85	<5.00	155.5	98.3	<1	11.5
1840_2	LISLANNAN BOG	1840-R2	23	0	>200	TMR	0.14		0.194	0.1	433	7	218	4.1	81.66	3.34	<1	<5.00	577.9	234.4	2.6	5.7
2077_1	NAFARTY FEN	2077-R1	12	-10	40	MSH	<0.03	<0.05	0.358	0.05	393	6.9	217	2.1	66.58	4.57	1.82	6.41	6737.4	603.9	2.3	19.2
2732_1	DRUMGALLAN BOG	2732-R2	13	0	>200	TMP			0.191		140	6.6	47	4.8	14.49	2.24	2.14	6.54	197	21.4	<1	<1
2732_2	DRUMGALLAN BOG	2732-R4	11	10	>200	TMP			0.483		103	6	32	4	12.84	2.1	<1	<5.00	507.6	226	6.4	7.3
2755_1	KILLYNEILL FEN	2755-R1	19	0	>200	TMR			0.35		460	6.60	200	1.6	66.56	8.78	4.72	11.24	102.2	199.6	2.9	<1
2755_2	KILLYNEILL FEN	2755-R2	26	-20	>200	PF			0.321		455	6.5	218	1.5	74.79	8.27	3.08	9.8	119.5	21.5	<1	5.1
2755_3	KILLYNEILL FEN	2755-R3	17	0	>200	TMR			0.476		482	6.5	196	2.9	76.26	7.18	2.49	14.4	173.6	11.4	4.1	<1
2755_4	KILLYNEILL FEN	2755-R4	14	-5	>200	PF			0.962		73	4.9	14	<1.0	<5.00	1.01	2.06	7.72	90.2	65	2.5	5.5
2893_1	LISNALEE FEN	2893-R1	18	0	120	TMR	0.19	<0.05	0.253	0.18	180	6.9	41	9	17.23	2.03	4.23	9.16	595.3	154.7	3.4	<1
2893_2	LISNALEE FEN	2893-R2	18	0	180	PF	0.06	<0.05	0.231	0.03	171	5.8	<12	2.7	5.48	1.92	1.62	19.04	658.8	91.8	2.9	<1
2896_1	LISQUIGNY FEN	2896-R1	12	0	>200	TMR	0.04	<0.05	0.247	0.02	210	6.2	66	2.6	22.67	3.64	2.76	10.69	107.5	398.6	<1	<1
2896_2	LISQUIGNY FEN	2896-R2	16	0	>200	TMR	0.32	<0.05	0.172	<0.02	215	6.4	82	2	24.3	3.42	2.14	9.9	306.2	231.2	<1	<1
2897_1	GREAGHGLAS FEN	2897-R1	15	0	>200	MSH	0.04	<0.05	0.07	<0.02	158	6.7	77	2.7	22.5	2.7	<1	5.05	312.3	97.5	<1	<1
2901_1	CORAVILLA - RAKEEN FEN	2901-R1	13	0	>200	TMP	0.13	<0.05	0.292	0.08	174	6.3	67	2.1	20.71	2.36	2.77	7.51	501.2	156	5.9	<1
2902_1	AGHACLOGHAN FEN	2902-R1	19	0	200	TMR	0.03	<0.05	0.089	<0.02	195	6.3	80	5.7	22.12	3.45	1.32	6.19	339	2893.5	2.1	<1

EPA Sample Code	Site Name	Releve Code Number	Species Richness	Water Table Depth (cm)	Peat Depth (cm)	Fen Type	Ammonia	Total Oxidised Nitrogen	Total Phosphorus	Ortho-Phosphate	Electrical Conductivity	pH	Alkalinity	Sulphate	Calcium	Magnesium	Potassium	Sodium	Iron	Manganese	Copper	Zinc
							mg/l N	mg/l N	mg/l P	mg/l P	µS/cm @25C		mg/l CaCO3	mg/l SO4	mg/l Ca	mg/l	mg/l	mg/l	µg/l	µg/l	µg/l	µg/l
2903_1	DUNAREE FEN	2903-R1	12	0	>200	TMP	0.07	<0.05	0.236	<0.02	208	6	21	41.8	11.57	3.72	5.5	10.95	285.7	1520.6	4	21.8
2904_1	AGHNAMULLEN FEN	2904-R1	20	0	>200	TMR	0.63	<0.05	0.277	<0.02	185	6	41	14.4	19.04	2.06	2.1	8.7	315.9	307.6	3.7	1
2904_2	AGHNAMULLEN FEN	2904-R2	16	0	>200	TMR	<0.03	<0.05	0.076	<0.02	207	6.9	65	6.5	25.43	2.98	1.28	7.65	67.1	51.3	6.6	<1
2911_1	LISINISKY MARSH	2911-R1	29	0	>200	TMR	0.19	<0.05	0.338	<0.02	184	6.4	80	7.9	25.41	3.68	1.73	6.31	2386	3053.7	5.6	31.8
2911_2	LISINISKY MARSH	2911-R2	27	-10	>200	TMP	0.58	<0.05	0.114	<0.02	210	6.5	94	3.5	22.73	3.56	1.42	6.51	786	6179	2.7	20.2
MFS1_1	CORNAGLARE LOUGH	MFS01-R1	23	5	>200	TMR			0.21		119	6.7	31	4.8	10.56	3.12	<1	6.91	438.8	235	2.5	4.3
MFS4_1	CRUMLIN LOUGH	MFS04-R1	11	0	>200	TMP			0.125		371	7.8	33	5.6	9.33	2.79	1.44	8.19	180.9	41.7	<1	5.9
MFS4_2	CRUMLIN LOUGH	MFS04-R2	19	0	>200	TMP			0.09		91	7.7	24	2.4	7.26	1.96	<1	6.17	383.9	65.4	<1	<1
MFS5_1	MORGANS LOUGH	MFS05-R1	18	-15	>200	TMR	0.3		0.325	0.24	573	6.9	278	5.5	104.46	3.3	1.93	5.17	2361.9	1090.2	<1	<1
MFS6_1	BOCKS UPPER	MFS06-R1	21	0	80	TMR	0.4	<0.05	0.147	<0.02	165	6.5	66	5.3	14.47	3.5	3.39	6.3	3978.8	1298.6	<1	8.8
MFS7_1	CRINKILL LOUGH	MFS07-R1	18	0	100	TMP	0.75	<0.05	0.619	<0.02	315	6.6	142	14.6	39.08	4.67	2.66	5.97	1892.1	11359	20.2	63.9
MFS7_2	CRINKILL LOUGH	MFS07-R2	16	-5	30	PF	0.29	<0.05	0.599	<0.02	79	5	32	3.7	<5.00	1.59	4.38	5.73	1973.6	173.9	5.5	26.8
MFS7_3	CRINKILL LOUGH	MFS07-R3	19	-20	40	PF	0.13	<0.05	0.971	0.02	80	5.1	20	2	<5.00	1.66	5.64	<5.00	4257.8	226.1	6.5	29.1
MFS8_1	KILLYCOOLY LOUGH	MFS08-R1	23	-15	40	TMR	0.18	<0.05	0.457	0.25	470	7.1	240	13.4	84.62	6.16	1.65	12.08	1733.5	972.2	<1	<1
1606_2	RAFINNY LOUGH	NA					0.09	<0.05	0.26	0.03	149	6.3	47	4	17.32	1.77	3.85	5.09	389	66.6	4.4	1
1781_2	LISARILLY BOG	NA							<0.010		406	6.8	184	1.9	69.56	4.7	<1	6.69	107.3	23.2	<1	4.7
1786_1	KILROOSKY LOUGH CL.	NA					0.27		0.173	0.18	531	7.3	260	13.6	94.7	4.94	<1	8.65	295.5	511.6	<1	<1
1836_2	ANNAGHEANE LOUGH	NA					0.09	<0.05	0.329	0.02	446	7.1	166	41.7	73.35	4.5	<1	8.05	139.6	4.1	3.6	<1
2077_2	NAFARTY FEN	NA					0.03	2.12	0.019	<0.02	516	7.1	242	7.3	84.2	5.28	1.25	8.46	623.3	199.7	<1	6.1
2897_2	GREAGHGLAS FEN	NA					<0.03	<0.05	0.247	<0.02	274	7	100	2.1	28.67	3.55	<1	18.09	168	15.4	<1	<1
2901_2	CORAVILLA - RAKEEN FEN	NA					0.31	<0.05	0.359	0.05	150	6.3	45	1.7	15.88	1.64	2.27	6.53	1076.6	97.8	<1	<1
2902_2	AGHACLOGHAN FEN	NA					0.13	<0.05	0.127	<0.02	183	6.2	68	8.4	21.56	3.55	1.21	7.08	316.3	372.2	<1	<1
2903_2	DUNAREE FEN	NA					1.49	0.41	0.096	<0.02	149	6.2	44	10.5	10.4	3.77	1.5	7.9	783.2	1122.5	<1	<1
MFS1_2	CORNAGLARE LOUGH	NA							1.234		217	6.5	86	10	25.08	6.75	1.66	6.51	405.4	583.2	2.4	5.6
MFS6_2	BOCKS UPPER	NA					0.2	<0.05	0.145	<0.02	129	6.3	57	6.1	11.91	3.41	2.97	6.54	2510	679.5	2.5	5
MINIMUM VALUE					**30**		**0.03**	**0.13**	**0.019**	**0.02**	**44**	**4.5**	**14**	**1**	**5.48**	**0.97**	**0.97**	**5.05**	**67.1**	**4.1**	**2.1**	**1**
MAXIMUM VALUE					**200**		**1.49**	**2.12**	**1.234**	**0.25**	**630**	**8.2**	**324**	**93.3**	**104.98**	**10.92**	**11.24**	**19.04**	**54616.5**	**11359**	**20.2**	**263.1**
AVERAGE					90.00		**0.23**	**0.89**	**0.29**	**0.07**	**#####**	**6.52**	**110.61**	**10.01**	**40.44**	**3.56**	**3.04**	**8.15**	**2154.54**	**772.27**	**4.80**	**20.33**
Standard Deviation					**57.8**		**0.279**	**1.077**	**0.2782**	**0.075**	**159.9**	**0.8**	**82.68**	**16.378**	**30.548**	**1.982**	**2.309**	**2.95**	**7470.85**	**1989.3**	**3.58**	**44.92**

The laboratory is accredited by the National Accreditation Board for a range of tests on water and wastewater samples. The laboratory's Scope of Accreditation is available on request.

The following information is provided to assist in the interpretation of this test report. For Specification limits refer to those values set out in Integrated Pollution Control licences, Local Authority licences and other legislative requirements.

The table below lists the parameters currently accredited by the NAB.
The table also gives the units of measurement, the Limit of Quantitation (LOQ), the Maximum Uncertainty of the analysis and our Laboratory Method Reference No. for each parameter.

Parameter	**Units of Measurement**	**Limit of Quantitation**	**Maximum Uncertainity (95%, K=2)**	**Laboratory Method Reference No.**
BOD	mg/l O2	1.5	± 18%	B.2
pH	pH units	--	± 0.2 *	B.7
Conductivity	µS/cm	9	±1%	B.4
Hardness	mg/l $CaCO_3$	9	±2%	B.6
Alkalinity	mg/l $CaCO_3$	12	±2%	B.9
Chemical Oxygen Demand	mg/l O_2	4	± 5%	B.3
Ammonia	mg/l N	0.03	±7%	B.1
Total Oxidised Nitrogen	mg/l N	0.05	± 4%	B.1
Nitrite	mg/l N	0.003	± 6%	B.1
o-Phosphate	mg/l P	0.02	± 7%	B.1
Chloride	mg/l Cl	1	± 7%	B.1
Fluoride	mg/l F	0.15	± 10%	B.10
Sulphate	mg/l So4	1	± 2%	B.10
Suspended Solids	mg/l	5	± 13%	B.8
Total Dissolved Solids	mg/l	23	± 5%	B.11
Residue on Evaporation	mg/l	23	± 6%	B.11
Colour	mg/l Pt/Co	5	± 6%	B.12
Total Suspended Solids	mg/l	5	± 12%	B.13
Turbidity	NTU	0.5	± 15%	B.14
TOC	mg/l C	1.5	± 9%	B.16
Chloroform	µg/l	0.2	± 10%	B.15
Benzene	µg/l	0.2	± 10%	B.15
Bromodichloromethane	µg/l	0.2	± 10%	B.15
Dibromochloromethane	µg/l	0.5	± 10%	B.15
1,2-dichloroethane	µg/l	0.2	± 10%	B.15
Tetrachloroethene	µg/l	0.3	± 10%	B.15
Trichloroethene	µg/l	0.2	± 10%	B.15
Bromoform	µg/l	0.3	± 10%	B.15

Note: For most tests, the Analytical Performance testing was carried out at low, mid-range and the upper end of the analytical range and the Uncertainty values were initially calculated from this data (based on precision and bias). This data is available from the laboratory on request.

Following the initial Performance testing the Uncertainty of measurement will be reviewed on an annual basis using results obtained from in-house duplicate results (precision) and in-house QC results (bias). When reviewing the data if there are significant changes, then the Uncertainty values for the tests in question will be updated accordingly.

In the table above the % Expanded Uncertainty is quoted for each test with the exception of pH, which is quoted in pH units ie. pH result ± 0.2

Monaghan Fen Survey 2007

Appendix 9: Conservation evaluation of sites surveyed on the Monaghan Fen Survey 2007.

Rating value: High - 5; Medium - 3; Low - 1; None - 0 **Maximum possible score 75**

	Site Code	Ranking	Total Site Score	Naturalness	Non-recreatability	Potential value	Typicality	Size	Diversity	Fen value	Rarity- Species	Rarity - Habitats	Viability	Recorded history	Educational value	Management needs	Intrinsic appeal	Expert opinion
Site Name/ Scoring System Applied				0 = high disturbance; 5 = no or minimal disturbance	0 = easy to re-create; 5 = difficult to re-create	0 = no improvement possible/ close to its maximum potential; 5 = significant improvement possible/ site not at its maximum potential	0 = habitat not representative; 5 = excellent example of habitat	0 = Site too small to be viable; 5 = site size large and viable	0 = poor habitat / species diversity; 5 = excellent habitat / species diversity	0 = no fen habitats present; 5 = good quality fen habitats present	0 = no species of note recorded; 5 = rare species of note confirmed on site	0 = no habitats of note recorded; 5 = rare habitat of note confirmed on site	0 = site not unviable; 3 = viable but only with management measures; 5 = site viable	0 = no previous research; 5 = extensive site information available	0 = no educational value; 5 = highly suitable educational site	0 = Site requires major management / restoration initiatives; 5 = site requires little or no change in current manageme	0 = no scenic/landscape appeal; 5 = high scenic/landscape appeal	0 = site has no value for conservation; 5 = site has high value for conservation
TOSSY CROSS FEN	002895	E	**3**	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0
ALLAGESH LOUGH NHA	001780	E	**6**	0	0	1	1	0	1	0	1	1	0	1	0	0	0	0
KILLYHOMAN MARSH NHA	001782	E	**7**	0	1	1	0	0	1	0	1	0	0	1	0	0	1	1
DUNAREE FEN	002903	E	**8**	0	0	0	1	0	1	1	1	1	1	0	0	0	1	1
LISNALEE FEN	002893	E	**9**	1	0	1	1	1	1	1	0	1	1	0	0	0	0	1
NAFARTY FEN NHA	002077	D	**13**	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1
KILNACLAY FEN	002899	D	**14**	1	3	1	1	1	1	1	0	1	1	1	0	0	1	1
AGHABOY FEN	002900	D	**15**	1	1	3	1	**3**	1	0	0	1	1	1	0	0	1	1
GRAFFAGH AND CORINSHIGO FEN	002898	D	**16**	1	3	1	1	3	3	0	0	1	1	0	0	0	1	1
TIRAGARVAN FEN	002894	D	**18**	3	1	3	1	3	0	0	0	1	3	0	0	1	1	1
LISQUIGNY (CORLONGFORD) FEN	002896	D	**19**	3	1	3	1	**3**	1	1	0	1	1	0	0	0	1	3
AGHACLOGHAN FEN	002902	C+	**22**	1	3	1	3	**1**	3	3	0	1	1	0	0	1	1	3
ARDKIRK	MFS-03	C+	**22**	1	3	1	1	3	3	0	3	1	3	0	0	1	1	1
SHEETRIM FEN	002892	C+	**23**	1	3	3	3	1	3	0	0	5	1	0	0	0	0	3
BOCKS UPPER	MFS-06	C+	**24**	1	3	3	3	3	1	3	0	1	1	0	0	1	1	3

Monaghan Fen Survey 2007

Appendix 9: Conservation evaluation of sites surveyed on the Monaghan Fen Survey 2007.

Rating value: High - 5; Medium - 3; Low - 1; None - 0 **Maximum possible score 75**

	Site Code	Ranking	Total Site Score	Naturalness	Non-recreatability	Potential value	Typicality	Size	Diversity	Fen value	Rarity- Species	Rarity - Habitats	Viability	Recorded history	Educational value	Management needs	Intrinsic appeal	Expert opinion
Site Name/ Scoring System Applied				0 = high disturbance ; 5 = no or minimal disturbance	0 = easy to re-create; 5 = difficult to re-create	0 = no improvement possible/ close to its maximum potential; 5 = significant improvement possible/ site not at its maximum potential	0 = habitat not representative; 5 = excellent example of habitat	0 = Site too small to be viable; 5 = site size large and viable	0 = poor habitat / species diversity; 5 = excellent habitat / species diversity	0 = no fen habitats present; 5 = good quality fen habitats present	0 = no species of note recorded; 5 = rare species of note confirmed on site	0 = no habitats of note recorded; 5 = rare habitat of note confirmed on site	0 = site not unviable; 3 = viable but only with management measures; 5 = site viable	0 = no previous research; 5 = extensive site information available	0 = no educational value; 5 = highly suitable educational site	0 = Site requires major management / restoration initiatives; 5 = site requires little or no change in current manageme	0 = no scenic/landscape appeal; 5 = high scenic/landscape appeal	0 = site has no value for conservation; 5 = site has high value for conservation
CORAVILLA - RAKEEN FEN	002901	C	**25**	3	3	3	3	**3**	1	3	0	1	1	0	0	0	1	3
GREAGHGLAS FEN	002897	C	**25**	3	3	1	3	1	1	0	0	1	3	0	0	3	3	3
PRIESTFIELD LOUGH	002614	C	**26**	1	3	1	1	3	3	0	0	0	5	1	3	1	3	1
MORGANS LOUGH	MFS-05	C	**27**	3	3	3	3	3	1	3	0	1	1	1	0	1	1	3
ANNAGHEANE LOUGH	001836	C	**27**	3	3	3	1	3	3	1	3	1	0	1	0	1	1	3
CRUMLIN LOUGH	MFS-04	C	**27**	3	3	1	1	3	3	1	0	1	5	1	0	1	3	1
LISINISKY MARSH	002911	C	**29**	3	3	3	3	1	3	3	0	1	3	1	0	1	1	3
DRUMCOR LOUGH	001841	C	**29**	3	3	3	3	3	1	0	1	3	3	3	0	1	1	1
KILLYCOOLY LOUGH	MFS-08	B	**37**	3	5	1	3	3	3	3	0	3	3	0	1	3	3	3
MULLAGLASSAN LOUGH	001837	B	**38**	3	3	3	3	3	3	3	1	1	3	3	0	3	3	3
DRUM LOUGH	MFS-02	B	**38**	5	3	1	3	5	5	0	0	1	3	0	3	3	3	3
CORNAGLARE LOUGH	MFS-01	B	**40**	5	3	1	3	5	5	3	0	1	5	1	1	1	3	3
KILLYNEILL FEN	002755	B	**41**	3	3	3	3	5	3	5	1	3	3	1	1	1	3	3
LOUGH SMILEY	001607	B	**43**	3	5	3	3	3	5	3	1	3	3	1	3	1	3	3
LISABUCK LOUGH	001835	B	**43**	5	5	3	3	3	3	0	5	3	3	3	0	1	3	3
CRINKILL LOUGH	MFS-07	B	**43**	3	5	3	3	5	3	3	0	5	3	0	1	3	3	3
ROSEFIELD LAKE AND WOODLAND	001784	B	**43**	3	5	1	3	5	5	0	0	5	3	3	1	3	3	3
RAFINNY LOUGH	001606	B	**46**	3	5	1	5	3	3	3	1	3	5	3	0	5	3	3
LISLANNAN BOG	001840	B	**48**	3	3	3	3	5	5	5	0	3	5	1	1	3	5	3
MOYLAN LOUGH	002531	A	**48**	3	5	3	3	5	1	0	3	5	5	3	3	1	3	5
DRUMGALLAN BOG	002732	B	**49**	3	3	1	3	5	3	5	5	3	5	3	1	3	3	3
MULLAGHMORE LAKE (SOUTH)	001785	B	**50**	5	5	1	5	5	5	0	0	3	5	3	0	3	5	5
AGHNAMULLEN FEN	002904	B	**51**	3	5	1	5	**5**	5	5	0	3	5	0	1	3	5	5
LISARILLY BOG	001781	B	**55**	3	5	1	5	1	5	5	1	3	5	5	1	5	5	5
KILLYVILLY LOUGH	001839	B	**58**	3	5	3	5	3	5	5	5	5	5	3	0	3	5	3
ESHBRACK BOG	001603	A	**61**	5	5	5	3	5	3	3	3	5	3	5	5	1	5	5
KILROOSKY LOUGH CLUSTER	001786	A	**67**	5	5	3	5	5	5	5	3	5	5	5	3	3	5	5

Appendix 10. List of sites in County Monaghan surveyed as part of the Monaghan Fen Survey 2007 where dumping and infill were noted.

Site Name & Code	Grid Reference	Date Site Surveyed	Site Status	Type of damage	Threat to overall site from dumping (Some Moderate; Severe)
Aghaboy Townland Marsh 2900	H 626 350	31 May 2007	Undesignated site	Infilling with soil/building waste;	Moderate
Aghacloghan 2902	H 802 089	24 May 2007	Undesignated site	Infilling with soil/building waste	Moderate
Annagheane 1836	H 469 181	30 May 2007	Designated NHA	Infilling with soil/building waste; numerous abandoned vehicles; within NHA boundary	Moderate
Ardkirk MFS03	H 872 144	5 June 2007	Undesignated site	Infilling with soil/building waste; Disposal of household, farm, garden waste	Severe
Bocks Upper MFS06	H 794 091	8 June 2007	Undesignated site	Infilling with soil/building waste	Some
Coravilla - Rakeen Fen 2901	H 648 241	23 May 2007	Undesignated site	Infilling with soil/building waste	Moderate
Crumlin Lough MFS04	H 642 330	28 May 2007	Undesignated site	Infilling with soil/building waste	Moderate/Severe
Drumcor Lough 1841	H 481 175	30 May 2007	Designated NHA	Infilling with farmyard / mushroom compost waste & plastic; within NHA boundary	Some
Drumgallan 2732	H 810 283	27 May 2007	Candidate NHA	Disposal of household, farm, garden waste	Some
Killy Lough	H 63 42	11 June 2007	Undesignated site	Infilling with soil/building waste	Moderate/Severe
Killyneill 2755	H 730 354	25 May 2007	Candidate NHA	Infilling with soil/building waste; Disposal of household, farm, garden waste	Moderate/Severe
Kilnaclay Fen 2899	H 632 303	28 May 2007	Undesignated site	Infilling with soil/building waste	Some
Lisabuck 1835	H 502 230	30 May 2007	Designated NHA	Infilling with soil/building waste; on field adjacent to wetland but within NHA boundary.	Some
Lisinisky Marsh 2911	H 706 096	8 June 2007	Undesignated site	Infilling with soil/building waste; Disposal of household, farm, garden waste	Severe
Lisquigny Fen 2896	H 732 267	25 May 2007	Undesignated site	Infilling with soil/building waste; Disposal of household, farm, garden waste	Some
Lough Smiley 1607	H 82 21	27 May 2007	Designated NHA	Infilling with soil/building waste; Disposal of household, farm, garden waste	Severe
Nafarty Fen 2077	H 837 045	5 June 2007	Designated NHA	Infilling with soil/building waste;	Moderate
Rafinny Lough 1606	H 618 263	23 May 2007	Designated NHA	Infill area of hardcore to create a boat jetty (?)	Moderate
Sheetrim Fen 2892	H 679 315	22 May 2007	Undesignated site	Infilling with soil/building waste	Severe
Tossy Cross 2895	H 769 154	24 May 2007	Undesignated site	Infilling with soil/building waste; Disposal of household, farm, garden waste	Some

Monaghan Fen Survey 2007

Appendix 11. List of fens in County Monaghan with a cross-border component where conservation designations require harmonisation

Site Code ROI	Site Name and Conservation Status ROI	Site Code NI	Site Name and Conservation Status NI	Cross border issue	Recommendation
001603	ESHBRACK BOG, NHA	UK0016622	SLIEVE BEAGH, SAC / ASSI	Area of blanket bog in NI which is contiguous in many parts with that in the ROI has been designated as an SAC in NI. Blanket bog areas and cross border lakes in ROI of the same quality.	Recommend that the NHA in ROI be designated as SAC for blanket bog, but also Transition Mire. A section of the bog around Lough Naheery in NI has no designation, while the section of lake in ROI is in NHA. NI section of lake and bog catchment should be included in extension of SAC.
001786	KILROOSKY LOUGH CLUSTER, SAC (Kilroosky, Burdauntien, Ramages, Summerhill and Dummys Loughs)	SAC009 (ASSI078, ASSI081, ASSI080, ASSI014)	MAGHERAVEELY MARL LOUGHS, SAC (Kilroosky Lough ASSI, Burdauntien Lough ASSI, Summerhill Lough ASSI, Knockballymore Lough ASSI)	Within the Kilroosky Loughs Cluster SAC (ROI) Dummys Lough in ROI which is designated as an SAC has no conservation designation in NI.	DOE NI should designate the northern side of Dummys Lough as at least an ASSI.
001839	KILLYVILLY LOUGH, NHA	SAC009	MAGHERAVEELY MARL LOUGHS, SAC	Killyvilly Lough is designated as a NHA in the ROI, but the section in NI is not designated. In addition Magheraveely Lough mostly in NI is a designated SAC but the section of the lake in the ROI has no designation.	Magheraveely Lough should be designated as an NHA/SAC in the ROI and included as a possible extension to the Killyvilly NHA, which should be given a conservation designation in NI.

Monaghan Fen Survey 2007

Appendix 11. List of fens in County Monaghan with a cross-border component where conservation designations require harmonisation

Site Code ROI	Site Name and Conservation Status ROI	Site Code NI	Site Name and Conservation Status NI	Cross border issue	Recommendation
002732	DRUMGALLAN BOG, Undesignated	ASSI182	DRUMCARN, ASSI	The extension of the Drumgallan site into NI has been designated an ASSI. The northern site has recorded 14 species of butterfly including the nationally rare Marsh Fritillary (Euphydryas aurinia). The site is listed as an important habitat for Marsh Fritillary in Northern Ireland.	Drumgallan Bog in ROI should be designated as a NHA. Recommend Marsh Fritillary (Euphydryas aurinia) Survey of ROI site and possible designation of site as SAC should this species be recorded in significant numbers.
001840	LISLANNAN BOG, NHA	NA	NONE	Lislannan Bog is a designated NHA in the ROI. Contiguous sections of the site in NI have no designation, making effective conservation difficult.	Sections of Lislannan bog in NI should be considered for conservation designation.

Appendix 12: Additional Data Fields and Layouts included in the NPWS Fen Survey Database

As part of the Monaghan Fen Survey data collected on sites was stored within a Filemaker Pro database which was originally created as part of the NPWS Fen Study (Foss 2007). To accommodate additional information collected during this field survey, a future surveys, a number of new data fields were created which were presented in four layouts (see Figure 1 to 4 below). The new data fields, their data contents and the layouts in which they occur are described here.

In the description of the additional fields added to the NPWS Fen Survey database, the respective data entry or display field (shown **in bold lettering below**) is the field title seen on the main NPWS Fen Study database when accessed in browse mode (used to scroll through records, edit records and create new site records).

The technical field name within the database (shown **underlined and in brackets**) is displayed when the database is viewed in layout mode (used when altering field names, layouts, sorting records or exporting data, to, for example, Excel spreadsheets).

Within the database the fields are arranged in a series of layouts. Layouts which formed part of the original database (see NPWS Fen Study, Foss 2007 for further details) include:

Title layout - opening or title page of database
Main Layout - includes key Site Details
Habitats Recorded - includes a list of Fen Habitats present or possibly present on each site; using the classification system adopted in this NPWS Fen Study (Foss 2007) together with various other workers fen classification systems; and other significant non-fen habitats present
NPWS Fen Study Area Information - includes a list of 6 Fen Habitats present or possibly present on each site as adopted by the NPWS Fen Study and the area of each in hectares
Species Information - includes information on rare or noteworthy Flora and Fauna
Summary Published Information/Surveys on site - includes date when site was most recently surveyed, and who undertook the survey; together with a list of publications, reports etc. that include information on the site
Site Evaluation - includes evaluation of the site based a variety of criteria
Data sources various - includes information on the site from this study and other sources including IPCC; NPWS Pat Warner database etc.

Additional Layouts created to accommodate field survey data from the Monaghan Survey include:

Survey Findings Home layout – Basic introduction to the different survey results layouts described below which occur within the database, providing an indication of where data obtained from the field survey is to stored or updated.

General Survey Results - includes Site survey details including Geology, Quaternary deposits, River Catchment, Townlands, Survey date, and Photographic, Relevé and Water Chemistry sample numbers.

Site Report Section - includes a summary and detailed site description based on the field survey with particular reference to fen interest on the site. This layout also includes a Note section with site observations made at particular locations on site during the field survey.

Hydrochemistry Results - includes results of the water sample analysis collected during the field survey.

Printable Site Report layout - a printable site description layout which includes all relevant site data collected during the survey.

The layouts can be accessed by clicking the appropriately named button on the Main Layout (and subsequent layouts) within the database window.

Within the NPWS Fen Survey database fields are colour coded as follows:

Data fields, when they first appear (and are to be filled) are colour coded in pale green;
Data fields that are repeated in a second or subsequent layout are colour coded in pale blue;
Data fields that are created from calculations; or automatically created when a site record is formed etc. are colour coded in pink.

A copy of the NPWS Fen Survey database for County Monaghan sites can be found on the CD attached to inside back cover of this report. Additional copies of the Monaghan and entire database are held with NPWS Research section, Dublin.

Data fields added to the NPWS Fen Survey database to accommodate Monaghan Fen Survey data:

Survey Findings Home Layout

No new data fields were added to this layout, which aims to provide the surveyor with guidance on where various field survey data results are to be added to the database.

General Survey Results Layout

Main Habitats (Fen survey main habitats)

List of the main habitats recorded on the site, using Fossitt naming system.

Date of survey (Fen survey Date of survey)

Date on which the filed survey was undertaken. .

Surveyor Names (Fen survey Surveyor Names)

Names of the surveyors who undertook the fen field survey.

River Catchment (Fen survey River Catchment)

Names of the river catchment in which the site is located.

Townland Names (Fen survey Townlands)

Names of the townland(s) in which the site is located.

Solid Geology (Fen survey solid geology)

Underlying bed rock geology of the site, as indicated in the GIS Solid Geology map of Ireland.

Quaternary Deposits (Fen survey quaternary deposits)

Underlying quaternary deposits of the site, as indicated in the GIS Quaternary Deposits map of Ireland.

Topography (Fen survey topography)

Topographic description of the site location.

Hydrology (Fen survey hydrology)

Hydrological description of the site location, with inflow and outflow observations.

Relevé Numbers (Fen survey releve numbers)

Relevé code numbers of vegetation descriptions taken on the site.

Photographic Numbers (Fen survey photographic numbers)

Photographic code numbers of photographs taken on the site.

Substrate Type (Fen survey substrate type)

Record of the substrate type(s) found on the site, namely Mineral, Mineral Peat Mixture, Peat or Marl.

Peat Depth (cm) (Fen survey peat depth)

Depth of peat (to a maximum of 2 m) recorded on the site (usually at Relevé locations).

Water Sample number (Fen survey water sample number)

Water sample(s) code number(s) taken on the site for subsequent laboratory analysis.

Water table depth (cm) (Fen survey water table depth)

Water table depth recorded at relevé/water sample point on site.

Site rating based on fen survey (Conservation Recommendation following survey)

A rating of the site based on evaluation of all data collected on habitats, threats and damage occurring on the site. Each site was scored on 15 site characters to come up with final rating and conservation recommendation (see Appendix 9 in this report). 6 point rating scale used: A – SAC status recommended; B – NHA status recommended; C + - County conservation status recommended; C – High local conservation value; D – Moderate local conservation value; E – Low local conservation value.

Fen Survey Evaluation (Fen survey evaluation)

Notes on the conservation evaluation of the site.

Fen Survey Conservation recommendations (Fen survey conservation recommendation)

Notes on the conservation or management recommendations for the site.

Fen Survey Landuse with site boundary (Fen survey landuse within site boundary)

Set of land use options occurring within the site boundary based on the NHA reporting system.

Site Report Section Layout

Brief Site Description (Fen survey brief description)

A brief site description with reference to fen interest on the site.

Fen Survey Site Synopsis with Fen interest description (Fen survey site synopsis)

A detailed site description with reference to fen and other habitats on the site, as well as threats and damage.

Fen Survey Site Notes (Fen survey site notes)

Note section with site observations made at particular locations on site during the field survey. Locations of notes within the site are indicated on the six inch map which forms part of the full site report (see Appendix 1, this report).

Hydrochemistry Results Layout

Field Survey pH reading (Fen survey site pH range field)

Water pH recorded with pH meter in the evening of the field survey.

Data fields for Hydrochemical analysis of water samples, for chemical elements or water parameters including:

Alkalinity mg/l CaCO3; (Fen survey site alkalinity range)
Ammonia mg/l N; (Fen survey site ammonia range)
Calcium mg/l; (Fen survey Calcium)
Conductivity uS/cm; (Fen survey site conductivity range)
Copper mg/l; (Fen survey copper)
Iron mg/l; (Fen survey iron)
Magnesium mg/l; (Fen survey magnesium)
Manganese mg/l; (Fen survey manganese)
Ortho-Phosphate mg/l; (Fen survey site ortho phosphate range)
pH (laboratory measurement); (Fen survey site pH range laboratory)
Potassium mg/l; (Fen survey potassium)
Sulphate mg/l; (Fen survey sulphate)
Sodium mg/l; (Fen survey sodium)
Oxidised Nitrogen mg/l; (Fen survey site nitrogen range)
Total Phosphorus mg/l; (Fen survey total phosphorus)
Zinc mg/l; (Fen survey zinc)

Appendix 13: Habitat Classification Scheme for Irish Fens used on the Monaghan Fen Survey 2007

Irish Fens have been classified using a number of different schemes based on a variety of ecological factors including the peat type on which they occur, features and composition of their surface vegetation, hydrological conditions and their topographic location.

A number of the most popular fen classification schemes used are reproduced here (after Foss 2007), to demonstrate how the classification systems differ and relate to one another, and introduce the reader to the features and terms used in relation to the classification and description of Irish fens.

1. Fen topography and hydrological classification scheme

Irish Fens may be divided into two major groups based upon the topographic and hydrological conditions prevailing. These are topogenous fens and soligenous fens.

1.1 Topogenous Fens

These are formed where the topography results in a basin-type water collection system with little water movement out of the system and water fluctuations are in a vertical direction, as in shallow depressions, or in transitional zones of vegetation bordering open waters.

There are three main types of topogenous fen recognised in Ireland (Crushell 2000; Sheehy-Skeffington & O'Connell 1998; Ratcliffe 1977):

1 **Open-water transition fens** form on lake edges, where they occur on the landward side of the emergent reed vegetation which occurs further out into deeper water areas. They are one of the most common fen type fund in Ireland. They occur predominantly in the limestone regions of Ireland and can be extensive. An example of such fens would be those around Lough Corrib, Co. Galway.

2 **Flood plain fens** occur on a waterlogged flood-plains adjacent to rivers or streams. They occur in depressions or low lying areas within the floodplain where still-standing water allows development of fen vegetation. This fen type is very rare in Ireland as many sites have disappeared as a result of arterial drainage. An example of such fens would be those alongside the River Shannon and its tributaries.

3 **Basin fens** form in waterlogged basins where there is little through flow of water, and open water may be present. These fens often support a floating raft of vegetation known as a **Schwingmoor**. These fens rare in Ireland as most sites which originally conformed to this fen type have developed into raised bogs as peat continued to accumulate. They mainly occur in the Irish midlands. An example of such a fen would be at Scragh Bog, Co. Westmeath.

1.2 Soligenous Fens

These are formed on sloping terrain where an adequate supply of water provides a continuous through flow of water. Smaller areas of soligenous fen may also occur within bogs or mires associated with routes of moving drainage water.

There are three main types of soligenous fens recognised in Ireland (Crushell 2000; Sheehy-Skeffington & O'Connell 1998; Ratcliffe 1977):

1 **Valley Fens** develop on the floor of shallow valleys. The slope within these fens may be very gentle and water movement may not be immediately apparent. The main source of water would be from springs and seepage from the surrounding valley which is usually calcium rich. Valley fens are rare and occur mainly in the eastern part of the country. The combination of calcium rich water input and low annual rainfall amounts may help explain why these fens have not developed into raised bogs in the eastern part of the country (Sheehy-Skeffington & O'Connell 1998). An example of such a fen would be Pollardstown Fen, County Kildare.

2 **Flush Fens** occur as small areas within other fen and peatland types, such as raised or more typically blanket bogs. Within these areas the localised flow of water supplies more minerals than are found in the surrounding peatland areas which results in the development of floristically and visually identifiable areas of fen vegetation. In certain cases unusual communities of plants are found in these flush fens, more typical of arctic conditions (Lockhart 1999). This fen type is widespread within blanket bog areas of the West of Ireland. An example of such a fen would be at Uggool, Co. Mayo.

3 **Calcareous Spring Fens** develop around permanent freshwater springs or areas of seepage that are especially rich in calcium. The up welling of water is often associated with an interface between permeable and impermeable rock or soil strata. The water feeding these fens wells up from the ground and often deposits a white calcareous crust known as tufa on the above ground vegetation. Spring fen sites are often very limited in extent and often occur within larger fen systems or completely unrelated habitats e.g. woodlands, or exposed rocky terrain. These fens are rare in Ireland. Examples of such spring fens would be those found on Pollardstown Fen, County Kildare; Errisbeg, County Galway; and Ballyman Glen, County Wicklow.

1.3 Rich and Poor Fens

Where fens are characterised by alkaline conditions resulting from water draining from limestone and other calcareous soil formations, they are distinguished as "**rich fen**", though there is often a general understanding that a "fen" will be relatively eutrophic (nutrient rich). A classic plant of rich fen is Saw-sedge (*Cladium mariscus*).

As we have seen from the definition of "fen" above, fens can also occur in sites with much lower mineral inputs (e.g. blanket bog) and a correspondingly higher acidity. Such areas may be described as "**poor fen**" and are commonly characterised by extensive development of *Sphagnum* moss carpets.

This variation and often imprecision of terminology has been examined by Wheeler & Proctor (2000), who make a number of recommendations. In examining a wide range of mire types they find a bimodal distribution of pH that backs up the rather vague existing concepts of "fen" and "bog". They consider fen to be defined by a pH generally above 6.0 and with relatively high levels of calcium and bicarbonate ions. The vegetation of such mires tends to be rich in herbs and 'brown mosses' (they cite *Drepanocladus, Campylium* and *Scorpidium*, and *Cratoneuron* also should be included).

By contrast, bog is defined by a pH generally below 5.0, with low levels of calcium ions, and with chloride and sulphate ions as the main anions. Vegetation includes members of the heather family (*Calluna*, *Erica* etc.), cotton-grasses (*Eriophorum*) and other calcifuge ("calcium-avoiding") members of the sedge family, and often an abundance of *Sphagnum* mosses.

Using this definition, many examples of so-called "poor fen" or "acid fen" are better considered as "bog" and this gives a more satisfactory treatment of phases and micro topography in complex acid mire systems.

Although this is an interesting concept , it is not one adopted in the present study where poor fen is recognised as a fen vegetation type rather than a bog vegetation type.

2. EU Habitats Directive Annex 1 classification scheme

The EU Habitats Directive(92/43/EEC) was transposed into Irish law in the European Union (Natural Habitats) Regulations, 1997. These Regulations have since been amended twice with under Statutory Instrument SI 233/1998 and SI 378/2005. The Directive lists (in Annex I) certain habitats that must be protected within Special Areas of Conservation (SACs). Under the various habitats listed in Annex 1 of the Directive, four fen types are listed which occur in Ireland.

The Habitats Directive interpretation manual of European Union habitats, Version EUR 15 (Rameo 1996) lists the following fen types found in Ireland for which Ireland was to select a representative sample of conservation worthy sites. Habitat type **7210 *Calcareous fens with Cladium mariscus and species of the Caricion davallianae** and **7220 * Petrifying springs with tufa formation (Cratoneurion)** are both listed as priority habitats requiring the highest level of conservation within member states.

The following is an abstracts from EU Habitats Directive Interpretation Manual for the 4 fen types listed in the Directive and occurring in Ireland:

7140 Transition mires and quaking bogs

PAL.CLASS.: 54.5

1) Peat-forming communities developed at the surface of oligotrophic to mesotrophic waters, with characteristics intermediate between soligenous and ombrogenous types. They present a large and diverse range of plant communities. In large peaty systems, the most prominent communities are swaying swards, floating carpets or quaking mires formed by medium-sized or small sedges, associated with sphagnum or brown mosses. They are generally accompanied by aquatic and amphibious communities. In the Boreal region this habitat type includes minerotrophic fens that are not part of a larger mire complex, open swamps and small fens in the transition zone between water (lakes, ponds) and mineral soil.

These mires and bogs belong to the Scheuchzerietalia palustris order (oligotrophic floating carpets among others) and to the Caricetalia fuscae order (quaking communities). Oligotrophic water-land interfaces with Carex rostrata are included.

2) Plants: *Eriophorum gracile*, *Carex chordorrhiza*, *Carex lasiocarpa*, *Carex diandra*, *Carex rostrata*, *Carex limosa*, *Scheuchzeria palustris*, *Hammarbya paludosa*, *Liparis loeselii*, *Rhynchospora alba, R. fusca*, *Menyanthes trifoliata*, *Epilobium palustre*, *Pedicularis palustris, Sphagnum* sp. (*S. papillosum*, *S. angustifolium*, *S. subsecundum*, *S. fimbriatum*, *S. riparium*, *S. cuspidatum*, *Calliergon giganteum*, *Drepanocladus revolvens*, *Scorpidium scorpioides*, *Campylium stellatum*, *Aneura pinguis*.

3) Corresponding categories
United Kingdom classification: "M4 - Carex rostrata-Sphagnum recurvum mire", "M5 - Carex rostrata- Sphagnum squarrosum mire", "M8 - Carex rostrata-Sphagnum warnstofii mire", "M9 Carex rostrata-Calliergon cuspidatum/giganteum", "S27 -Carex rostrata - Potentilla palustris fen".

7210 *Calcareous fens with Cladium mariscus and species of the Caricion davallianae

PAL.CLASS.: 53.3

1) *Cladium mariscus* beds of the emergent-plant zones of lakes, fallow lands or succession stage of extensively farmed wet meadows in contact with the vegetation of the Caricion davallianae or other Phragmition species [Cladietum marisci (Allorge 1922) Zobrist 1935].

2) Plants: *Cladium mariscus, Kostelezkia pentacarpos*.

3) Corresponding categories
United Kingdom classification: "S2 Cladietum marisci", "S24 Peucedano - Phragmitetum australis", "S25 Phragmites australis - Eupatorium cannabinum fen", "M9 Carex rostrata- Calliergon spp. mire", "M13 Schoenus nigricans - Juncus subnodulosus mire", "M14 Schoenus nigricans -

Narthecium ossifragum mire", "M24 Molinia caerulea - Cirsium dissectum fen meadow", "SD 14 Salix repens - Campylium stellatum dune slack" and "SD 15 Salix repens - Calliergon cuspidatum dune slack".

4) In contact with calcareous fens (7230), but also with acid fens, extensive wet meadows, other reed beds and tall sedge communities.

7220 * Petrifying springs with tufa formation (*Cratoneurion*)

PAL.CLASS.: 54.12

1) Hard water springs with active formation of travertine or tufa. These formations are found in such diverse environments as forests or open countryside. They are generally small (point or linear formations) and dominated by bryophytes (Cratoneurion commutati).

2) Plants: *Arabis soyeri, Cochlearia pyrenaica* (in sites with heavy metals), *Pinguicula vulgaris, Saxifraga aizoides*. Mosses: *Catoscopium nigritum, Cratoneuron commutatum, C. commutatum* var. *falcatum*, *C. filicinum, Eucladium verticillatum, Gymnostomum recurvirostrum*. In the Boreal region also *Carex appropinquata, Epilobium davuricum, Juncus triglumis, Drepanocladus vernicosus, Philonotis calcarea, Scorpidium revolvens, S.cossoni, Cratoneuron decipiens, Bryum pseudotriquetrum.*

3) Corresponding categories
United Kingdom classification: "M37 Cratoneuron commutatum - Festuca rubra spring community" and "M38 Cratoneuron commutatum-Carex nigra spring community".

4) Can form complexes with transition mires, fens, chasmophytic communities of cold and humid environments and heaths and calcareous grassland (Festuco-Brometalia).
In order to preserve this habitat of very limited expanse in the field, it is essential to preserve its surroundings and the whole hydrological system concerned.

7230 Alkaline fens

PAL.CLASS.: 54.2

1) Wetlands mostly or largely occupied by peat- or tufa-producing small sedge and brown moss communities developed on soils permanently waterlogged, with a soligenous or topogenous base rich, often calcareous water supply, and with the water table at, or slightly above or below, the substratum. Peat formation, when it occurs, is infra-aquatic. Calciphile small sedges and other Cyperaceae usually dominate the mire communities, which belong to the *Caricion davallianae*, characterised by a usually prominent "brown moss" carpet formed by *Campylium stellatum*, *Drepanocladus intermedius*, *D. revolvens*, *Cratoneuron commutatum*, *Acrocladium cuspidatum*, *Ctenidium molluscum*, *Fissidens adianthoides*, *Bryum pseudotriquetrum* and others, a grasslike growth of *Schoenus nigricans*, *S. ferrugineus*, *Eriophorum latifolium*, *Carex davalliana*, *C. flava*, *C. lepidocarpa*, *C. hostiana*, *C. panicea*, *Juncus subnodulosus*, *Scirpus cespitosus*, *Eleocharis quinqueflora*, and a very rich herbaceous flora including *Tofieldia calyculata*, *Dactylorhiza incarnata*, *D. traunsteineri*, *D. traunsteinerioides*, *D. russowii*, *D. majalis* ssp. brevifolia, *D. cruenta*, *Liparis loeselii*, *Herminium monorchis*, *Epipactis palustris*, *Pinguicula vulgaris*, *Pedicularis sceptrum - carolinum*, *Primula farinosa*, *Swertia perennis*.

Wet grasslands (Molinietalia caerulaea, e.g. Juncetum subnodulosi & Cirsietum rivularis, 37), tall sedge beds (Magnocaricion, 53.2), reed formations (Phragmition, 53.1), fen sedge beds (Cladietum mariscae, 53.3), may form part of the fen system, with communities related to transition mires (54.5, 54.6) and amphibious or aquatic vegetation (22.3, 22.4) or spring communities (54.1) developing in depressions. The sub-units below, which can, alone or in combination, and together with codes selected from the categories just mentioned, describe the composition of the fen, are understood to include the mire communities sensu stricto (Caricion davallianae), their transition to the Molinion, and assemblages that, although they may be phytosociologically referable to alkaline Molinion associations, contain a large representation of the Caricion davallianae species listed, in addition to being integrated in the fen system; this somewhat parallels the definition of an integrated class Molinio - Caricetalia davallianae in Rameau

et al., 1989. Outside of rich fen systems, fen communities can occur as small areas in dune slack systems (16.3), in transition mires (54.5), in wet grasslands (37), on tufa cones (54.121) and in a few other situations. The codes below can be used, in conjunction with the relevant principal code, to signal their presence. Rich fens are exceptionally endowed with spectacular, specialised, strictly restricted species. They are among the habitats that have undergone the most serious decline. They are essentially extinct in several regions and gravely endangered in most.

2) Plants: *Schoenus nigricans, S. ferrugineus, Carex* spp*., Eriophorum latifolium, Cinclidium stygium, Tomentypnum nitens*.

3. Heritage Council classification scheme for fens and related wetlands

The Heritage Council Guide to habitats in Ireland (Fossitt 2000) sets out a standard hierarchical scheme for the identification of habitats in Ireland. The guide lists the main fen habitats in Ireland under the category of peatlands and freshwater. The guide is a practical tool to allow identification and recording of habitat types.

The 5 specific descriptions which most closely relate to those being recorded in the present NPWS Fen Study are reproduced for information here, namely:

Level 1 Category: Peatlands (P)
Level 2 Categories: Fens & Flushes (PF)
Level 3 Categories:

Rich fen and flush PF1
Poor fen and flush PF2
Transition mire and quaking bog PF3

Level 1 Category: Freshwater (F)
Level 2 Categories: Springs (FP)
Level 3 Categories:

Calcareous springs FP1
Non-calcareous springs FP2

One category of Fossitt namely Rich fen and flush PF1, corresponds to two of the categories being investigated in this study namely Alkaline fens (7230) and Calcareous fens with *Cladium mariscus* and species of the Caricion davallianae (7210).

In addition to the descriptions of habitats that most closely relate to those of interest to this NPWS Fen Study, descriptions are also provided in this section for a number of related wetland habitats which may often be confused with "fen" vegetation as defined in this study. These habitats are Freshwater Marsh GM1; Wet grassland GS4; Reed and large sedge swamps FS1; Tall-herb swamps FS2.

The descriptions below are taken from Fossitt (2000) with some minor corrections and changes to the text.

Peatlands (P)

Fossitt (2000) describes fens as "peat-forming systems that differ from bogs in that they are fed by groundwater or moving surface waters. They occur in river valleys, poorly drained basins or hollows, and beside open stretches of water (lake margins or river flood plains). Fens may also be associated with the fringes or other parts of acid bogs where there is enrichment of the water supply."

Any areas of fen that have been modified by turf cutting should be considered under **cutover bog - PB4**. Flushes are usually smaller features that are maintained by the movement or seepage of water. They occur on slopes and may or may not be peat-forming. Some flushes feed into fens while others may be associated with a range of different habitat types including bogs, woodlands and grasslands. Flushes in bogs are usually characterised by changes in the vegetation that are brought about by an enhanced supply of nutrients. Note that springs are considered in the **freshwater section (FP1-2)** (see below).

Fens and flushes **(PF)** are divided into 'rich' (basic) and 'poor' (acid) types depending on the origin and nature of the water supply. A third category, **transition mire and quaking bog - PF3**, is also distinguished because it has vegetation characteristics that are intermediate between rich and poor fen categories.

Rich fen and flush PF1

Rich fens and flushes are fed by groundwater or flowing surface waters that are at least mildly base-rich or calcareous, and are usually found over areas of limestone bedrock. The substratum is

waterlogged peat (except in the case of some flushes) and this usually has a high mineral content. Vegetation is typically dominated by Black Bog-rush (*Schoenus nigricans*) and/or small to medium sedges such as *Carex viridula, C. nigra, C. dioica* and *C. panicea*. Other prominent components of the vegetation include rushes, particularly Blunt-flowered Rush (*Juncus subnodulosus*), Purple Moor-grass (*Molinia caerulea*), Marsh Pennywort (*Hydrocotyle vulgaris*), Lesser Spearwort (*Ranunculus flammula*), Water Mint (*Mentha aquatica*), Common Marsh-bedstraw (*Galium palustre*), Grass-of-Parnassus (*Parnassia palustris*), Common Butterwort (*Pinguicula vulgaris*) and Devil's-bit Scabious (*Succisa pratensis*). Rich fen and flush can be important for orchids such as *Epipactis palustris* and *Dactylorhiza* spp. A well-developed moss layer with *Campylium stellatum, Scorpidium scorpioides* and *Drepanocladus revolvens* is also characteristic. The tops of Black Bog-rush (*Schoenus nigricans*) tussocks are relatively dry and may support plants such as heathers (*Calluna vulgaris, Erica tetralix*), Tormentil (*Potentilla erecta*), Bog-myrtle (*Myrica gale*) and Bog Asphodel (*Narthecium ossifragum*).

Rich fens and flushes may have some patchy cover of Common Reed (*Phragmites australis*), Bulrush (*Typha latifolia*), or tussock-forming species such as Great Fen-sedge (*Cladium mariscus*) and Greater Tussock-sedge (*Carex paniculata*). If large areas are dominated by species-poor or mono dominant stands of tall herbaceous plants, they should be considered under **reed and large sedge swamps - FS1**. Fens may contain patches of scrub or woodland, or bodies of open water with aquatics such as Bogbean (*Menyanthes trifoliata*). If the surface is quaking and very wet, and the vegetation comprises some species that may also be found in acid bogs, consider the category **transition mire and quaking bog - PF3.**

Links with EU Habitats Directive Annex I: This category corresponds to two annexed habitats, 'alkaline fens (7230)' and '*Calcareous fens with *Cladium mariscus* and species of the Caricion davallianae (7210)'. The latter is a priority habitat that describes stands of species-rich alkaline fen vegetation in which Great Fen-sedge (*Cladium mariscus*) is dominant.

Poor fen and flush PF2

This category includes peat-forming fens and flushes that are fed by groundwater or flowing surface waters that are acid. Flushes that are acidic but not peat-forming should also be considered here. In most cases the substratum is acid peat which has a higher nutrient status than that of ombrotrophic bogs. The vegetation of poor fens and flushes is typically dominated by sedges (particularly *Carex rostrata, C. nigra, C. curta, C. lasiocarpa and C. echinata*) and/or rushes (*Juncus effusus, J. articulatus, J. acutiflorus*). Other common components include Common Cottongrass (*Eriophorum angustifolium*), Velvet Bent (*Agrostis canina*), Purple Moor-grass (*Molinia caerulea*), Yorkshire-fog (*Holcus lanatus*) and broad-leaved herbs such as Marsh Violet (*Viola palustris*), Bogbean (*Menyanthes trifoliata*), Heath Bedstraw (*Galium saxatile*), Tormentil (*Potentilla erecta*) and Marsh Cinquefoil (*Potentilla palustris*). There may be some limited cover of dwarf shrubs. Extensive carpets of mosses including, in particular, *Sphagnum palustre, S. recurvum, S. auriculatum, Calliergon stramineum* and *Polytrichum commune*, are characteristic.

Although poor fen and flush is not listed in Annex I of the Habitats Directive, it is very limited in extent in Ireland and should be regarded as being of special conservation importance (C. Ó Críodáin, pers. comm.).

Transition mire and quaking bog PF3

Transition mires and quaking bogs are extremely wet peat-forming systems with characteristics that are intermediate between poor and rich fens. For this reason, they are considered as a separate habitat but they may occur within, or on the fringes of other peat-forming systems. Transition mires and quaking bogs are usually associated with the wettest parts of a bog or fen and can be found in wet hollows, infilling depressions, or at the transition to areas of open water. Vegetation frequently forms a floating mat or surface scraw over saturated, spongy or quaking peat. Standing water may occur in pools or along seepage zones. The vegetation typically comprises species that are characteristic of bog, fen and open water habitats. Small to medium sedges, mainly Carex spp. (particularly *Carex diandra, C. lasiocarpa, C. limosa and C. viridula*), usually dominate and may occur together with White Beak-sedge (*Rhynchospora alba*), cotton grasses (*Eriophorum angustifolium*, and the much rarer *E. gracile*), Creeping Bent (*Agrostis stolonifera*), Purple Moor-grass (*Molinia caerulea*), and a range of broad-leaved wetland herbs such as Bogbean (*Menyanthes trifoliata*), Marsh Pennywort (*Hydrocotyle vulgaris*), Lesser

Spearwort (*Ranunculus flammula*), Marsh Cinquefoil (*Potentilla palustris*) and Marsh Lousewort (*Pedicularis palustris*). Extensive moss cover is characteristic; *Sphagnum* spp., *Calliergon* spp. and *Scorpidium scorpioides* are usually abundant.

Links with EU Habitats Directive Annex I: Corresponds to the annexed habitat, 'Transition mires and quaking bogs (7140)'

Springs (FP)

Springs are usually very small local features that are maintained by a more or less continual supply of water from up welling groundwater sources, or along seepage zones. They occur in upland and lowland areas and may be associated with a variety of different habitat groups such as woodland, heath, grassland or exposed rock. Springs are characterised by abundant mosses and may or may not be peat-forming.

Calcareous springs FP1

This category is used for springs that are irrigated and kept permanently moist by water that is calcareous and oligotrophic. These springs may be associated with shallow peaty or skeletal mineral soils. There may be some precipitation of marl, or tufa formation. Calcareous springs are typically dominated by mosses, and by *Cratoneuron* spp. in particular; *Bryum pseudotriquetrum* is also characteristic. Other common components of the vegetation include grasses (*Festuca rubra, Briza media*), sedges (*Carex dioica, C. pulicaris, C. flacca, C. nigra*), Common Butterwort (*Pinguicula vulgaris*) and Marsh Horsetail (*Equisetum palustre*). The relatively rare Yellow Saxifrage (*Saxifraga aizoides*) can occur in calcareous springs and is diagnostic of this habitat.

Links with EU Habitats Directive Annex I: Calcareous springs with tufa formation are recognised as the priority habitat, '*Petrifying springs with tufa formation (*Cratoneurion*) (7220)'.

Non-calcareous springs FP2

This category is used for springs that are irrigated and kept permanently moist by acidic to neutral water that is base-poor and typically oligotrophic. They may be associated with skeletal mineral or peaty soils. Vegetation is typically dominated by mosses (*particularly Sphagnum auriculatum, Calliergon sarmentosum and Polytrichum commune*), grasses (*Agrostis spp., Deschampsia caespitosa, Nardus stricta*), Bulbous Rush (*Juncus bulbosus*), and wetland species such as Marsh Violet (*Viola palustris*), Lesser Spearwort (*Ranunculus flammula*) and Marsh Pennywort (*Hydrocotyle vulgaris*).

Other wetland habitats that may be found in association with fens

Marsh

Freshwater Marsh GM1

Marsh is found on level ground near river banks, lake shores, and in other places where mineral or shallow peaty soils are waterlogged, and where the water table is close to ground level for most of the year. Unlike swamps, standing water is not a characteristic feature except, perhaps, during very wet periods or in winter months. Marsh is comparatively species-rich and supports a high proportion of wetland species in addition to the typical dominants: rushes (*Juncus* spp.), sedges (*Carex* spp.) and Meadow sweet (*Filipendula ulmaria*). Grasses such as Creeping Bent (*Agrostis stolonifera*), Tall Fescue (*Festuca arundinacea*) and Purple Moor-grass (*Molinia caerulea*) may be present but not abundant. To be considered as marsh, the proportion of sedges and grasses should not exceed 50%. The broad-leaved herb component may include Water Mint (*Mentha aquatica*), Marsh Thistle (*Cirsium palustre*), Wild Angelica (*Angelica sylvestris*), Marsh Pennywort (*Hydrocotyle vulgaris*), Marsh-marigold (*Caltha palustris*), Common Valerian (*Valeriana officinalis*), Ragged-robin (*Lychnis flos-cuculi*), Purple-loosestrife (*Lythrum salicaria*), Marsh Woundwort (*Stachys palustris*) and Marsh Cinquefoil (*Potentilla palustris*). Marsh may also support horsetails (*Equisetum* spp.), Yellow Iris (*Iris pseudacorus*), reeds and other large grasses and sedges but these should not dominate. Herbs that are characteristic of drier ground are rare or absent in marshes. Mosses, particularly *Calliergon* and *Climacium* spp., may be plentiful.

Marsh differs from swamps in that the vegetation is usually more species-rich, standing water is absent for much of the year, and reeds and other tall or bulky grasses and sedges, and tall herbs are not overwhelmingly dominant in the former. The distinction between marsh and **wet grassland - GS4** is less clear but, in marsh, wetland herbs should be prominent, and species of drier ground should generally be absent. If there is greater than 50% cover of grasses and sedges, the habitat should be considered under grassland or, **if it is a peat-forming system, under fens and flushes. Marsh is not a peat-forming habitat**.

Links with EU Habitats Directive Annex I: Marsh may contain pockets of the annexed habitat, 'Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels (6430)'.

Grassland

Wet grassland GS4

This type of grassland can be found on flat or sloping ground in upland and lowland areas. It occurs on wet or waterlogged mineral or organic soils that are poorly-drained or, in some cases, subjected to seasonal or periodic flooding. On sloping ground, wet grassland is mainly confined to clay-rich gleys and loams, or organic soils that are wet but not waterlogged. This category includes areas of poorly-drained farmland that have not recently been improved, seasonally-flooded alluvial grasslands such as the River Shannon callows, and wet grasslands of turlough basins (See also turloughs - FL6).

Species composition varies considerably. Wet grassland often contains abundant rushes (*Juncus effusus, J. acutiflorus, J. articulatus, J. inflexus*) and/or small sedges (*Carex flacca, C. hirta, C. ovalis*), in addition to grasses such as Yorkshire-fog (*Holcus lanatus*), Creeping Bent (*Agrostis stolonifera*), Marsh Foxtail (*Alopecurus geniculatus*), Rough Meadow-grass (*Poa trivialis*) and Tufted Hair-grass (*Deschampsia caespitosa*). Purple Moor-grass (*Molinia caerulea*) may also be present but should not dominate. The proportion of broad-leaved herbs is often high; those that commonly occur in wet grassland include Creeping Buttercup (*Ranunculus repens*), Marsh Thistle (*Cirsium palustre*), Silverweed (*Potentilla anserina*), Meadow sweet (*Filipendula ulmaria*), Water Mint (*Mentha aquatica*), Common Marsh-bedstraw (*Galium palustre*), Devil's-bit Scabious (*Succisa pratensis*), Lesser Spearwort (*Ranunculus flammula*) and Cuckoo flower (*Cardamine pratensis*). Other common broad-leaved herbs that occur on drier grasslands may also be present, depending on the degree of wetness. Wet grassland may be important for orchids such as Spotted-orchid (*Dactylorhiza maculata*). Horsetails (*Equisetum* spp.), Yellow Iris (*Iris pseudacorus*), Floating Sweet-grass (*Glyceria fluitans*) and clumps of tall reeds may be locally abundant.

Wet grassland frequently grades into **marsh - GM1** and there are many similarities in the range of species present in both habitats. To be included in the wet grassland category, the cover of grasses should exceed 50%, except in areas where rushes or small sedges predominate, and the total cover of reeds, large sedges and broad-leaved herbs should be less than 50%. Among the suite of broad-leaved herbs that are present, there should be a significant proportion of drier grassland species in addition to those that are more commonly associated with wetlands.

Links with EU Habitats Directive Annex I: Wet grassland may contain examples of the annexed habitat, 'Molinia meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caerulea*) (6410)'.

Swamps

Swamps are stands of emergent herbaceous vegetation that generally occupy a zone at the transition from open water to terrestrial habitats. Water levels may fluctuate but swamps typically remain wet with the water table above ground level for most of the year. They can be associated with freshwater or brackish systems, and the water may be stagnant, slow-moving or tidal. Swamps occur along the margins of rivers, lakes, canals, lagoons and estuaries, but may also occupy more extensive flooded areas or infilling basins. Some swamps occur as floating mats of vegetation.

Reed and large sedge swamps FS1

This category includes species-poor stands of herbaceous vegetation that are dominated by reeds and other large grasses or large, tussock-forming sedges. Most reed and large sedge swamps are

overwhelmingly dominated by one or a small number of species, as in the case of reed beds. Stands of vegetation can range from very dense to open. Typical components include Common Reed (*Phragmites australis*), Common Club-rush (*Schoenoplectus lacustris*), Reed Sweet-grass (*Glyceria maxima*), Branched Bur-reed (*Sparganium erectum*), Reed Canary-grass (*Phalaris arundinacea*), Great Fen-sedge (*Cladium mariscus*), Greater Tussock-sedge (*Carex paniculata*), Bulrush (*Typha latifolia*) and Water Horsetail (*Equisetum fluviatile*). Stands of Sea Club-rush (*Bolboschoenus maritimus*) may also occur in brackish waters. Note that a number of the possible dominants have a late growing season and their full extent may be difficult to determine before mid-May. **Unlike tall-herb swamps - FS2 below, the broad-leaved herb component is minor.** Vegetation typically lacks stratification as there is little or no development of an under storey element. In some situations there may be a mixture of other species such as Common Marsh-bedstraw (*Galium palustre*), Water Mint (*Mentha aquatica*), forget-me-nots (*Myosotis* spp.), Bogbean (*Menyanthes trifoliata*), Marsh Cinquefoil (*Potentilla palustris*), Wild Angelica (*Angelica sylvestris*), Meadow sweet (*Filipendula ulmaria*) or Fool's Water-cress (*Apium nodiflorum*).

Tall-herb swamps FS2

Tall-herb swamps are comparatively species-rich stands of herbaceous vegetation that occur in wet areas where the water table is above the ground surface for most of the year, or where water levels fluctuate regularly as in the case of tidal sections of rivers. Tall or robust broad-leaved herbs dominate and common components include Lesser Water-parsnip (*Berula erecta*), Fool's Water-cress (*Apium nodiflorum*), Gipsywort (*Lycopus europaeus*), Brooklime (*Veronica beccabunga*), Hemlock Water-dropwort (*Oenanthe crocata*), Hemp-agrimony (*Eupatorium cannabinum*) and Water Forget-me-not (*Myosotis scorpioides*). These swamps may also support Yellow Iris (*Iris pseudacorus*), Water-plantain (*Alisma plantago-aquatica*) and Water Horsetail (*Equisetum fluviatile*), in addition to occasional reeds, large grasses (*Glyceria maxima, Festuca arundinacea*) and sedges. Cover of the latter should, at most, be patchy or dispersed; swamps that are dominated by reeds, and other large grasses or sedges should be considered under reed and large sedge swamps - FS1 above. Tall-herb swamps may have an under storey element with a range of smaller wetland plants.

Links with EU Habitats Directive Annex I: Tall-herb swamps can include pockets of the annexed habitat 'Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels (6430)'. In Ireland, however, stands of the latter are usually fragmented and poorly developed.

Woodland and Scrub

Wet willow-alder-ash woodland WN6

This broad category includes woodlands of permanently waterlogged sites that are dominated by willows (*Salix* spp.), Alder (*Alnus glutinosa*) or Ash (*Fraxinus excelsior*), or by various combinations of some or all of these trees. It includes woodlands of lake shores, stagnant waters and fens, known as carr, in addition to woodlands of spring-fed or flushed sites. Carr is dominated by Rusty Willow (*Salix cinerea ssp. oleifolia*) and Alder (*Alnus glutinosa*). The field layer comprises Creeping Bent (*Agrostis stolonifera*), Meadowsweet (*Filipendula ulmaria*), Common Marsh-bedstraw (*Galium palustre*), Purple-loosestrife (*Lythrum salicaria*) and Skullcap (*Scutellaria galericulata*). Mosses such as *Climacium dendroides, Calliergon cordifolium* and *Homalia trichomanoides* are characteristic. Carr occurs on organic soils and fen peats that are subject to seasonal flooding but remain waterlogged even when flood waters recede.

Woodlands of flushed or spring-fed sites are typically dominated by Alder (*Alnus glutinosa*) or Ash (*Fraxinus excelsior*) and the ground flora is often 'grassy' in appearance with abundant Remote Sedge (*Carex remota*) and Creeping Bent (*Agrostis stolonifera*). Other common components of the field layer include Bramble (*Rubus fruticosus agg.*), Creeping Buttercup (*Ranunculus repens*), Meadowsweet (*Filipendula ulmaria*), Common Marsh-bedstraw (*Galium palustre*), Yellow Pimpernel (*Lysimachia nemorum*) and Lady-fern (*Athyrium filix-femina*). This type of woodland occurs on mineral soils or fen peats, and may occasionally be associated with river banks or lake shores. Note that riparian woodland - WN5 is treated as a separate category.

Also included in this category are woodlands of calcareous spring-fed hollows that are characterised by a mixture of trees including willows (*Salix* spp.), Alder (*Alnus glutinosa*), Ash (*Fraxinus excelsior*) and Downy Birch (*Betula pubescens*). Greater Tussock-sedge (*Carex*

paniculata) dominates the field layer and tussocks may support species of drier land. Common Reed (*Phragmites australis*) may be abundant in open wet areas. The ground surface is often treacherous and water-filled hollows and channels typically support aquatic plants.

Turloughs

Turloughs FL6

Turloughs are ephemeral lakes that occupy basins or depressions in limestone areas, and where water levels fluctuate markedly during the year. They are virtually unique to Ireland and their greatest concentration is in counties Clare, Galway and Roscommon. The general pattern is to flood in winter and dry out in summer, but there may be other sporadic rises in response to high rainfall. Turloughs normally fill through underground passages and sinkholes but some also have inflowing rivers or streams. Some turlough basins retain standing water in channels, pools or small lakes when flooding subsides. All areas within the normal limit of flooding are considered as part of the turlough habitat. The presence of the distinctive dark moss, *Cinclidotus fontinaloides*, on stone walls or rocks can help to establish this level. Soils of turlough basins can include marls, peat, clays or loams. Large boulders or exposures of bedrock may also be present.

Turloughs support a range of different plant communities that comprise a mixture of aquatic, amphibious and terrestrial species. Plant communities typically form a concentric pattern around the basin; the different zones reflect differences in the extent

and duration of flooding. Wet grassland usually dominates and characteristic species include Creeping Bent (*Agrostis stolonifera*), small sedges (particularly *Carex nigra* and *C. panicea*), Silverweed (*Potentilla anserina*), Meadowsweet (*Filipendula ulmaria*), Creeping Buttercup (*Ranunculus repens*), Marsh Pennywort (*Hydrocotyle vulgaris*) and Amphibious Bistort (*Polygonum amphibium*). Permanent pools, channels and lakes may also be present and may support Common Spike-rush (*Eleocharis palustris*), Water-plantain (*Alisma plantago-aquatica*), pondweeds (*Potamogeton* spp.), and tall reeds such as Common Club-rush (*Schoenoplectus lacustris*).

Links with EU Habitats Directive Annex I: Corresponds to the priority habitat, '*Turloughs (*3180*)'.

4. Fen floristic and phytosociological classification

Fens can be conveniently classified on floristic grounds (due to chemistry) into rich (basic pH) and poor (acidic pH) fens as mentioned earlier in section 4.1. A summary overview of the phytosociological scheme for the classification of Irish fen vegetation is provided in Table: 4.6.1 (based on the classification scheme of Ó Críodáin & Doyle 1994, and White & Doyle 1982):

Table 4.6.1: Phytosociological classification scheme for Irish Fens

SCHEUCHZERIO-CARICETEA (synonym **PARVOCARICETEA)** (Small sedge vegetation of swamps, rheotrophic mires, calcium-rich fens, drainage channels and some acid wet grasslands) CARICETALIA NIGRAE (Small-sedge communities of **poor fen**) Small-sedge poor-fen vegetation of acid, oligotrophic flushes and soligenous bogs on peat's or peaty mineral soils. **Four associations in Ireland**: Carici curtae-Agrostidetum caninae, Caricetum magellanicae, Sphagneto-Juncetum effusi, Drepanoclado exannulati-Caricetum aquatilis CARICETALIA DAVALLIANAE *(*Small-sedge communities of **rich fen**) Vegetation of rich fens on calcareous, alkaline peats. **Four associations in Ireland**: Carici nigrae-Juncetum articulati, Campylio-Caricetum dioicae, Schoenetum nigricantis, Juncetum subnodulosi SCHEUCHZERIETALIA PALUSTRIS *(*Small-sedge vegetation of **quaking transition fens** between poor and rich) **Sphagno Caricion lasiocarpae** **Two associations in Ireland**: Sphagneto-Caricetum lasiocarpae, Calliergo-Caricetum diandrae
PHRAGMITIO - MAGNOCARICETEA (**Tall reed and herb vegetation** within fens) PHRAGMITALIA *(*Vegetation of **tall emergent aquatics**) MAGNOCARICETALIA *(*Vegetation dominated by **large sedges** often in zones around open water behind reed swamps)
FRANGULETEA (**Shrub-willow vegetation**) SALICETALIA AURITAE *(*Vegetation of hygrophilic shrubs 1-5 m high, usually found on margins of lakes or slow-flowing streams on peat or mineral soil)
ALNETEA GLUTINOSAE (**Fen woodland** dominated by Alnus glutinosa, climax vegetation for many fens) ALNETALIA GLUTINOSAE
MONTIO - CARDAMINETEA (Vegetation of cold springs, commonly dominated by bryophytes) MONTIO - CARDAMINETALIA **Cardamino-Montion** (Vegetation of base-poor, **non-calcareous springs**) **Cratoneurion** (Vegetation of **calcareous springs**)

Source: White & Doyle 1982; Ó Críodáin & Doyle, 1994; O'Connell, Ryan and Macgowran 1984; Kelly & Iremonger 1997. (Phytosociological classification scheme: **Class** - Caps/bold; **Order** - Caps /plain; **Alliance** - lowercase/ bold; **Association** - lowercase/plain)

A more detailed account of Irish fen types and their plant communities is provided by White & Doyle (1982); Ó Críodáin 1988; Crushell (2000) and Wheeler (1984) inter alia.

Only outline summaries of the main vegetation types are provided here.

SCHEUCHZERIO-CARICETEA (synonym **PARVOCARICETEA)**

Small sedge vegetation of swamps, rheotrophic mires, calcium-rich fens, drainage channels and some acid wet grasslands.

Character species for Ireland: *Carex demissa, C. nigra, Epilobium palustre, Galium palustre, Hydrocotyle vulgaris, Pedicularis palustris, Potentilla palustris, Ranunculus flammula*

CARICETALIA NIGRAE

Small sedge **communities of poor fen** and bog flushes. Vegetation of swamps, rheotrophic mires, some acid grasslands and drainage channels.

Character species: *Carex echinata, Viola palustris*

Differential species of order and alliance: *Sphagnum palustre*

Carici curtae-Agrostidetum caninae

Poor fen located in slightly enriched areas on acid peat (water pH range 4.0-5.6), on the fringes of bog streams, pools and lakes and in bog hollows in cutover.

Character species: *Agrostis canina, Carex curta, C. echinata*

(also *Carex nigra, C. rostrata, Eriophorum angustifolium, Holcus lanatus, Juncus bulbosus, Molinia caerulea* and *Potentilla erecta*)

Caricetum magellanicae

Poor fen located in impoverished wet bog hollows (water pH range 3.8-5.0).

Character species: *Carex magellanica*

(also *Carex rostrata, Eriophorum angustifolium, Vaccinium oxycoccus, Sphagnum papillosum, S. palustre, Polytrichum commune*)

Sphagneto-Juncetum effusi

Fen vegetation on drainage channels or flushes in acid bogs (water pH range 3.1-6.2). Striking morphology with vegetation reaching 1 m in height, with pronounced Sphagnum carpet.

Character species: *Juncus effusus, Sphagnum recurvum*

Differential species: *Galium saxatile, Polytrichum commune*

Drepanoclado-Caricetum aquatilis

Species rich vegetation in which *Carex aquatilis* is dominant. Occurs in river and lake margin vegetation in north of country.

Character species: *Carex aquatilis*

CARICETALIA DAVALLIANAE

Small sedge **rich fen communities.** Vegetation of mineral-rich fens and base-rich fens on calcareous, alkaline peats.

Character species of order and alliance: *Aneura pinguis, Carex lepidocarpa, Dactylorhiza incarnata, Parnassia palustris, Pinguicula vulgaris, Campylium stellatum, Drepanocladus revolvens, Fissidens adianthoides, Scorpidium scorpioides*

Carici nigrae-Juncetum articulati

Waterlogged habitats in low lying areas in hollows along mesotrophic lake shores, deep drainage channels in blanket bog areas and neglected drainage channels in rough grassland. Also lakes in machair and wet dune hollows (water pH range 5.5-8.3).

Character species: *Carex nigra, Hydrocotyle vulgaris, Juncus articulatus, Ranunculus flammula*

(with other commonly occurring *Galium palustre, Mentha aquatica, Calliergon cuspidatum*)

Differential species against the Plantaginetea majoris: *Caltha palustris, Carex rostrata, Eleocharis palustris, Equisetum fluviatile, Lythrum salicaria, Myosotis laxa, Menyanthes trifoliata, Phragmites australis*

Campylio-Caricetum dioicae

Vegetation typical of grazed calcareous flushes, sometimes surrounded by relatively calcifuge vegetation (water pH range 4.6-7.5).

Character species: *Carex demissa, C. dioica, C. hostiana, Eleocharis quinqueflora*

(with other commonly occurring *Carex nigra, C. echinata, C. panicea, C. pulicaris, Anagallis tenella, Eleocharis multicaulis, Hydrocotyle vulgaris, Juncus bulbosus, Ranunculus flammula* and *Succisa pratensis* with some acid indicators such as *Eriophorum angustifolium, Molinia caerulea* and *Potentilla erecta*)

Differential species within the Caricion davallianae: *Carex echinata, Juncus bulbosus*

Schoenetum nigricantis

Schoenus nigricans dominated base-rich fens and in well established flushes that are ungrazed, where tussock formation is typical (water pH range 5.5-8.1).

Character species: *Schoenus nigricans*

Juncetum subnodulosi

Juncus subnodulosus dominated calcium-rich fen vegetation (water pH range 5.6-8.5), typical of the contact zone between Cladietum marisci and the Schoenetum nigricantis.

Character species: *Juncus subnodulosus*

(with other commonly occurring *Carex lepidocarpa, C. panicea, Galium palustre, Mentha aquatica, Molinia caerulea* and *Ranunculus flammula*)

SCHEUCHZERIETALIA PALUSTRIS

Sphagno Caricion lasiocarpae

Vegetation of wet hollows on bogs. Small-sedge vegetation of quaking transition fens between poor and rich.

Character species: *Carex limosa, Rhynchospora alba, Menyanthes trifoliata, Sphagnum cuspidatum, Sphagnum apiculatum, Sphagnum subsecundum, Cladopodiella fluitans*

Sphagneto-Caricetum lasiocarpae

Floating quaking-bog vegetation, usually confined to the waterlogged marginal areas around areas of acid peat or fens (water pH range 3.8-5.8). *Carex lasiocarpa* prominent species, along with *Carex limosa, Hydrocotyle vulgaris, Menyanthes trifoliata, Molinia caerulea, Myrica gale, Potentilla palustris,* and *Ranunculus flammula.*

Character species: *Carex lasiocarpa*

Differential species: *Myrica gale, Sphagnum auriculatum*

Calliergo gigantei-Caricetum diandrae

Floating or quaking mire vegetation, calcicole in character (water pH range 5.0-7.5), rich in pleurocarpus mosses, found in seepage areas around fens.

Character species: *Carex diandra, Bryum pseudotriquetrum, Calliergon giganteum*

Differential species within the alliance: *Carex lasiocarpa*

(with other commonly occurring *Carex diandra, C. rostrata, C. lasiocarpa, C. nigra, Scorpidium scorpioides, Galium palustre, Hydrocotyle vulgaris, Menyanthes trifoliata, Potentilla palustris, Calliergon cuspidatum*)

PHRAGMITIO - MAGNOCARICETEA

Tall clonal reed and sedge and herb vegetation. Species poor or mono dominant stands with pronounced mosaic structure. Swampy areas near lakes, rivers, streams and within fens

PHRAGMITALIA

Vegetation of tall emergent aquatics, mostly poor in species, often mono dominant, stagnant to slightly running water 0.2 to 3 m deep.

Character species: *Phragmites australis, Typha latifolia, Iris pseudacorus, Sparganium erectum*

MAGNOCARICETALIA

Vegetation dominated by large sedges, eutrophic to mesotrophic water, often in zones around open water behind reed swamps of the alliance Phragmition.

Character species: *Carex vesicaria, C. paniculata, C. acuta, C. aquatilis, Galium palustre, Poa palustris, Cladium mariscus*

FRANGULETEA

Shrub-willow vegetation growing on minerotrophic peat or mineral soil where there is a constant, high water table. Water may be oligotrophic to eutrophic.

SALICETALIA AURITAE

Vegetation of hygrophilic shrubs 1-5 m high, usually found on margins of lakes or slow-flowing streams on peat or mineral soil, poor to moderately rich, continually high water table.

Character species: *Salix aurita, Salix atrocinerea, Frangula alnus, Myrica gale*

ALNETEA GLUTINOSAE

Fen woodland dominated by *Alnus glutinosa*, climax vegetation for many fens.

ALNETALIA GLUTINOSAE

Character species: *Alnus glutinosa, Thelypteris palustris*

MONTIO - CARDAMINETEA

Vegetation of springs fed by water of more or less even temperature, commonly dominated by bryophytes.

MONTIO - CARDAMINETALIA

Diagnostic species of class and order: *Cardamine amara, Saxifraga stellaris, Epilobium alsinifolium, Brachythecium rivulare*

Cardamino - Montion

Spring vegetation fed by **base-poor waters** often in western and mountain areas

Diagnostic species: *Stellaria alsina, Epilobium obscurum, Chiloscyphus polyanthus var. rivularis*

Differential from Cratoneurion: *Pellia epiphylla*

(with other species occurring *Philonotis fontana, Saxifraga stellaris, Montia fontana ssp. rivularis, Montia fontana ssp. fontana, Dicranella palustris, Scapania uliginosa, Chrysosplenium oppositifolium, Mnium punctatum*)

Cratoneurion

Vegetation of calcareous springs fed by **mineral rich water**

Character species: *Cratoneuron filicinum, Philonotis calcarea, Saxifraga aizoides*

Differential from Cardamino-Montion: *Equisetum telmateia*

(with other species occurring *Saxifraga hirculus, Cardamine pratensis, Holcus lanatus, Calliergon cuspidatum, Sagina nodosa, Plagiomnium ellipticum, Galium palustre, Potamogeton polygonifolius, Juncus bulbosus, Aneura pinguis, Caltha palustris* and the rarer species: *Homalothecium nitens, Drepanocladus vernicosus, Drepanocladus exannulatus var. rotae, Sphagnum teres*)

Appendix 14: Habitat areas mapped on the sites surveyed during the Monaghan Fen Survey 2007

Site code and site name with calculation of total site survey area (ha), for sites examined during the Monaghan Fen Survey 2007.

Abbreviated habitat codes are those used in Fossitt, J., 2000, A Guide to Habitats in Ireland, The Heritage Council, Ireland.

Area figures presented are hectares, while the length of river types (FW1; FW2; FW4) are given in meters.

Habitat abbreviations and Fossitt (2000) title:

PF1 – Rich fen and flush (two subtypes PF 1 Alkaline fen and PF1 Cladium fen were distinguished during the current survey)
PF2 – Poor fen and flush
PF3 – Transition mire and quaking bog
FS1 – Reed and large sedge swamp
PB4 – Cutover bog
FL - Freshwater
FL1 – Dystrophic lakes
FL2 – Acid oligotrophic lakes
FL3 – Limestone/marl lakes
FL6 - Turlough
GA1 – Improved agricultural grassland
GA2 – Amenity grassland (improved)
GS4 – Wet grassland
GM1 – Freshwater marsh
WN2 – Oak-ash-hazel woodland
WS1 - Scrub
WD1 – (Mixed) broadleaved woodland
WD4 – Conifer plantation
WN6 – Wet willow – alder – ash woodland
WN7 – Bog woodland
ED2 – Spoil and bare ground
FW4 – Drainage ditches
FW2 – Depositing lowland rivers
FW1 – Eroding/upland rivers
WL1 – Hedgerows

This appendix is available as Excel file on the CD ROM accompanying this report.

Monaghan Fen Survey 2007

Appendix 14 Habitat areas mapped on the sites surveyed during the Monaghan Fen Survey 2007.

Site Code	Ssite Name	Total Site Area	Total Area of Mapped Habitat	PF1 Alk. Fen	PF1 Clad. Fen	PF2 Poor Fen	PF3 Trans Mire	FS1	PB4	FL	FL1	FL2	FL3	FL6	FW1	GA1	GA2	GS4	GM1	WN2	WS1	WD1	WD4	WN6	WN7	ED2	FW4 (Length (m))	FW2 (Length (m))	FW1 (Length (m))	WL1 (Length (m))
2900	AGHABOY FEN	**7.3**	0.0																											
2902	AGHACLOGHAN FEN	**5.1**	4.3			0.45	0.70									0.34		1.46	0.58				0.36	0.45		0.33				499.18
2904	AGHNAMULLEN	**8.2**	8.3				2.14	0.44		1.36						0.11		0.41		1.84	0.67			1.29						
1780	ALLAGESH LOUGH	**5.5**	0.0																											
1836	ANNAGHEAN	**12.3**	12.0				0.21	0.39			0.27							4.81	0.60						5.69	0.31				
MFS3	ARDKIRK FEN	**8.4**	7.7					0.16							0.07			1.92	1.29		4.28						88.89		691.50	372.67
MFS6	BOCKS UPPER	**11.1**	10.2				4.15									0.65		2.17	1.00				0.82	1.39		0.19				
2901	CORAVILLA - RAKEEN FEN	**12.9**	12.9				3.94											3.92	4.87		0.15					0.06	281.29			1720.31
MFS1	CORNAGLARE LOUGH	**18.8**	18.7				1.05	6.14	0.48	4.54								1.08			1.95			3.48						
MFS7	CRINKHILL LOUGH	**22.1**	24.7			2.58	1.01	0.44		8.09								2.47		3.11	7.05						124.13			
MFS1	CRUMLIN LOUGH	**5.1**	4.8				1.93			0.13								0.57	0.21					2.00		0.05				126.04
MFS2	DRUM LOUGH	**42.7**	42.2					16.26		7.92						8.65		1.34						8.01						
1841	DRUMCOR LOUGH	**32.7**	32.6					0.98				2.08				19.37		0.45	3.19		5.23			1.34						
2732	DRUMGALLAN BOG	**34.3**	33.9				11.88		3.40									9.49			8.09			1.02						
2903	DUNAREE	**3.2**	0.5				0.48																							
1603	ESHBRACK BOG	**1183.0**	4.1	1.04		2.14	0.92																							
2898	GRAFFAGH AND CORINSHIGO	**75.7**	0.0																											
2897	GREAGHGLAS FEN	**8.9**	8.9													1.32		3.89	2.83			0.85								212.53
MFS8	KILLYCOOLEY LOUGH	**6.4**	6.3				1.50	1.15		0.47								2.08						1.15			155.33			593.09
1782	KILLYHOMAN	**6.1**	0.0																											
2755	KILLYNEILL FEN	**80.9**	**72.0**			8.74	22.71									2.03		7.62	8.72					22.20		1.90	538.90			
1839	KILLYVILLY LOUGH	**3.1**	3.0		0.24								0.83					0.53						1.44			205.75			73.62
2899	KILNACLAY FEN	**7.7**	0.0																											
1786	KILROOSKY LOUGH CLUSTER	**58.0**	57.8	0.46	0.81			5.10					8.07			18.17		14.71			3.48	1.80	2.85	2.34			334.38			689.62
1835	LISABUCK	**17.0**	16.6							3.37						9.38								3.83		0.18				242.63
1781	LISARILLY BOG	**9.9**	9.9			1.48										7.82		0.27						0.31						1540.61
2911	LISINISKY MARSH	**22.4**	20.7				4.23	1.86		2.03						0.48		3.77			8.37					0.81	370.25			
1840	LISLANNAN BOG	**14.9**	15.1				5.48	3.26								4.74		1.65									598.99			799.13
2893	LISNALEE	**8.6**	2.3			1.46	0.81																							
2896	LISQUIGNY FEN (CORLONGFOR	**15.7**	2.7				2.68																							
1607	LOUGH SMILEY	**75.7**	**73.3**				5.91	6.07	3.25	10.17						2.59	2.91	30.90	0.29					11.26		1.00		551.01		
MFS5	MORGANS LOUGH	**5.1**	5.0				2.93											0.62						1.49						132.07
2531	MOYLAN LOUGH	**12.8**	12.8											12.82																
1785	MULLAGHMORE LAKE (SOUTH)	**16.1**	15.9					2.60		3.88								2.75						6.67						
1837	MULLAGLASSAN LAKE	**5.8**	5.6				0.44	0.81		1.81						0.50		1.79						0.29			218.16			
2077	NAFARTY FEN	**3.6**	0.0																											
2614	PRIESTFIELD LOUGH	**7.2**	7.2							4.81												2.40								
1606	RAFINNY LOUGH	**5.2**	5.2				1.08		0.14			2.99				0.13		0.51						0.34		0.01				
1784	ROSEFIELD LAKE & WOODLANE	**16.8**	16.8					0.18		0.31			2.65			8.87		0.91						3.88			480.12			
2892	SHEETRIM FEN	**6.3**	6.3					1.61		0.51															4.18		105.88			
2894	TIRAGARVAN FEN	**8.3**	0.0																											
2895	TOSSY CROSS FEN	**8.1**	0.0																											
	TOTAL AREA / LENGTH	**1919.0**	**580.6**	**1.5**	**1.1**	**16.8**	**76.2**	**47.4**	**7.3**	**49.4**	**0.3**	**5.1**	**11.5**	**12.8**	**0.1**	**85.2**	**2.9**	**102.1**	**23.6**	**5.0**	**39.3**	**5.1**	**4.0**	**74.2**	**9.9**	**4.8**	**3502.1**	**551.0**	**691.5**	**7001.5**

ESHBRA	AREA
1	ESHBRACK 58.1
2	ESHBRACK 17.7
3	ESHBRACK 38.1
4a	ESHBRACK 36.2
4	ESHBRACK 59.6
5	ESHBRACK 57.8
6	ESHBRACK 14.2
7	ESHBRACK 13.9
8	ESHBRACK 18.5
9	ESHBRACK 3.0

Total County Area (ha)
129355.67

10. Monaghan Fen Survey 2007 CD ROM

Contents

Volume 1:

Monaghan Fen Survey 2007 Final Report by P. Foss & P. Crushell (In PDF format, requires Adobe Acrobat to view) Size: 28 mb

2. NPWS Monaghan Fen Survey Database Version 1.0 (Requires Filemaker Pro 8.0v2)
Subset of sites located in County Monaghan exported from the NPWS Fen Survey Database **Version 1.4** used to calculate report results and produce site lists and site reports. Size: 6 mb

3. Selected Excel tables to accompany the Monaghan Fen Survey Report including appendices; Size: 1 mb

3. List of Fens in County Monaghan Surveyed in detail on the MFS

4. List of Sites in County Monaghan Surveyed in Brief on the MFS to assess their potential fen interest

5. List of Sites Worthy of Survey supplied by Alan Hill, BSBI County Recorder for Monaghan to the MFS

6. Phytosociological Relevé Classification and Twinspan Vegetation Data Analysis from the MFS

7. Fen Survey Relevé Card

8. Hydrochemistry Data from Water samples taken on sites during the MFS

9. Conservation Evaluation of Sites Surveyed on the MFS

10. List of sites where dumping and infill were noted as part of the MFS

11. Cross Border Sites where Conservation Designations require harmonisation

14. Habitat areas mapped on sites surveyed during the MFS

4. Selected GIS Shape files from the Monaghan Fen Survey 2007
(Requires ArcView 8.1 GIS Software, total of 1.2 mb size for all files)

Volume 2:

Monaghan Fen Survey 2007 Individual Site Reports, containing:
Site Survey Report; Six Inch Site map, Boundary data and locaton of Field Survey Notes; Site Air Photograph; Site Habitat Map. (In PDF format, requires Adobe Acrobat to view) Size: 135 mb

Volume 2:

Monaghan Fen Survey 2007 Site Photographic Record and Notes (In PDF format, requires Adobe Acrobat to view) Size: 341 mb