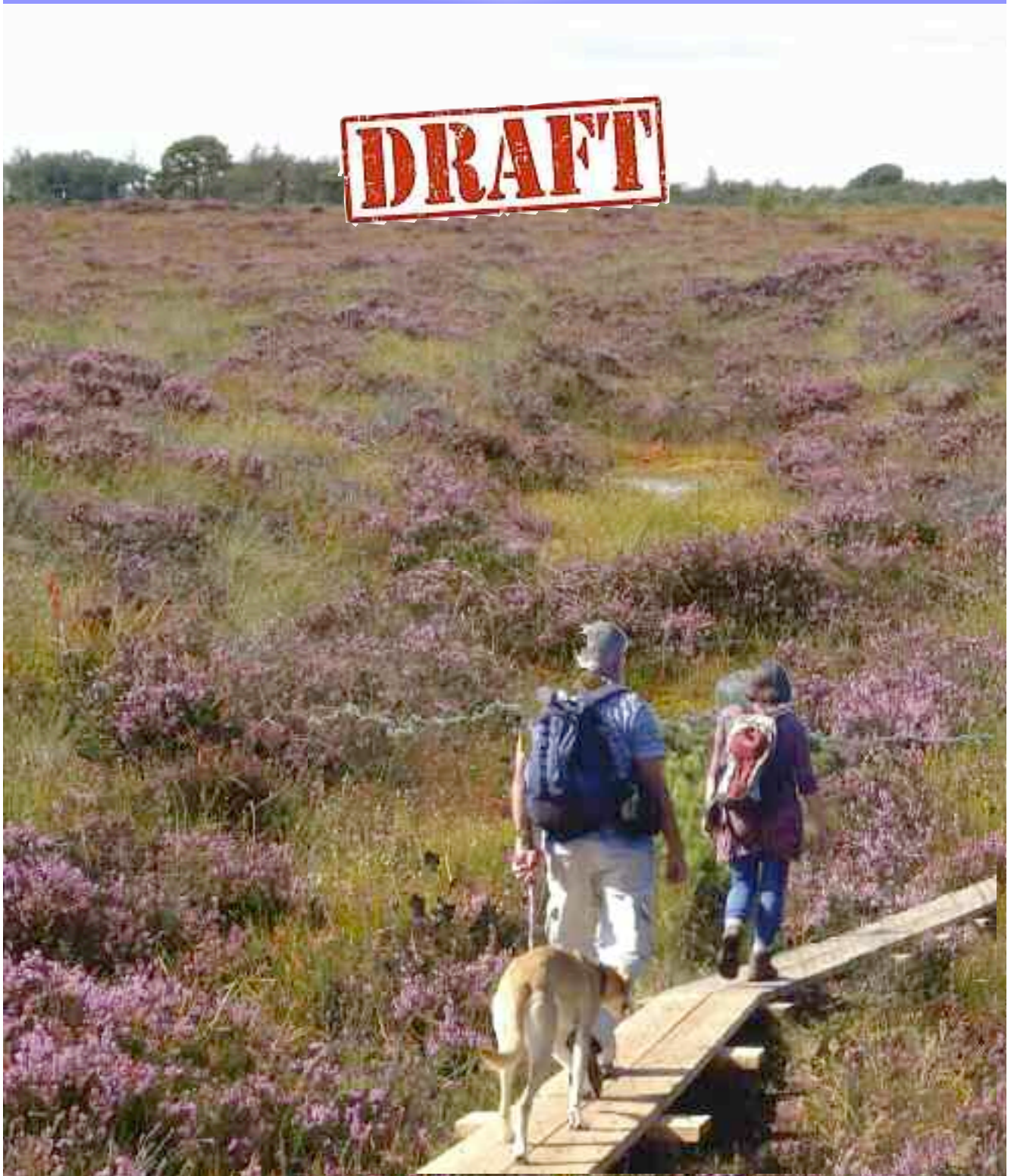




Girley Bog Conservation Action Plan

Girley Bog NHA No.1580, Co. Meath, Ireland

2016-2020



***Go to the people.
Live with them.
Learn from them.
Love them.***

***Start with what they know.
Build with what they have.
But with the best leaders,
So that when the work is done,
the task accomplished,
The people will say
“We have done this ourselves.”***

Attributed to Lao Tzu - 4th century BC

Girley Bog NHA No.1580, Co. Meath, Ireland Conservation Action Plan 2016-2020



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Lullymore, Rathangan, Co. Kildare, Ireland
www.ipcc.ie

Cover Image: Surface view of Girley Bog with boardwalk inset. Catherine O'Connell

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Experience, Maurice Eakin and Annette Lynch National Parks and Wildlife Service, John Connolly and Sharon Byrne Coillte Teo, Rebecca Doyle Native Woodland Trust, Ray Flynn and Hugh Cushman Queens University Belfast and the following members of the local community: Oliver Usher, Eamonn O'Donnell, Christina Sweeney, John Dowds, The Sullivan Family.

Friends of the Bog

All those individuals who participated in the opinion survey on the content and focus of this plan.

Message from Girley Bog Meitheal

This Conservation Action Plan 2016-2020 sets out the significance of Girley Bog, a valuable heritage asset in County Meath. It describes how that significance is to be retained by the different stakeholders in Girley Bog in any future use, management, alteration or restoration action. The Plan is based on a simple thinking process which starts with a description of what is there, why it matters, what is happening to it and the principles by which it is to be managed over the next five years. It also sets out more detailed work programmes for its maintenance, scientific monitoring, management, public access and educational use.

An holistic approach is taken to the plan as Girley Bog has more than one type of value - the site is of value for both heritage and recreation. IPCC, one of the stakeholders in Girley Bog and acting on behalf of the Girley Bog Meitheal Team received an overwhelming mandate from the public to develop this action plan as the first steps in a bright future for this wonderful community asset.

We have been very fortunate at Girley that some of the top hydrologists, ecologists and historians in the country have studied our bog and have shared their findings with us. Thanks to the hydrological assessment by Flynn and Regan (2012), the peat forming vegetation survey of Denyer (2014) and the environmental and social history research of Flood (2015) we have an integrated and robust knowledge on which to base our Conservation Action Plan that will help to bring better results for nature and people.

There is strong and sufficient evidence in this plan to support the notion that, with on-going tree removal and the creation of favourable hydrological conditions through drain blocking, it will be possible to restore active raised bog habitat within Girley Bog. Where slope and hydrological conditions preclude the possibility of active raised bog and supporting habitats developing, there is scope to create or facilitate the natural regeneration of areas of semi-natural deciduous woodland, orchid rich grassland and bog woodland.

With careful management the local community and visitors will continue to enjoy the natural and cultural history of Girley Bog through the use of the site for walking, education and recreation.

Vision for the Plan

The aim of this Conservation Action Plan for Girley Bog is:

to bring about the restoration and conservation of raised bog habitats and biodiversity and to work together with the community to ensure there are opportunities for everyone to learn about and care for the heritage of Girley Bog and to take part in understanding and protecting it.

Girley Bog Site Summary

Site Name: Girley Bog NHA 1580

County: Meath

Grid Reference: N 705 680

GPS: Lat- 53.68483, Long- -6.94971

Location: Girley Bog is located 8km south west of Kells off the N52, Co. Meath

Discovery Map: (1:50,000) No. 42

Area: 100 hectares, 247 acres (high bog 72.48ha NHA Review 2014)

Ownership: Irish Peatland Conservation Council, National Parks & Wildlife Service, Coillte, Native Woodland Trust and private owners

Status: Natural Heritage Area No. 1580, SI 2003

Endangered Habitats Present: 3 Annex I habitats as defined under the Habitats Directive 92/43/EEC Active Raised Bog 7110 (1.8ha NHA Review 2013), Degraded Raised Bog 7120 (1.8ha NHA Review 2014), Bog Woodland 91D0

Rare/Indicator Species Present: *Rana temporaria* (Common Frog), *Gallinago gallinago* (Snipe), *Alauda arvensis* (Skylark), *Coenonympha tullia* (Large Heath), *Lepus timidus hibernicus* (Hare), *Sphagnum* spp., *Cladonia* spp., *Drosera anglica* (Sundew), *Lacerta vivipara* (Common Lizard)

Conservation Assessment: The site is a midlands raised bog on the eastern extreme of the range of raised bog distribution in Ireland. It is the only site in County Meath which supports EU priority peatland habitats and species and is managed solely for the purpose of conservation.

Conservation Management Plan Aim: To bring about the restoration and conservation of raised bog habitats and biodiversity and to work together with the community to ensure there are opportunities for everyone to learn about and care for the heritage of Girley Bog and to take part in understanding and protecting it.

Interpretation: The perimeter of the bog is a national loop walk (No. 51), interpretive signs, visitor parking

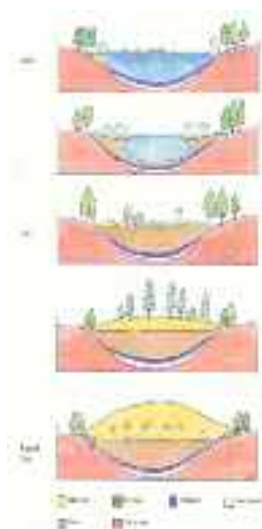
Threats: Drainage, Fire, Scrub Encroachment, Dumping, Visitor Trampling, Theft

Raised Bog Fact Sheet

Raised bogs are discreet, raised, dome-shaped masses of peat occupying former lakes or shallow depressions in the landscape. They occur throughout the midlands of Ireland. Their principal supply of water and nutrients is from rainfall and the substrate is acid peat soil, which can be up to 12m deep. Raised bogs are characterised by low-growing, open vegetation dominated by mosses, sedges and heathers, all of which are adapted to waterlogged, acidic and exposed conditions.

Distribution of Raised Bogs in Ireland

Raised bogs are a distinctive and characteristic feature of the landscape of the midlands of Ireland in which they are concentrated. They also occur in the Bann River Valley in Northern Ireland, in the vicinity of Omagh, Co. Tyrone, and in East Clare and North Limerick on either side of the mouth of the River Shannon. They occur on land below 130m and in that climatic zone where rainfall is between 800 and 900mm per year.



Formation of Raised Bogs

Raised bogs began to develop 10,000 years ago. Most often raised bogs developed in depressions occupied by shallow lakes in which anaerobic conditions occurred. A layer of clay lines the bottom of the lake creating waterlogged conditions. Complete decomposition of plant material is prevented. In time this un-decomposed plant material forms a thick layer of peat that rises towards the surface of the lake. Eventually the surface peat is invaded by sedges to form a fen. The fen peat layer thickens so that the roots of plants growing on the surface are no longer in contact with the calcium-rich groundwater. The only source of minerals for plants is now rainwater, which is very poor in minerals. Raised bog species, such as *Sphagnum* mosses begin to invade and eventually the fen becomes a raised bog. The *Sphagnum* plant's lower parts are dead and resistant to decay. Their remains can form peat as long as the habitat remains saturated with water.

Raised bogs developing in two adjacent basins can coalesce to cover a larger area. In this case the raised bog peat forms over the intervening sand, silt and gravel soils.

Sphagnum moss - the bog building plant

The *Sphagnum* plant's lower parts are dead and resistant to decay. Their remains can form peat as long as the habitat remains saturated. Some species form hummocks, others grow as carpets/lawns, while others grow in wet hollows. As *Sphagnum* hummocks grow upwards, the water table gradually rises over time, trapping more of the partly decayed plant remains in the stable lower layer and so forming peat. *Sphagnum* mosses store up to twenty times their own weight in water and help keep the bog surface saturated. Water is trapped around the outside of a plant with the help of hanging branches which are pressed close to the stem. The spreading branches interlock individual plants together which also helps to retain moist conditions all around. Internally there are large water storing hyaline cells which contribute to the wetness created by *Sphagnum* mosses at the bog surface. *Sphagnum* mosses are also very important at retaining acidic conditions on the bog surface. All of the water reaching the bog from rainfall is "filtered" for its nutrients. Any nutrients in the water are absorbed into the moss in an exchange process that involves pumping hydrogen out of the moss which acidifies bog water even further to pH levels of 4. *Sphagnum* mosses are "keystone species" on raised bogs producing an environment in which all other bog plants need to survive. That is why plant species numbers tend to be low on bogs because only specialist plants can survive the acidic, waterlogged environment created by *Sphagnum* moss plants. As all growth of *Sphagnum* moss takes place in the plant's tip, extending upwards, the plants are sensitive to grazing, trampling and burning. Five species are of particular importance for peat formation on raised bogs including: *Sphagnum austini*, *S. fuscum*, *S. papillosum*, *S. magellanicum* and *S. capillifolium*.



Raised Bog Structure and Hydrology

In raised bogs water peat and vegetation are strongly interconnected

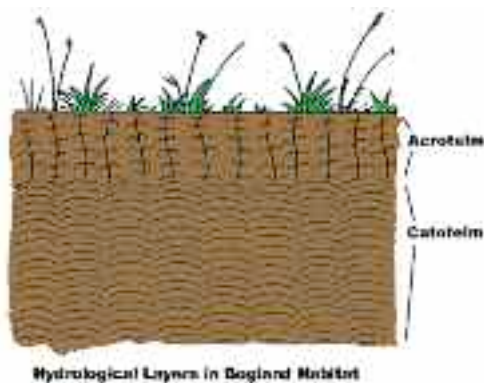
Water in a raised bog is continuously circulating and changing even though it looks the same. A healthy bog eco-hydrology is nutrient poor and waterlogged on the surface. The principal supply of water and nutrients in a raised bog is from rainfall. Rain reaching the surface of the raised bog is lost through evapo-transpiration from

the plants that grow there. More water is lost through surface runoff. In a naturally undisturbed bog where slopes are shallow, rainwater slowly travels across the surface of the bog. In a natural bog more water is also lost from the bottom of the bog through seepage.

If the slopes on the bog are increased through marginal drainage water runs off the bog dome rapidly. If water is leaving the bog more quickly than it can be recharged from rainfall, this causes a deterioration in the natural peat forming capability of the bog.

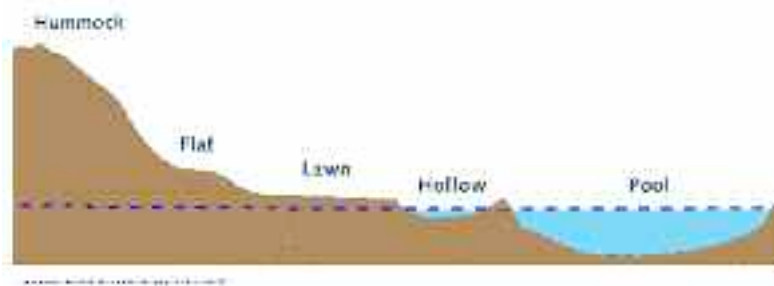
Depending on the intensity of drainage, a lot of water may be lost out through the bottom of the bog. This happens if marginal drains cut through the natural clay liner that occurs in the bottom of raised bogs. Bogs that have formed over sands, silts and gravels without a clay liner are very susceptible to water loss in this way.

The diagram inset drawn by Dr Ray Flynn of Queens University in Belfast shows how water behaves in a raised bog.



The surface of a raised bog consists of a soft living carpet of vegetation, which floats on a material, which is nearly all water. By weight, a raised bog may be up to 98% water and only 2% solid matter. This volume of water is held within dead *Sphagnum* moss fragments. Raised bogs consist of two hydrological layers (see figure inset); the upper, very thin layer, known as the acrotelm where peat is formed, is usually less than 50cm deep, and consists of living stems of *Sphagnum* mosses, recently dead plant material and water. The acrotelm has high permeability to water near to the surface, but becomes more impermeable with depth as the peat becomes more consolidated and decomposed (humified). Water movement and fluctuations mean that conditions in the acrotelm remain largely aerobic and it is here that microbial activity is

strongest. These properties mean that the acrotelm is critical to the normal development and functioning of a raised bog. Below this is a very much thicker bulk of peat, known as the catotelm where peat is stored. Here individual plant stems have collapsed under the weight of mosses above them to produce an amorphous, chocolate-coloured mass of *Sphagnum* fragments. By contrast with the acrotelm, catotelm peat is typically well consolidated and often strongly humified. It is permanently saturated with water. Water movement through this



amorphous peat is very slow, typically less than a meter a day. This is where most of the rain water is stored.

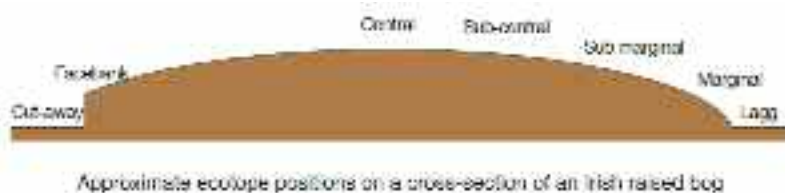
In a raised bog, which is ombrotrophic, the only source of water to the surface is from precipitation. Under normal circumstances the water table is very stable, remaining within a few centimetres of the bog's surface about 95% of the time.

Because the surface of a bog typically consists of low hummocks, hollows and

pools, this stable water table produces intense competition for living space between species.

Raised Bog Ecotopes

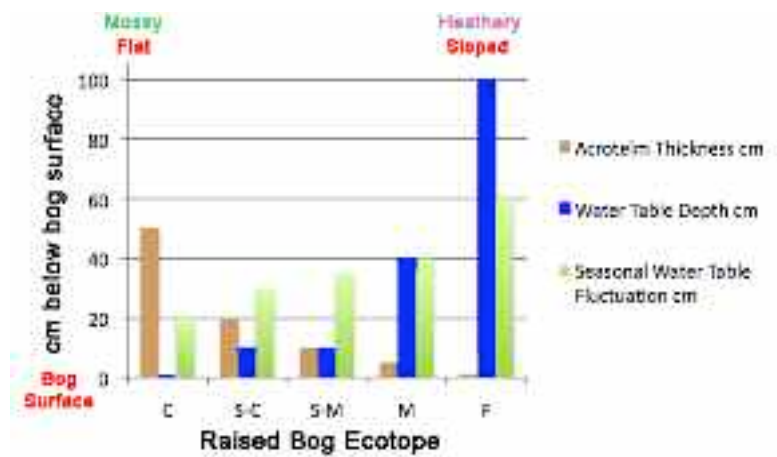
With active *Sphagnum* growth, raised bogs develop a system of hummocks, pools and hollows with flat areas and lawns in between. The water level is at or near the surface (within 10cm) or fluctuating only by a few centimetres, for most of the year. Slopes are gentle, usually 0.3%, *Sphagnum* mosses form a complete growth pattern over the surface of the bog. The bog is actively accumulating



peat in its lower layer or catotelm. The catotelm is kept saturated by the protective peat producing layer or acrotelm.

From the air raised bogs look patterned, reflecting their micro-topography or certainly the contrast between

pools and hummocks. On the ground the micro-topography of raised bogs determines the types of plant communities that are present. The scale of raised bog communities is very small: for example 20cmx40cm is typical for hollows and pools while 100cmx100cm is the size of hummock communities. This has given rise to the idea of a community complex to describe an area of hummock and hollow complex on a raised bog. Community complexes are strongly correlated with the abiotic conditions prevailing particularly hydrological conditions such as water level, nutrient supply, drainage and slope on the raised bog. It is the combination of the biotic and abiotic components that defines an ecotope. The ecotope is very useful for discussion of raised bog management because it is based on an ecohydrological approach. The different ecotopes found on a raised bog are shown in the diagram below. The central and sub-central ecotopes are actively forming peat.



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The concept of the ecotope was developed by Irish and Dutch researchers working on Clara and Raheenmore Bogs in Co. Offaly over a 10 year period. A book entitled Conservation and Restoration of Raised Bogs edited by Matthijs Schouten and published in 2002 describes the results of this joint Irish-Dutch research project in detail. The basic ecotopes system is founded on a concentric approach from the centre to the margin of a raised bog. The characteristics of the five common ecotopes found on Irish raised bogs are shown in the chart below. The presence and thickness of the Sphagnum moss layer or acrotelm is critical for peat formation. It is best developed in the Central ecotope. An acrotelm is very sensitive to drainage and fire and it is absent in the facebank ecotope where, for example, turf is cut.

Importance of Raised Bogs

Raised bogs are beautiful landscapes with a unique biodiversity. They provide mankind with services that are worth billions of euro that may be easily jeopardised by inappropriate or short-sighted exploitation. Raised bogs are:

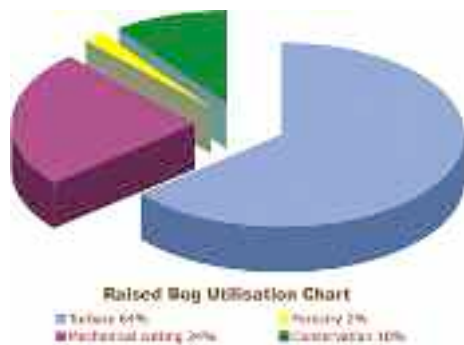
- * the finest example of their type in Europe, and probably the world
- * a wildlife haven rich in biodiversity
- * a living history book and repository of information of past climates, vegetation and human activity
- * a valuable genetic resource of potential use to humanity
- * valuable outdoor laboratories in which plants, animals and natural processes in an extremely inhospitable environment can be studied
- * of national and international importance as part of the biosphere in which they are inextricably linked to other ecosystems
- * a unique feature of the Irish landscape of considerable tourist value
- * a priority habitat under the EU Habitats Directive because of their scarcity in Europe
- * a vital store of carbon, helping to control greenhouse gases
- * an important reservoir of water within river catchments

Conservation Status of Irish Raised Bogs

Under the EU Habitats Directive the National Parks and Wildlife Service (NPWS) are obliged to designate sites that contain a variety of habitats so as to conserve European biodiversity. In raised bogs three habitats are commonly described: active raised bog, degraded raised bog still capable of natural regeneration and bog woodland. Active raised bog and bog woodland are regarded as priority habitats for action as they are rare and under serious threat of loss without adequate protection. An obligation of the Habitats Directive is that the NPWS must complete a report every 7 years on the condition of designated habitats. The assessments carried out in 2006 and in 2013 found that no peatland type of priority importance in Ireland is in good conservation status. Raised bogs have been given a BAD status in these reports because of a significant decrease in their range, habitat structure, habitat function and area.

Extent and Utilisation of Raised Bog

The original extent of raised bog in the Republic of Ireland was 308,742ha according to the Peatland Map of Ireland drawn by Hammond in 1979. IPCC monitors the status of the resource on an on going basis. Our latest assessment was carried out in 2009 and published in Ireland's Peatland Conservation Action Plan 2020. Developmental pressures on raised bogs are intense, particularly extraction for fuel and horticulture mainly due to the development of new markets for these products and the establishment of numerous peat producing



businesses. The most serious impact of mechanised peat extraction in Ireland has been on the Midland raised bogs accounting for a loss of 24% of the resource in less than 50 years. Hand peat cutting accounts for a staggering 64% loss and afforestation accounts for 2% of the loss of habitat in the Republic of Ireland. This leaves 10% of the raised bogs remaining which are deemed suitable for conservation.

Conserving Raised Bogs

In the Republic of Ireland the National Parks and Wildlife Service of the Department of Arts, Heritage and the Gaeltacht are the Government agency responsible for the conservation of raised bogs.

Major field surveys have been undertaken so that the raised bogs of conservation importance could be identified from 1983 to the present day. Initially sites were designated as Areas of Scientific Interest. Thereafter sites were identified as Natural Heritage Areas, some of which were then designated as Special Areas of Conservation under the EU Habitats Directive.

Between 1997 and 2002, Ireland nominated a total of 53 raised bog sites for designation as Special Areas of Conservation (SACs) under the Habitats Directive. Ireland must protect, manage and restore these sites to ensure they achieve their objective of conserving raised bog habitats and species. In addition, 75 raised bogs were designated as Natural Heritage Areas (NHAs) in 2004 under the Wildlife Amendment Act (2000).

Most sites were designated without adequate consultation with the tens of thousands of landowners who retained their right to cut turf in these sites. Rather than acquiring control of turf cutting areas within raised bogs to create manageable hydrological units, the Government put in place a derogation which essentially allowed turf cutting to continue on sites of conservation importance for a minimum period of 10 years. During this period a limited number of turf cutting rights were acquired from landowners on sites, however, in the case of most sites not all turf cutting rights were acquired. Once the deadline for the cessation of turf cutting was reached, landowners who retained turf cutting rights refused to stop cutting turf. As a result of the Government's failure to protect raised bogs from turf cutting and drainage, the area of active raised bog in the country is less than 4,000ha today.

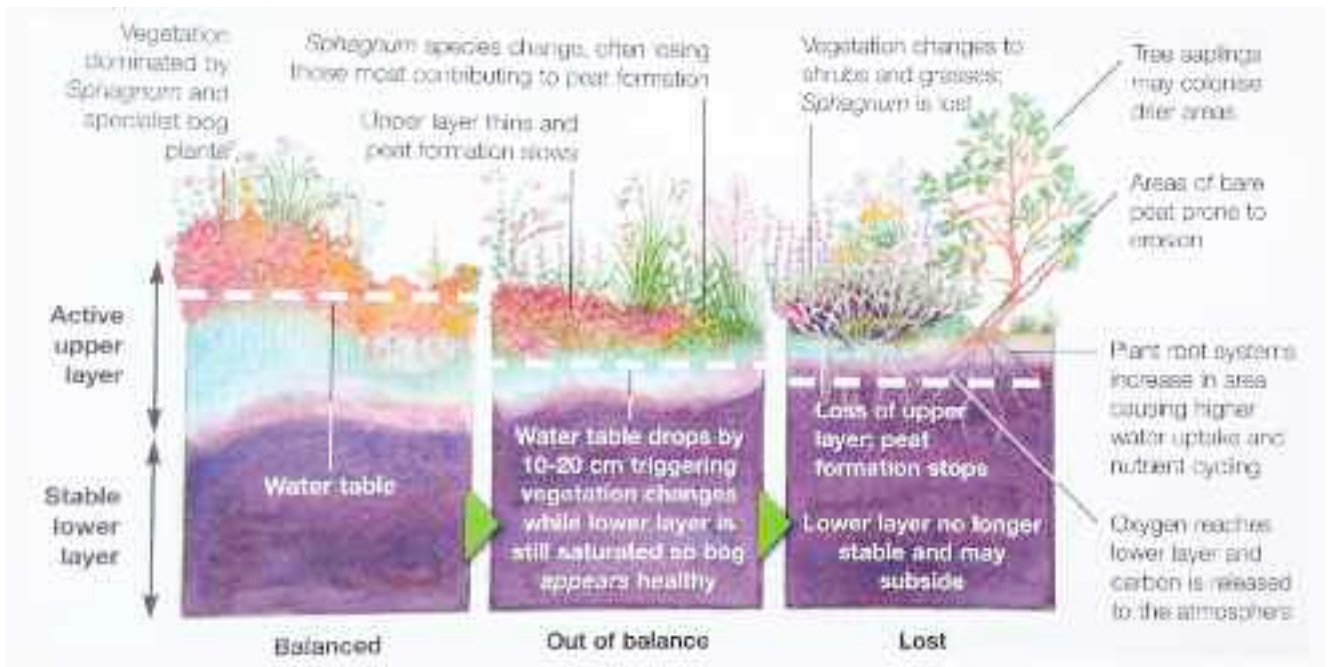
In parallel with the public unrest in relation to raised bog conservation within the country, the European Union took a number of cases against Ireland for infringements of EU law. The Court of Justice of the European Union have threatened to fine the country for their lack of compliance.

Against this background, in 2013, the Irish Government launched a study to provide a scientific basis for raised bog conservation in Ireland. The study is expected to be completed in 2016. The first documents to be produced from the study were the Draft Raised Bog SAC Management Plan and the Draft Raised Bog NHA Review. These went out to public consultation in 2014. Several key decisions in relation to the conservation and management of raised bogs are contained within these documents:

- * A national conservation target for active raised bog amounting to 3,600ha has been set.
- * 53 raised bogs will be managed as SACs.
- * 2 sites owned by Bord na Móna are to be designated as SACs.
- * The NHA network of 75 sites established in 2004 has been reconfigured and a new network has been established which will contain 61 sites (36 of the existing NHAs are to be retained, 25 previously undesignated sites are being proposed for NHA status, all or part of 46 previously designated NHAs are to be de-designated).
- * The conservation and management of raised bogs will follow a six year progress and review cycle.
- * Turf cutting may be allowed on some raised bog SACs.
- * Turf cutting is to be allowed to continue on all 61 NHAs in the new network until 2017.
- * The key management strategy for raised bogs is to block drains so as to bring the water levels in the bog back up to the surface.

Raised Bog Restoration

When damaged through drainage, raised bogs waste away through oxidation, adding carbon dioxide to the atmosphere. As most raised bog sites in Ireland designated for conservation have suffered drainage damage, restoration is necessary. Blocking drainage ditches, removing invasive trees from the bog surface and controlling burning can lead to increases in peat-forming *Sphagnum* vegetation provided the slopes and water flow patterns that are needed for peat forming vegetation to develop are present. Emissions of methane (a strong greenhouse gas) can increase when sites are re-wetted, particularly if they are initially dominated by cotton grass. However emissions are likely to reduce subsequently, if *Sphagnum* re-establishes across the restored



What happens to the vegetation on the bog surface when a bog is drained? Photo: O'Reilly et al 2012 adapted from a drawing by Richard Lindsay.

area. In extreme cases previous damage have led to loss of *Sphagnum* from large areas, such as mechanically cut sites, it may be necessary to re-vegetate bare peat and re-introduce *Sphagnum*.

Source: <http://www.ipcc.ie/a-to-z-peatlands/raised-bogs/>

Girley Bog Timeline

A timeline of the history and milestone achievements in the conservation of Girley Bog

- 1655 Girley Bog mapped as part of the Down Survey 1656-1658 and the area of the bog was estimated to be 334 acres, 2 roods, 32 perches
- 1802 Statistical Survey of the County of Meath 1802 describes turf cutting on Girley followed by small scale land reclamation by the poor
- 1836 Six inch Ordnance Survey map show trees planted at the edge of the Drewstown section of Girley bog to the south west by the landowner Ferdinand Meath McVeagh
- 1836 Field Survey for the first edition Ordnance Survey maps show six drains running from the centre to the perimeter of the bog demarcating townlands, forested areas to the south and south west, houses (mud cabins) and turf cutting plots on the north west, north and north eastern edges of the in the townlands of Ethelstown and Chamberlainstown. The survey calculates the area of Girley bog at 191ha or 472 acres
- 1850-80 Balrath Estate who managed the portion of Girley Bog in Ethelstown record shooting Red Grouse, Partridge, Quail, Snipe, Woodcock, Rail, Teal and Plover
- 1910 25" Ordnance Survey Map shows drainage and tree planting on the high bog to the southwest, extension of turf cutting and drainage to the east and a general expansion in the planted areas to the west of the bog to establish Bell's Wood, Bog Wood and Larch Wood
- 1931 Death of a man who lived on the edge of Girley Bog in a fire
- 1941 Turf Cutting during the Emergency: 4,833 tons of turf were harvested from Girley Bog in the townland of Chamberlainstown bog show that 4,833 tons of turf were harvested in the 1941
- 1972 Scientific Interest of Girley Bog first recorded and recognised
- 1990 Girley Bog Environmental Committee organise clean up of Girley Bog supported by a FAS Scheme
- 2002 Girley Bog surveyed as part of the Natural Heritage Areas
- 2003 S.I. No. 600 declares Girley Bog an NHA 1580.
- 2005 Illegal drainage affecting 20-25ha of the high bog
- 2009 EULIFE09 NAT/IE/000222 Demonstrating best practice in raised bog restoration in Ireland by Coillte
- 2009 Bog EcoWalk/Loop Walk No. 51 established on site
- 2011 Conifer plantation felled by Coillte and the last turf cut on Girley Bog
- 2012 James Keegan from University College Dublin completes an MSc thesis on Girley Bog entitled: *Assessment of Current Status and Proposed Restoration Plan for a Lowland Raised Bog (Girley Bog) in the Irish Midlands.*
- 2012 Ray Flynn (Queens University) and Shane Regan (Trinity College) complete a Hydrological Baseline Assessment of Girley Bog supported by the East Bord Region Action for Biodiversity, the EU and the Department of Arts Heritage and the Gaeltacht
- 2013 IPCC purchase 8.5ha of Girley Bog
- 2013 Native Woodland Trust purchase **7ha** of Girley Bog
- 2013 Drains blocked in the former forest plantation area by Coillte and bog bridge constructed with interpretive signs and visitor welcome information sign at the Drewstown entrance to the bog
- 2013 **1.5km** Drains in the cutover bog owned by IPCC blocked by NPWS
- 2014 Girley Bog Meitheal set up
- 2014 Girley Bog Map and Guide published by IPCC
- 2014 IPCC block **xx** km of drains on the high bog at Girley, begin water monitoring and establish a *Sphagnum* moss restoration area in the cutover bog
- 2014 Native Woodland **????**
- 2014 A boardwalk upgrade to the part of the Loop Walk is completed by NPWS and Meath County Council
- 2014 Girley Bog Bridge opened across the high bog by Coillte
- 2014 Girley Bog Ecotopes Mapped by Denyer Ecology
- 2015 IPCC complete drain blocking on land owned in the high bog of Girley and establish two further *Sphagnum* restoration areas in the cutover bog
- 2015 Kate Flood completes study entitled: Integrating scientific, historic, and local knowledge for conservation and management of peatlands in Ireland. MSC Thesis, School of Biology & Environmental Science, University College Dublin.
- 2015 IPCC present a poster paper entitled: Collaborative Conservation of Girley Bog to Peatlands: A New Conversation Conference in Tullamore organised by the Irish Peat Society on behalf of the International Peatland Society.
- 2015 Development of a 10 year Conservation Action Plan for Girley Bog by Girley Bog Meitheal.

Hugh Cushnan Ph.D. work

Site Description, Status and Condition of Girley Bog

Location

Girley Bog, a raised bog Natural Heritage Area (NHA No. 1580) with an area of 100ha. The site is located eight kilometers (km) south-west of Kells and seven kilometres north of Athboy in County Meath. The bog lies within the townlands of Chamberlainstown, Girley, Drewstown Great and Ethelstown. Access and parking are available at the trail head for the Girley Bog National Loop Walk (No. 51, see **Figure 1**, Appendix 1) which is signposted from the N52, a national secondary road. Access is also possible from a minor road heading in a south westerly direction from Fordstown on the R164 with parking on request in the Causey Farm Experience.

Description

Girley bog is one of the most easterly occurring raised bogs in Ireland and lies at 80m OD. The total area of the site is 100ha, with 72.48 of high uncut bog and the remainder is cutover bog. The high bog is divided by six drains which were established initially to mark out townland boundaries in the 19th century (see **Figure 2**, Appendix 1). In latter years some of these were deepened and cleared by turf cutters and contractors seeking to extract turf and moss peat from the site. Water run off from Girley Bog to the north enters the Blackwater River, a tributary of the Boyne River. To the south the bog drains into the Athboy River, also a tributary of the Boyne. On former cutover bog areas surrounding the high bog dome, a mosaic of heathland and deciduous woodlands have established intermixed with state owned conifer plantations.

Surrounding Land Use

The landscape around Girley Bog consists of farmland, with relatively small fields surrounded by hedgerows as can be seen on the satellite image for the site (see **Figure 3**, Appendix 1).

Girley Bog Meitheal

The first Girley Bog Environmental Committee was set up in the 1990 by Mr Christy Lynch and engaged in a clean up of the bog and the installation of guiding signs to the nature walks available at the site around that time. A further burst of community work on the site came in the lead up to the designation of the Girley Bog Ecowalk in 2009. Following the acquisition of the lands from the last turf cutter on Girley Bog by the Irish Peatland Conservation Council and the Native Woodland Trust, the time was right to organise meetings of the community and other stakeholders and so the Girley Bog Meitheal was formed. The group have been meeting three to four times a year since 2014 to discuss research and management developments on the project. Members of the Girley Bog Meitheal include: Loreto Guinan Meath County Council, Kate Flood Meath Ecotours, Matt Murtagh, Angela Murtagh and Deirdre Murtagh Causey Farm Experience, Maurice Eakin and Annette Lynch National Parks and Wildlife Service, John Connolly and Sharon Byrne Coillte Teo, Ray Flynn and Hugh Cushnan Queens University Belfast, Rebecca Doyle Native Woodland Trust and the following members of the local community: Oliver Usher, Eamonn O'Donnell, Christina Sweeney, John Dowds, The Sullivan Family.

IPCC presented a poster paper entitled ??? to the Irish Peat Society/International Peat Society meeting in Tullamore in 2015 on the theme of Peatlands - A New Conversation (see **Figure 4**, Appendix 1) which described the work of the Girley Bog Meitheal members in managing the bog.

Origin of the Name Girley

In the early 1820s, a consistent island-wide valuation of property in Ireland was initiated by the British parliament as a basis for an effective taxation system. The Valuation involved military engineers, through the Ordnance Survey, mapping and setting administrative boundaries and assessing the productive capacity of all property in the country in a uniform way. The Ordnance Survey Letters are the surveyors' field notes, commentaries and correspondence to the Ordnance Survey headquarters in Dublin. They were written between 1834 and 1841 and exist for twenty-nine counties, excluding Cork, Antrim, and Tyrone. The Letters' collection is commonly known as O'Donovan's Ordnance Survey Letters, after the historian, John O'Donovan (1806-1861), who led the project of information collection, notation and compilation. Information about the origin of the name Girley comes from the O'Donovan letters. Reproduced below is an O'Donovan letter written from Kells, July 15th 1836.

OF THE PARISH OF GIRLEY

This is the most southern Parish in the barony of Kells It is called by the Irish the more correct name of *Greille* (IS) which gives us a clue to discover its history and founder. Its patron Saint, according to tradition, is St. *Raed* (IS), who seems to have been a very distinguished old soldier of Christ, as he and his crozier are

among the sureties and guarantees in a charter in the Book of Kells.

In this charter the Saint is called *Reot* (IS) his crozier *bacall reodaide* (IS) (*Baculus Reodii*) and the Erenach of the Parish *Ercennec Grellege* (IS). This affords a clue to the original name, for by reducing *Grellege*, the Genitive form, to the *casus rectus* we shall have *Grellagh* i.e. *Luteus campus*...

Girley is anglicised by a metathesis or transposition of letters which frequently takes place, as the peasantry style in, by the *turn of the tongue* in English, and still I cannot conceive how *Girley* is more agreeable to an English ear than *Grilly*.

The Down Survey

The earliest map of Girley Bog was produced as part of the Down Survey (see **Figure 5**, Appendix 1). The Down Survey was a survey of Ireland's confiscated lands and was carried out by William Petty, an English scientist in 1655 and 1656. The Survey came about as part of the Act for the Settlement of Ireland 1652. Following the defeat of the Irish by Cromwell, soldiers who served in Ireland were entitled to an allotment of confiscated land in lieu of wages as were sponsors of the army and settlers from England. The Down Survey provided the information needed to settle the lands. The survey method included surveying the boundaries of parishes. The scale used was generally 40 Irish perches to an inch (sometimes 80 perches), one perch equalling 21 feet (6.4 m). Profitable and unprofitable land were distinguished, and there were abbreviated captions for arable, meadow, bog, woodland, mountain and several kinds of pasture, with area figures for each of these categories. Coverage of other subjects was uneven. In the parish maps, dwelling houses with the owners' names are entered in each townland.

Status

In 1972 Girley Bog was designated as an Area of Scientific Interest. On the 21st November 2003 under Statutory Instrument No. 600, Girley Bog was awarded the status of Natural Heritage Area (No. 1580) by Martin Cullen, Minister for the Environment, Heritage and Local Government. The site is legally protected under the Wildlife Act 2000. The map accompanying the statutory instrument shows the site to contain high bog (containing active peat forming habitat and supporting habitat), cutover bog and woodland (see **Figure 6**, Appendix 1).

One area of the woods to the west of the high bog was found to have scientific interest when it was surveyed as part of the National Parks and Wildlife Service National Survey of Native Woodlands 2003-08. The Girley Bog Wood (Cloncat Wood) is **included** within the boundary of the Natural Heritage Area (Perrin et al 2008).

The Natural Heritage Area status was instrumental in protecting the site from a planning application in 2003 to establish an 8.9ha dump on the site which was refused by Meath County Council.

Land Ownership

Land ownership in Girley Bog is divided among the National Parks and Wildlife Service, Coillte, Irish Peatland Conservation Council, the Native Woodland Trust and Private Landowners including Causey Farm (see **Figure 7**, Appendix 1).

In 2013 two non governmental organisations - the Native Woodland Trust and the Irish Peatland Conservation Council purchased a significant portion of Girley Bog that was under threat of turf cutting from a private landowner despite the site being designated as a Natural Heritage Area. The acquisition of these lands, which were the last piece in a conservation jigsaw of Girley Bog meant that all of the owners could work together to manage the entire bog for nature conservation. It also helped to secure access and a permanent right of way to the Loop Walk surrounding the bog.

Geology

The landscapes of County Meath formed over hundreds of millions of years and have been shaped by various geological processes. The majority of the bedrock underlying the county consists of Lower Carboniferous aged rocks, which are mainly limestone (Clarke et al, 2007). During the Quaternary period (1.6 million years ago to present), a series of large ice sheets moved over Ireland depositing glacial till (clay, sand and gravel) and scouring the underlying bedrock giving Meath much of its present day appearance (Clarke et al, 2007). Geological maps for Girley Bog and surrounding area suggest that a Lower Carboniferous clayey limestone underlies the bog. Quaternary geological (subsoil) maps of overlying deposits indicate that more permeable fluvioglacial sand and gravel deposits may underlie the uncut peat along the bog's western margins, which may have implications for the hydrology of the bog (Flynn & Regan, 2012). Field work discovered that Girley Bog is more than nine metres in depth in places and cores taken for a hydrology survey in 13 locations across

the bog revealed materials such as fine grained silty sands, silts, and shell marl in one location. The presence of more permeable fluvioglacial sand and gravel deposits underlying the uncut peat in the western section indicate that the bog may display some groundwater dependency.

Carbon Storage

The peat depth in Girley Bog was found to be as much as 9m in places by Flynn and Regan 2012. In Ireland, peat soils cover approximately 20% of the land area and are a store for an estimated 1-1.5 billion tonnes of carbon (Wilson et al, 2013). Girley Bog is estimated to store between 3500 and 5000 tonnes of carbon (Flynn, R. pers. comm.). However due to the extensive peat extraction in the past from Girley and the lowered level of the water table year round in areas affected by drainage, it is likely at present that a substantial portion of the bog may be a carbon source as the peat soils are oxidised and decomposed and bare peat is eroded in response to weathering.

Archaeology

The Sites and Monuments Record for Co. Meath issued by the National Monuments and Historic Properties Service 1996 identifies a number of monuments and places of importance in the vicinity of Girley Bog. The distribution of the sites and monuments are presented in **Figure 8**, Appendix 1 and are summarised below.

Archaeological Monument No.	Townland	Classification
12	Girley	Mound
13	Drewstown Great	Portal Tomb Site
14	Girley	Motte
15	Girley	St Margarets? Church
20	Girley	Brid's? Holy Well
21	Drewstown Great	Earthwork

National Loop Walk, Access and Recreation

The National Loop Walk (No. 51) on Girley Bog was launched on the 22nd May 2009 at the Kells Heritage Centre by Meath Tourism and Meath County Council. The Loop is 6km, with a trailhead sign posted off the N52 (Kells to Mullingar Road). The walk covers a varying landscape of forest and bogland. Most of the walk is around the edge of the bog in areas of 'cutover ' bog. The terrain is flat and uneven and walking boots are recommended. There is a wonderful variety of birdlife, plant and animal life on the walk.

The loop walk project was funded by Fáilte Ireland and Meath County Council with support from Meath Tourism, Kells Chamber of Commerce, Girley Landowners, the National Parks and Wildlife Service and Coillte. The overall aim of the project was to attract increased domestic and overseas tourists to County Meath and to raise awareness of the countryside (themethchronicle.ie 2009).

The walk was featured in the Irish Independent as the Walk of the Week on the 1st August 2009 by Christopher Somerville. Mr Somerville was shown around the walk by Oliver Usher (a member of the Girley Bog Meitheal).

The walk is also featured on the following web sites: <http://walksireland.com>, www.irishtrails.ie and www.discoverireland.ie. The walk is also featured on www.coillteoutdoors.ie as a recreation site as it does not have facilities other than parking and marked trails see **Figures 9, 10 and 11**, Appendix 1.

There are four interpretive signs posted along the walk including a welcome sign with information about Girley Bog at the car park trail head off the N52 and three others around the walk. Information on the interpretive signs include a Human History Panel, Plants and Animals Panel and a Forest and Scrub Panel (see **Figure 12**, Appendix 1).

There are two parking lots on the loop, the first is open to the public and is to be found at the Trailhead off the N52. The other is for authorized access only and is at Drewstown.

Girley Bog was chosen as a demonstration site as part of an EU Life funded project focusing on the restoration of forested areas of the bog. This project allowed for an extension feature to the existing Loop Walk through the construction of a boardwalk or bog bridge (1.28km long) onto the dome of Girley Bog in 2014. In addition two visitor information panels, one in English and the other in Irish describing the LIFE project and features particular to the site were erected together with a site name panel (see **Figure 12**, Appendix 1). On the actual boardwalk itself there are three fold-out information signs featuring *Sphagnum* moss, bog cotton and the insect-eating sundew plant. **Figure 13**, Appendix 1 shows the location of the loop walk, the position of the

interpretive signs, parking and the various services for visitors surrounding the bog.

Turf Cutting

The history of turf cutting on Girley Bog goes back to 1802 (Flood 2015). An extensive body of peat has been removed from the bog since this time as can be seen from a comparison of the hydrological extent of the bog and the current distribution of high bog on the site (see **Figure 14**, Appendix 1). Land that was formerly cut-away has been reclaimed for agriculture or planted with trees or has become overgrown with trees. Derwin and MacGowan (2000) estimated that only 36.2% of the high bog remains. In 2000 these workers identified limited turf cutting to the south east of the bog with a very small area of cutting to the north west, mainly Hopper peat cutting. They estimated that this turf cutting was affecting 10.9% of the bog margin.

The last active private turf cutter on Girley Bog cut turf in 2011 and had an active spreading ground on the southern margin of the bog. This turf cutter was bought out by the Irish Peatland Conservation Council and the Native Woodland Trust in 2013.

The Natural Heritage Area Review published in 2014 described 3 active turf plots on Girley within the previous 7 years.

Many of the people who had turf cutting rights on this bog decided to sell up to the National Parks and Wildlife Service from 1999 onwards when Síle de Valera TD announced the first compensation package for the Derogation on Turf Cutting.

Fire History

Derwin and MacGowan (2000) pointed to the air photograph 1995 of Girley Bog for evidence of a burn in the north-west section of the site along the margin of the high bog. Two further burn scars can be clearly seen on the high bog on an air photograph taken on behalf of the Native Woodland Trust in 2013. Local knowledge documented in Flood (2015) states: “*I remember the fire there in 2010 because I called the fire brigade for it*” These extend from the north west towards the centre and across to the south east of the bog. These fire events are mapped in **Figure 15**, Appendix 1.

Dumping

Dumping is an on-going issue on Girley Bog. In 1990 Girley Bog Environmental Committee was formed. The object of the committee was to remove the years of accumulated rubbish from the bog, to repair the through roads and to open up the area as an amenity for the public. A FAS scheme was approved for the employment of two people. Others helped out on a voluntary basis. Some 200 trailer-loads of refuse were taken from the 400 acres of bogland, helped by both Meath County Council and Coillte Teoranta (Judge 1993). Local farmers provided their machinery to help in this task. Dumping was also noted by Derwin and MacGowan in 2000 who were surveying the site for the National Parks and Wildlife Service.

Dumping continues to be recorded by the Girley Bog Meitheal Group and is dealt with on an on-going basis. The material dumped includes abandoned cars, car parts, household furniture and domestic waste. With road access to the bog at a number of points dumping is relatively easy. See **Figure 16**, Appendix 1 showing dumping locations in 2015.

Afforestation

Derwin and MacGowan (2000) described extensive areas of cutaway bog on Girley to the north-west and south-west which had been planted with coniferous forestry. Some of the forestry planted on the high bog in the western section in the 1960's was and due to be felled in 2015. They described individual *Pinus sylvestris* and *Pinus contorta* trees growing all over the high bog surface. The historic 1910 version of the 6" map for the site shows a coniferous plantation on the high bog and the spreading individual *Pinus* trees on the bog surface indicating a long history of coniferous colonization of the high bog area of Girley.

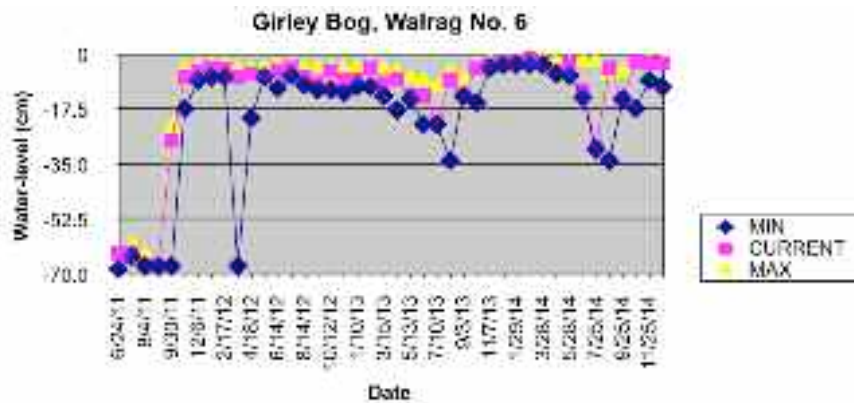
This map also names four woodland areas to the west of the bog including Bell's Wood, Davin's Wood, Larch Wood and Bog Wood (two areas) to the west merging with Girley wood to the south. See **Figure 17**, Appendix 1.

LIFE Project

Girley Bog was one of 17 sites included in the Coillte managed “Demonstrating Best Practice in Raised Bog Restoration in Ireland” – No. : LIFE09 NAT/IE/000222. This nature conservation project jointly funded by EU DG-Environment, the Department of Arts, Heritage and the Gaeltacht and Coillte (The Irish Forestry Board) under the EU LIFE-Nature Programme focused on restoring 32.2ha of Girley bog that had been planted with

conifer trees in the 1960's (http://www.coillteoutdoors.ie/index.php?id=171&rec_site=152 on 23.0.15).

The conifer plantation on Girley Bog was clear felled in 2011. Waste material of no commercial value was wind-rowed on the site. Drains were blocked in 2013. Maximum and minimum water table levels in the plantation area were monitored before and after tree felling and following drain blocking via a series of six walrags.



Hydrograph from Walrag No. 6 on Girley Bog. This water table measuring device was located within a closed canopy conifer woodland on the high bog. The conifers were clear-felled in August 2011 and the drains were blocked in 2013. Source: J. Derwin, Coillte



The location of Walrag No. 6 on Girley Bog in Co. Meath. The forest was clear-felled in August 2011. The image on the left was photographed in July 2012 and the one on the right was photographed in January 2014. The dramatic increase in water levels can be seen. Photo: J. Derwin, Coillte



Air photograph taken in October 2013 showing the former Coillte forested area of the high bog, the wind rowed waste wood material and the water pooling on the bog surface due to the effect of drain blocking. Photo: Coillte/NPWS the drains have been blocked.

The hydrograph below shows the dramatic increase in the water levels from 70cm below the surface to 10cm below the surface for walrag number 6 after tree removal and drain blocking.

Coillte prepared a predictive map for the future habitats on the restored areas of Girley Bog which is presented in **Figure 18**, Appendix 1. This includes active raised bog and supporting habitat, dry birch woodland on both

cutover peat bog and on mineral soil.

Hydrological Assessment of Girley Bog

Derwin and MacGowan (2000) describe Girley Bog as being extensively drained with 8.8km of old surface drains on the high bog probably dating from 1836 (see **Figure 2**, Appendix 1). They found 0.8km of drains on the marginal areas. A number of drains were improved illegally in 2005 across the high bog. Following lengthy legal proceedings the NPWS got the developers to block the drains on a phased basis between 2009 and 2010 using peat, geoflex and combination dams.

During 2012, under the Action for Biodiversity initiative, an INTERREG IVa project operating in the East Border Region in co-operation with 10 local authorities, including Meath County Council commissioned Dr Ray Flynn (Queen's University Belfast) and Dr Shane Regan (Trinity College Dublin) to undertake a baseline hydrological assessment of Girley Bog. These workers looked at geological data and topographic maps, undertook a drain survey, a hydrochemical survey, a morphology survey, a substrate survey and installed 60 piezometers on the site to monitor water levels. Their work is summarised in a series of maps for Girley Bog including drainage and hydrochemistry (**Figure 19**, Appendix 1) and a water table contour map (see **Figure 20**, Appendix 1). The water table is located at, or very close to the ground surface over much of the central part of the bog. Gradients over the central part of the bog are relatively flat, which will aid active raised bog restoration in this central part of the bog. The steep water table gradients at the bog margins correspond to areas of vegetation which are presently not peat forming. Water levels in the formerly forested part of Girley are lower than in the adjacent central part of the bog at the time this map was drawn. As the drains have been blocked in this area a more up to date contour map may show an improvement in this situation. These workers installed 60 piezometers across the bog to monitor its water table. The locations of the piezometers are shown in **Figure 21**, Appendix 1 together with the principal surface water discharge points off the bog.

Flynn & Regan (2012) came up with a cost of €35,000 to block drains and to monitor hydrology across the entire site (see **Figure 22**, Appendix 1). The aim of this work would be to conserve the core wet, *Sphagnum*-rich area of Girley Bog. The hydrological survey also recommended obtaining further geological data on the site in the form of cores and boreholes, to better understand the inter-relationship between the bog and its surroundings. Hydrological monitoring should continue, including monitoring piezometer levels, groundwater levels and surface water discharge. Rainfall for Girley Bog is measured from Mullingar Met Station, but rates of evaporation should also be measured if possible. Measurements should be carried out before, during and after engineering works to ensure restoration is going as planned (Flynn & Regan, 2012).

Another general study of the hydrological aspects of raised bogs was initiated in 2013 by Hugh Cushnan of Queen's University Belfast as part of his doctoral research. Mr Cushnan is investigating the impact of forestry on raised bog hydrology. He is examining natural unforested, afforested and recently felled forested raised bog sites. He increased the number of piezometers on the bog and is monitoring over 150 piezometers on Girley Bog as part of his research. At this level Girley bog is the most instrumented site currently being studied in Ireland (see **Figure 23**, Appendix 1). The results from this study will provide insights into the hydrological functioning of Girley bog and will feed into a series of hydrological management objectives for the site. **Any refs??**

IPCC undertook extensive blocking of drains in the south western portion of Girley Bog in 2014 and 2015 following acquisition of the lands there. Prior to drain blocking on Girley bog IPCC installed 32 piezometers to monitor the effects (see **Figure 23**, Appendix 1). 50 dams were installed consisting of sheets of geoflex or combination dams consisting of a layer of peat sandwiched between two layers of geoflex drain piling (see **Figure 24**, Appendix 1). Water levels in the restored area are being monitored on an on-going basis. Between the centre of the bog and the margin along one of the drains a fall in slope of 550m was recorded, a direct result of drainage of the bog (Ó Corcora 2014).

Past blocking of drains has largely been successful but a number of drains are still active and are continuing to discharge water from the bog. These include older drains which have filled in with *Sphagnum* species but are still functioning drains. Fissures present in the peat near to the facebanks measure 50cm in depth and can extend 10 metres into the bog. These can hinder effective drain blockage by acting as alternative routes for water to leave the bog (Flynn & Regan, 2012).

Species Diversity on Girley Bog

A number of naturalists have recorded casual records of the flora, birds, moths and other fauna of Girley Bog and its surrounding woodland habitats including Eamonn O'Donnell on moths, Oliver Usher on birds, Kilian Kelly on flora and fauna. Staff from the National Parks and Wildlife Service and the Irish Peatland Conservation Council have also recorded species from the site. To date our knowledge of the species diversity of the site is presented in the table below. A species list for the site determined by IPCC staff and volunteers was submitted to the National Biodiversity Data Centre in 2014. In addition IPCC holds 5 frog records for the

site in our Hop to It Irish Frog Database dating from 2002 to 2015. Numbers of species recorded in the woodlands and the bog are provided:

Species Group	Number Recorded
Plants	31
Animals	
Birds	5
Moths	216

With funding assistance from the Heritage Council, Dr Pat Moran surveyed the nocturnal macromoth biodiversity on Girley Bog between March and September 2008. He drew up a list of 77 species and published a report in 2009 (Project no. 16296 Heritage Council). Thanks to the work of Eamonn O'Donnell from trapping mainly in the woodlands of Girley Bog between 2011 and 2015, the list for the site has been extended to 216 species (see **Figure 25**, Appendix 1).

In 2015 Meath County Council funded a project to determine the species diversity of Spiders and other invertebrates on Girley Bog. The work was carried out by **Miles Nolan**.

In July 2013 the Meath Branch of Birdwatch Ireland visited the site and recorded a bird species list for Girley Bog (Oliver Usher email 7th July 2013). Casual records recorded by the IPCC have been added to the list for the woodland and bogland habitats. Flood (2015) provides evidence for the presence of Red Grouse on Girley Bog in the mid 19th century which are absent today.

Birds of Girley Bog and Woods

Blackbird	Blackcap	Bulfinch	Buzzard
Chiffchaff	Coal Tit	Crow	Goldcrest
House Martin	Lesser Black-backed Gull	Long-tailed Tit	Mallard
Meadow Pipit	Mistle Thrush	Raven	Redpoll
Reed Bunting	Robin	Rook	Skylark
Snipe	Swallow	Swift	Whitethroat Warbler
Woodpigeon	Wren	Yellowhammer	

As part of the EU Life Project on Girley Bog, Birdwatch Ireland carried out a bird survey of the Coillte Girley Bog property prior to felling and following restoration works (Coillte 2015). A transect was established in 2011 and two bird survey visits were made. Bird communities present in the woodlands prior to felling included Coal Tit, Lesser Redpoll and Goldcrest. On recently clear felled sites Wren and Blackbird were common, but on older clear fell sites species such as Meadow Pipit were recorded. The results of the bird monitoring of Girley Bog and three other sites are to be published as a scientific paper (Alec Copeland pers comm 2015.).

Habitats

Girley Bog was surveyed as part of the Natural Heritage Area assessment in 2002 and a report submitted to the National Parks and Wildlife Service which described Girley Bog NHA as supporting a good diversity of raised bog microhabitats, including hummocks and pools with the typical bog species. The Site Synopsis for Girley Bog is presented in **Figure 26**, Appendix 1).

Denyer (2014) describes four habitats present on Girley Bog that are listed in Annex 1 of the Habitats Directive including: 7110 Active Raised Bog, 91D0 Bog Woodland, 7150 Rhynchosporion and 7120 Degraded Raised Bog still capable of natural regeneration. The area for each habitat is presented in the table below.

Habitat Type	Habitats Present on Girley Bog	
	Area (ha)*	Details
7110 Active Raised Bog	1.36 (2.4%)	Represented by sub-central ecotope with an unusually high cover of <i>Sphagnum austinii</i> and <i>S. fuscum</i>
7120 Degraded Raised Bog	54.43 (97.56%)	Represented by marginal and sub-marginal ecotopes
7150 Rhynchosporion		Occurs in a mosaic within the sub-central and marginal ecotopes
91D0 Bog Woodland		May be present on the high bog and on the cutover but not surveyed

*Please note that the Coillte property was not included in this analysis.

A species list taken from the Site Synopsis and from IPCC's records is presented in the Table below.

Plant Species List for Girley Bog

<i>Andromeda polifolia</i>	<i>Cladonia uncialis</i>	<i>Leucobryum glaucum</i>	<i>Scirpus cespitosus</i>
<i>Aulacomnium palustre</i>	<i>Cladonia verticillata ssp cervicornis</i>	<i>Molinia caerulea</i>	<i>Sphagnum austinii</i>
<i>Betula pubescens</i>	<i>Desmococcus viridis</i>	<i>Narthecium ossifragum</i>	<i>Sphagnum capillifolium</i>
<i>Calluna vulgaris</i>	<i>Dicranum scoparium</i>	<i>Odontoschisma sphagni</i>	<i>Sphagnum cuspidatum</i>
<i>Cladonia ciliata var ciliata</i>	<i>Drosera anglica</i>	<i>Parmelia species</i>	<i>Sphagnum fuscum</i>
<i>Cladonia ciliata var tenuis</i>	<i>Drosera rotundifolia</i>	<i>Pinus contorta</i>	<i>Sphagnum magellanicum</i>
<i>Cladonia crispata</i>	<i>Erica tetralix</i>	<i>Pinus sylvestris</i>	<i>Sphagnum papillosum</i>
<i>Cladonia floerkeana</i>	<i>Eriophorum angustifolium</i>	<i>Pleurozium schreberi</i>	<i>Sphagnum tenellum</i>
<i>Cladonia furcata</i>	<i>Eriophorum vaginatum</i>	<i>Polytrichum commune</i>	<i>Vaccinium myrtillus</i>
<i>Cladonia portentosa</i>	<i>Hypnum jutlandicum</i>	<i>Ramalina species</i>	<i>Vaccinium oxycoccus</i>
<i>Cladonia pyxidata</i>	<i>Hypogymnia physodes</i>	<i>Rhynchospora alba</i>	<i>Zygodonium ericetorum</i>

A one hectare area of woodland on the western margin of Girley Bog was examined as part of the National Survey of Native Woodlands 2003-2008 by Perrin, et al (2008). The woodland is marked on the 1840's map of the area and was called Site 704 Bog Woods, Cloncat, Co. Meath (Girley Bog Wood) by the survey team (see **Figure 27**, Appendix 1). The wood is developed on cutover raised bog. The dominant canopy species is birch (*Betula pubescens*) with occasional pedunculate oak (*Quercus robur*) and holly (*Ilex aquifolium*). The field layer is dominated by *Vaccinium myrtillus* with frequent *Rubus fruticosus* and *Dryopteris dilatata*. *Pteridium* is locally dominant. *Prunus laurocerasus* is rare on site but dominant at the boundary of the site. The woodland is owned by Coillte. This woodland area is **outside** the boundary of the Girley bog NHA but the Loop Walk runs through it.

A species list for the woodland recorded by Perrin et al (2008) is presented in the table below. The field survey of the site took place in 2005.

Girley Bog Woodland Species List

<i>Acer pseudoplatanus</i>	<i>Hedera helix</i>	<i>Mnium hornum</i>	<i>Salix cinerea</i>
<i>Betula pubescens</i>	<i>Hypnum andoi</i>	<i>Molinia caerulea</i>	<i>Scleropodium purum</i>
<i>Calluna vulgaris</i>	<i>Hypnum cupressiforme s.s.</i>	<i>Polytrichum commune</i>	<i>Sphagnum palustre</i>
<i>Calypogeia muelleriana</i>	<i>Hypnum resupinatum</i>	<i>Polytrichum formosum</i>	<i>Thuidium tamariscinum</i>
<i>Campylopus flexuosus</i>	<i>Ilex aquifolium</i>	<i>Prunus laurocerasus</i>	<i>Ulex europaeus</i>
<i>Chamerion angustifolium</i>	<i>Isoetes myosuroides</i>	<i>Pteridium aquilinum</i>	<i>Ulota bruchii</i>
<i>Dicranum scoparium</i>	<i>Juncus effusus</i>	<i>Quercus robur</i>	<i>Ulota phyllantha</i>
<i>Dryopteris dilatata</i>	<i>Kindbergia praelonga</i>	<i>Radula complanata</i>	<i>Urtica dioica</i>
<i>Eurhynchium striatum</i>	<i>Larix kaempferi</i>	<i>Rubus fruticosus ag.</i>	<i>Vaccinium myrtillus</i>
<i>Fraxinus excelsior</i>	<i>Lepidozia reptans</i>	<i>Rubus idaeus</i>	<i>Veronica chamaedrys</i>
<i>Frullania dilatata</i>	<i>Lophocolea bidentata</i>	<i>Rumex acetosa</i>	

Ecotope Surveys

The first field ecotopes survey of Girley bog was undertaken by Derwin and MacGowan (2000) as part of an NPWS project to determine the location of degraded raised bog habitat with potential for restoration to active raised bog. These workers found that there was no central ecotope or primary habitat present. There was a small (1.8ha) area of wet sub-central ecotope identified which had been secondarily re-wetted through flooding of drains. Girley bog was flown in 2003 by the NPWS as part of the turf cutting impact assessment project carried out by National Parks and Wildlife Service between 2003 and 2006.

In 2014 Denyer Ecology undertook an Ecotopes and Vegetation Mapping Survey of Girley Bog as a cross border Action for Biodiversity Project. This field study focused on the area of Girley Bog that had never been afforested. This confirmed the presence of active raised bog ecotopes across 1.36ha of the bog in six discrete units. The active raised bog ecotope present is classified as Sub-central. This ecotope is characterised by abundant *Calluna vulgaris* and *Eriophorum vaginatum* with high *Sphagnum* cover. Pools are absent. This ecotope occurs in a mosaic with the sub-marginal ecotope, so it is difficult to map precise boundaries. *Sphagnum fuscum* and *Sphagnum austinii* are locally abundant in the most well developed example of sub-central ecotope on Girley Bog.

The active raised bog ecotopes are surrounded by non peat forming ecotopes including sub-marginal, marginal and facebank types. See **Figures 28 and 29, Appendix 1**.

NHA Review 2014

The Review of the Natural Heritage Area Network published in 2014 provided valuable information on the status of priority raised bog habitats and on the socio-economic use of Girley Bog. The review undertook an eco-hydrological assessment of Girley Bog using detailed topographic data obtained from LiDAR surveys to assess the potential for the bog surface to support active raised bog. The criteria include shallow slopes of

0.3% or less and a water table within 10cm of the surface year round.

By using the detailed topographic survey data, it is proven possible to model eco-hydrological conditions (based on the raised bog's slope, drainage patterns and rainfall) and relate these conditions to ecological surveys of the vegetation present on the site. In this way it is possible to determine the area of each bog that has suitable conditions for the development of active raised bog habitat, whether or not active raised bog currently occurs on that area.

The review found Girley bog to be worthy of inclusion in a new network of 61 of raised bog NHAs helping to contribute to achieving the national conservation objective for active raised bog habitat of 3,600ha together with the sites designated as SACs (see **Figure 30**, Appendix 1). Specific findings of the review in relation to Girley bog are summarised in the table below. Information maps relating to the compilation of these data are presented in **Figures 31,32 and 33**, Appendix 1 and include slope, LiDAR and contours (Macklin pers comm 2015). Please note that the active raised bog area found in the NHA survey is greater than that found by Denyer which measured active raised bog at 1.36ha.

Girley Bog Feature	Area (ha)
Area of High Bog	72.48
Active Raised Bog Habitat	1.8
Degraded Raised Bog Habitat	1.8

Potential for active Peat formation in the cutover bog

In 2014 following modelling using LiDAR data and a field survey by members of the NPWS sponsored RPS Raised Bog Restoration Team a series of maps were drawn up showing potential within the cutover areas of Girley bog for active peat growth with appropriate management in the future. Maps of general drainage patterns off the high bog into the cutover, slope within the cutover and enclosed depressions have been drawn up for the site. The workers verified that where there is a lot of flow off the high bog to areas with suitable slopes or to a depression in the cutover bog landscape one is most likely to see regeneration of raised bog vegetation in the future with appropriate management. See **Figures 34, 35 and 36, Appendix 1**.

In 2014 and 2015 following drain blocking by the NPWS of the former peat spreading grounds in the south eastern portion of the bog, seasonal ponds were created from pooling of water. Around three of these pools IPCC undertook to re-introduce *Sphagnum* mosses using the Canadian peat transfer method (Ó Corcora 2014). The locations of these experiments are presented in **Figure 37, Appendix 1**.

Peat Depth

Flynn & Regan (2012) took nien cores from the Girley bog NHA and found seven of these to contain peat. Peat in the central part of the bog was found to exceed 9m in thickness. Peat in the cutover areas around the margins was heavily compacted. Material underlying the peat was found to consist of localised deposits of shell marl and fine grain silty sand/sandy silt. See **Figure 38, Appendix 1**.

Education

The number of children visiting Girley Bog each year as part of education programme entitled "An Irish Farm Day" undertaken by the Causey Farm Experience is 20,000 (Matt Murtagh pers comm 2015).

In 2014, the IPCC published a Visitor Map and Guide to Girley Bog in printed format and on line at www.ipcc.ie (see **Figure 39, Appendix 1**). In addition an exhibition poster about Girley Bog was printed for mounting in Causey Farm and in the Bog of Allen Nature Centre. A video about the work of restoring Girley Bog entitled *Girley Bog Meitheal* was uploaded to IPCC's facebook channel at <https://www.youtube.com/user/ConservationPeatland>.

IPCC's Education Officer Miss Nuala Madigan delivered a training course on the ecology of peatlands to 11 guides from the Causey Farm Experience in 2014.

Public Engagement

A key priority of the Conservation Management Plan was to assess the views of the local community as well as stakeholders further afield on what they thought might be required to increase the value of Girley Bog into the future. It is widely accepted that in order to successfully implement any management actions in conservation work that the community need to be fully engaged and supportive of work being done. The aim of this review was to assess opinion on the ground as well as search for ideas which would help the plan achieve it's goals going forward.

Paper survey

The survey was initially brainstormed by the Girley Bog Meitheal at a meeting on the 29th April 2015. Following this a draft was created by staff at the IPCC and this was circulated, commented and modified by the Management Committee. The survey was then printed and distributed to stakeholders through the IPCC and staff at Causey Farm. A copy of the survey is shown in Figure 41, **Appendix 1**).

Online survey

An online version of the survey was also created and hosted by www.surveymonkey.com. The online survey was widely distributed using email and also given prominence on the IPCC website (www.ipcc.ie) and facebook page. To allow for full analysis of the results on completion of the paper surveys these were manually entered on the surveymonkey site by IPCC staff.

Outputs

In total 131 individuals responded to the survey. Here outcomes for each question derived from final analysis will be described while the full detailed responses can be seen in Appendix I.

Question 1: How often would you visit Girley Bog? (Respondants: 131)

	Daily	Weekly	Monthly	Never	Once a year	Other
Total	4	14	23	22	31	35

As shown in the table above the majority of respondants chose other. The main reason behind this is that a significant number of respondants (26) were leaders of school groups to Causey Farm who stated that they visited the site only for school tours. There were also a 9 respondants who clicked other and stated that they visited the bog quarterly or a few times a year. Given that the survey was widely available on line it was encouraging in terms of on the ground awareness to see that only 22 individuals or 16% of our total respondants had never visited the bog.

Question 2: Why would you visit Girley Bog? (Respondants: 129)

For this section respondants could choose multiple supplied options and again were able to choose other and list any non-listed activities for which they might visit the bog. In this case respondants could select as many of the activites as they wished. The predetermined options were; Event, Walking, Wildlife, Work, Fundraising, Adventure, Bird Watching, Fitness, Volunteering, Walking the Dog, Research, Foraging and Other. The top three chosen activites were:

1. Walking (82)
2. Wildlife (58)
3. Fitness (34)

This showed that the bulk of people (82 individuals or 63%) responding to the survey were visiting the bog in order to utilize the site as a recreational resource highlighting the importance of the loop walk in retaining a community interest in the site. It can be assumed that the

Question 3: What does Girley Bog mean to you? (Respondants: 85)

This was our first open-ended question where respondants could write a couple of words, a sentence, or a paragraph to outline their own experience of the bog and how they personally felt about same. In order to analysis this each answer was taken and inserted into a word cloud generator. Effectively this leads to a highlighting of the words which are being used repetitively in answers and brings common themes to the fore. The major themes which were found to emerge from this question were the idea of nature and a wilderness high-

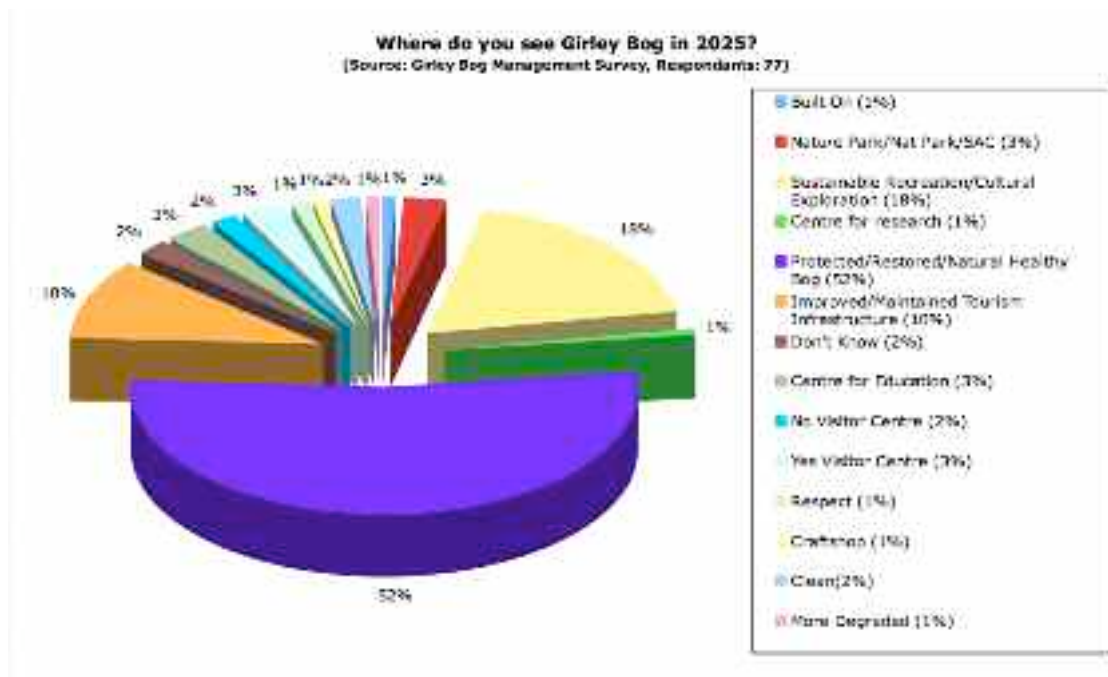
lighting that an unspoiled natural landscape is what people enjoy when visiting the loop walk. This in turn indicates that the driver behind the management plan should be to make and retain the entire site as a natural and relatively untouched environment.



Question 4: Do you think a Conservation Action Plan is the best way to protect the bog? (Respondants: 97)

This was a relatively simple question with 91 respondents feeling that a Conservation Action Plan was relevant and necessary in order to ensure the conservation of the bog with 6 respondents feeling that different measures would be appropriate.

Question 5: Where do you see Girley Bog in 10 years time? (Respondants: 77)



This was a second open ended question and was aimed at gauging where respondents anticipated the bog would be after 10 years of work. It also allowed for further appraisal of developments that they wanted to see in terms of the bogs future. In analysing the answers IPCC developed 14 themes which we felt were capable of succinctly presenting the opinions voiced in response. Again the idea of a natural and healthy wilderness

environment came to the fore. There was also a strong feeling that the bog should be available for sustainable recreation and the improved/maintained tourism infrastructure this requires. Overall people seem to want the bog to be easily accessible yet still maintaining the overall sense of wilderness that it holds. This is a challenge that the Conservation Action Management Plan needs to meet head on.

Question 6: What do you think are the most important issues facing Girley Bog? (Respondants: 102)

Here respondents were asked to rank 7 issues in order of importance going into the future. Analysing the percentage of number 1 votes we can see that the Protecting/Conserving Wildlife receive almost 40% of the vote and was deemed to be the number 1 issue going forward. This was closely followed by restoring the bog habitat, an action that would fall very close to the above. While dumping and education were quite high on the agenda it was quite surprising to see that upgrading the loop walk received less than 2% of first preference votes.

Ranking	% No 1 votes	Works
1	37.63	Protecting/Conserving Wildlife
2	27.72	Restoring the bog habitat
3	14.85	Tackling illegal dumping
4	8.91	Educating the public
5	4.95	Providing visitor facilities
5	4.95	Involving the community
7	1.98	Upgrading the loop walk

Question 7: Are you aware of the following measures? (Respondants: 69)

This question was aimed at allowing for analysis of how aware people were of the work to date, which in turn would allow us to engage how well we were spreading the word as well as how many of our respondents were tuned in with the workings of Girley Bog. Respondants were acutely aware that there was work ongoing with trees, with both planting and removal ranking quite high. The visibility of rubbish was evident with its removal being notable and paramount. Overall many of the respondents were aware of at least some conservation works being carried out on the bog, indicating that the awareness campaign being run is successful, but it would be a key action of the plan to increase numbers in order to have greater awareness of the best practice work that is being carried out on the site.

Activity	Drain Blocking	Tree Planting	Rubbish Removal	Moss Transfer	Removal of Invasive Species
No of responses	42	54 (1)	48 (2)	28	31

Bog Bridge	Water Monitoring	History Research	Tree Removal	Parking	Information Signs
28	27	31	41	35	47 (3)

Question 8: Have you any suggestions on how to spread the word? (Respondants: 72)

This open ended question brought in a wide variety of responses. Notable in particular was the demand for a greater number of events to be held on the bog. While social media was the most frequently chosen outlet only one less individual suggested greater promotion of events, indicating that a hands on interaction with the public is as important in successfully promoting the conservation of the bog. Many respondents also stated here that they had been to previous events and it was such things that peaked their interest in the bog and particularly in understanding the need for it to be conserved. A number of ideas were uncovered by this question with new methods of spreading the word put forward such as through churches, libraries and walking groups, which can now be utilised into the future. There was also commitment from some respondents to help us to do so going forward.

Question 9: Are you interested in getting involved? (Respondants: 85)

This question allowed for people to be specific on what they personally would like to engage in on Girley Bog was a precursor for the final question in which people were asked to leave contact information should they wish to become involved. Many used the other here to expand on why they could not attend such events with workload and distance from the site itself the key issues in relation to this.

Work Projects	Info Events	None	Other
17	22	29	17

Question 10: Contact Details (Respondants: 54)

Contact information was received in the form of names, addresses and email/telephone information for people who had specified that they wanted to be informed on events and volunteer workcamp. This information was added to relevant contact databases and email lists by the Irish Peatland Conservation Council. This information has been held back from the plan for privacy reasons and contact can be made by those organising such activities through directly contacting the IPCC.

Conservation Objectives for Girley Bog

Parameter	Attribute	Measure	Target	Notes
Area	Habitat Area	Hectares	Restore area of active raised bog to 3.6ha, subject to natural processes	The active raised bog area on high bog was estimated by Denyer (2014) to be 1.36ha and was modelled by the NPWS Raised Bog Project (2014) to be 3.6ha
Range	Habitat Distribution	Occurrence	Restore the distribution and range of active raised bog across the NHA	See Figures 28 and 29 in Appendix 1 for the distribution of active and degraded raised bog habitats across the site and Figure 42, Appendix 1 for the distribution of bog woodland
Structure & Functions	Structure & Functions: High Bog Area	Hectares	No decline in the extent of the high bog area	The high bog area in Girley Bog is 72.48. See Figure 30 in Appendix 1
Structure & Functions	Hydrological Regime: water levels	cm	Restore water levels appropriate to the various ecotopes on the bog	For active raised bog, mean water level needs to be near or above the surface of the bog lawns for most of the year - usually within 10cm of the surface. Seasonal fluctuations should not exceed 20cm, and should only be for very short periods of time. Flynn & Regan 2012 suggested that a central core area of 11% of the high bog had potential for active raised bog based on slope and hydrology.
Structure & Functions	Hydrological Regime: flow patterns	Flow direction, slope	Restore where possible appropriate high bog macro-topography	For active raised bog, mean water level needs to be near or about the surface of the bog lawns for most of the year. Long and gentle slopes of (0.3%) or less are the most favourable to achieve these conditions. Changes to flow directions due to subsidence of bogs can radically change water regimes and cause drying out of areas of active raised bog. There has been substantial subsidence and fissuring on Girley Bog due to drainage and turf cutting. See Figure 40, Appendix 1.
Structure & Functions	Transitional areas between high bog and adjacent mineral soils (including the cutover)	Hectares distribution	Restore the transition from the high bog to the cutover so that they protect the raised bog ecosystem and the ecosystem services it provides	All margins of Girley Bog have been cut for turf in the past. Projects in the cutover areas need to focus on restoring semi-natural margins and transition areas with mineral soils

Parameter	Attribute	Measure	Target	Notes
Structure & functions	Vegetation quality: ecotopes	Hectares	Restore 1.8ha of central/sub-central ecotope	At least 50% of the active raised bog habitat should be central ecotope. The active raised bog target area for the Girley has been set at 3.6ha (1% of the national target of 3600ha). Both the hydrological and ecotopes surveys predict that restoration is likely to lead to more active raised bog at the site.
Structure & functions	Vegetation quality: micro-topography	Hectares	Restore adequate cover of micro-topographical structure	High quality micro-topography includes hummocks, lawns, hollows and pools. The development of this structure is limited in its extent on Girley bog at present
Structure & Functions	Vegetation Quality: Bog moss (<i>Sphagnum</i> species)	% cover	Restore 100% cover of <i>Sphagnum</i> mosses to ensure peat forming capacity	Girley Bog has six fragmented areas of sub-central active peat forming ecotope with a high cover of <i>Sphagnum austinii</i> and <i>S. fuscum</i> - two important peat forming mosses. <i>S. magellanicum</i> , <i>S. capillifolium</i> , <i>S. subnitens</i> and <i>S. papillosum</i> are also peat forming mosses that occur abundantly on site. Similarly the marginal ecotope has an unusually high occurrence of these principal peat-forming mosses.
Structure & Functions	Typical species: bog flora	Occurrence	Restore typical raised bog flora	Raised bog flora is typically specialist with adaptations to the abiotic environment of the peatland. The flora includes typical widespread species and those with restricted distribution within the geographical range or habitat subtypes.
Structure & Functions	Typical species: bog fauna	Occurrence	Restore typical raised bog fauna	Raised bog fauna includes typical widespread species and species with restricted distribution within the geographical range or habitat subtypes.
Structure & Functions	Elements of local distinctiveness	Occurrence	Maintain elements of local distinctiveness subject to natural processes	At present there are no distinctive features or species of local significance in Girley Bog
Structure & Functions	Negative physical indicators	% Cover	Negative features absent or insignificant	Negative indicators include bare peat, algae dominated pools and hollows, marginal cracks or fissures, subsidence features such as dry mounds emerging or expanding and burning evidence, see Figure 40, Appendix 1.
Structure & Functions	Vegetation composition: native negative indicator species	% Cover	Native negative indicator species at insignificant levels	Native negative indicator species that suggest drying out on the high bog include abundant bog asphodel (<i>Narthecium ossifragum</i>), deer-grass (<i>Trichophorum germanicum</i>) and hare-tail cotton-grass (<i>Eriophorum vaginatum</i>) forming tussocks; abundant magellanic bog-moss (<i>Sphagnum magellanicum</i>) in pools previously dominated by <i>Sphagnum cuspidatum</i> . Indicators of frequent burning events include abundant <i>Cladonia floerkeana</i> and high cover of carnation sedge (<i>Carex panicea</i>). <i>Campylopus introflexus</i> is a non native species that can cover bare peat after fires. Small amounts of this species is normal on a healthy bog. The widespread presence of birch seedlings and small trees on the high bog surface and of large trees in the townland drains on the high bog are a negative indicators

Parameter	Attribute	Measure	Target	Notes
Structure & functions	Vegetation composition: non native invasive species	% cover	Non-native invasive species at insignificant levels and not more than 1% cover	The most common non-native invasive species on Girley bog are Scot's pine (<i>Pinus sylvestris</i>) and lodgepole pine (<i>Pinus contorta</i>) and their cover is too high on the high bog, Rhododendron (<i>Rhododendron ponticum</i>) may also occur.
Structure & functions	Air quality: nitrogen deposition	kg N/ha/year	Air quality surrounding bog close to natural reference conditions. The total N deposition should not exceed 5kg N/ha/yr	Change in air quality can result from fertiliser drift; adjacent quarry activities; or other atmospheric inputs. The critical load range for ombrotrophic bogs has been set as between 5 and 10kg N/ha/yr (Bobbink & Hettelingh 2011). The latest N deposition figures for the area around Girley Bog suggests that the current level is approximately ??kg N/ha/yr (Henry & Ahern 2014)
Structure & Functions	Water quality	Hydrochemical measures	Water quality on the high bog and in transitional areas close to natural reference conditions	Water chemistry within raised bogs is influenced by atmospheric inputs (rainwater). Water chemistry in areas surrounding the high bog varies due to influences of different water types (bog water, regional groundwater and runoff from surrounding mineral lands). The reference pH for raised bog is 4.

Amenity Conservation Objectives

Parameter	Attribute	Measure	Target	Notes
Amenity	Loop Walk	Visitor impact survey	Maintain loop walk surface in a condition suitable for walking through annual monitoring	The loop walk is open all year round and is prone to heavy footfall from 20,000 visitors annually. As a result some areas have been degraded and bare peat exposed. Remedial work has been undertaken through provision of boardwalks but the entire walk needs to be monitored.
Amenity	Boardwalk	condition survey	Ensure boardwalks are in safe, flat walking condition through annual survey	Boardwalk planks have been found to shift with time and this needs to be carefully monitored from a visitor safety point of view and reported online. Non slip staples need to be inserted when required.
Amenity	Information Signage	Occurrence and condition	Maintain high quality signage on site in their present locations	At present there are 10 visitor signs on Girley Bog, 9 of which contain information and one is a finger sign.
Amenity	Warning Signs	Occurrence and condition	Extend signs on site to include no dumping, CCTV, fire warning and safety warning	Girley has a strong history of fire incidents and dumping. Signs are needed to warn offenders of the consequences. Visitors also need to exercise due care if wandering off the prescribed loop walk route and some warning signs are already in place at potential entry points and drains to the open bog.
Amenity	reporting facility	provide service	Provide contact service for visitors to report on the loop walk experience	Email, web site comments or social media comments.
Amenity	Vehicular access	Regulate	Restrict access of vehicles to site to those on official business only	Gates need to be installed at the access points to the site from Causey Farm, Drewstown, Chamberlainstown and the N52 to curtail fly tipping and dumping and theft of scientific or commercial resources.
Amenity	Visitor Rewards	Occurrence	Provide a variety of panoramic view points along the loop walk to enhance visitor experience of Girley Bog and give an indication of the timing of the loop walk	Currently there are no dedicated viewing points over the bog or the landscape from which to take in the significance of its wildlife habitats and cultural heritage. For example the Coillte boardwalk on the high bog ends at a bog drain filled with birch trees and brush waste impeding a panoramic view of the high bog to reward the visitor. Another possibility is a Loughcrew viewpoint from the eastern side of the loop walk. In addition the signage gives no indication of the timing of the walking from point to point.

Management Restoration Actions

Management and restoration of Girley Bog is absolutely essential if the site specific conservation objectives and targets for Active Raised Bog (ARB) at Girley Bog NHA are to be met. Figure x, Appendix 1 shows the restoration plan put forward by Flynn and Regan 2012 for the high bog. The main restoration actions are drain blocking, tree removal, and a continual cycle of vegetation and hydrological monitoring to ensure these measures are successful in achieving the overall conservation goal for the site - the maintenance and creation of active raised bog, Annex 1 habitat. In the cutover bog drain blocking and *Sphagnum* restoration in suitable sites is required to support the work being undertaken on the high bog.

Hydrological processes are key drivers of raised bog ecology. The different raised bog communities, assemblages, and species are affected by various hydrological attributes. For active raised bog to develop or be maintained and improved, mean water levels need to be near or above the bog's surface for most of the year. Seasonal fluctuations should not exceed 20cm, and water level should be within 10cm of the surface, except for very short periods of time (Kelly & Schouten 2002). Gentle slopes of 0.3% or less that limit intermittent lateral losses of water (through surface runoff) and encourage sustained water logging are the most favourable to achieve these conditions.

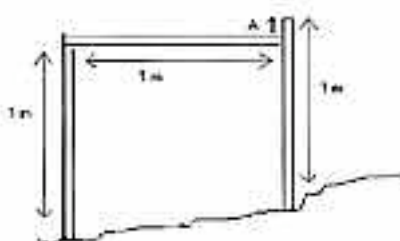
At Girley Bog achieving the active raised bog target will include working on both the high bog and on some of the cutover areas. Working on selected cutover areas will help to minimise the impact of past drainage and cutting on the hydrological integrity of the high bog and support a diversity of other wetland habitats (e.g. wet woodland and fen), as well as the species they sustain. These transitional cutover zones, once restored, can provide ecosystem services through flood attenuation and water purification to downstream areas, increase carbon sequestration and improve the site's biodiversity.

A summary of the main restoration options that may be considered for improving hydrological conditions on Girley bog are outlined below.

Blocking of high bog drains

The purpose of blocking high bog drains is to raise the water table within the peat, not only within the drain but also the adjacent areas. Where the water table is successfully maintained within 10cm of the surface, except for very short periods of time (Kelly & Schouten 2002), the hydrological conditions are suitable for active raised bog habitat to develop. Typically drain blocking on the high bog involves using peat dams to block the drain, damming at every 10cm drop in elevation with a minimum of three and maximum of ten dams per 100m length of drain (Schouten et al., 1994). The peat dams are usually installed using a specially adapted tracked machine and Bord na Móna and the National Parks and Wildlife Service have much experience in this technique. Hand-blocking has taken place extensively on the high bog at Girley. Some drain dams have been constructed from peat which is very cheap. Only highly humified, fully waterlogged peat should be used to construct a dam. As the peat is inserted into the drain, it should be compacted. Upon completion the dam is raised 30cm above the surface of the bog. It should be covered with a living layer of peatland vegetation. The width of the peat dam is generally between 50 and 75cm. The borrow pit from which the peat was removed should be inoculated with *Sphagnum* using the *Sphagnum* transfer technique developed in Canada.

But an alternative method used by IPCC has been the use of plastic sheet piling 3m in length which is inserted into the drain and driven down to an appropriate depth. Plastic drain piling is impermeable, light, sturdy and easy to transport. It can be purchased in lengths up to 3m at a cost of €25 per sheet. Sheets of the piling measuring 30cm wide interlock with one another using a tongue and groove system. They can be hammered into a drain individually using a large rubber mallet.



Height levelling of a peatland surface. The length of A indicates the distance the surface rises or falls over 1m.

In some cases, a combination of peat dams with plastic sheet piling can be effective where significant flow is experienced, as the plastic can prevent erosion of the peat in the dam while the peat forms a more effective seal in the drain than plastic alone.

Put something in here about a huge dam needed reinforced with wood as on Aughrim bog

The first step in restoration of drained peatlands is to undertake a survey to determine the slope of the drains on the peatland. This is called levelling the drains. A professional survey team will use electronic equipment. Depending on the availability of both resources and time, drains can be levelled using three metre sticks and a spirit level. On the bank of the drain

the first metre stick is held in place vertically. The second metre stick is placed one metre further along the bank of the drain. The vertical difference between the two metre sticks is measured by placing the third metre stick horizontally from the top of the lowest metre stick to the second metre stick. The spirit level is used to ensure the third horizontally placed metre stick is level. The difference in height between the two vertical metre sticks is recorded in relation to the first. The profile graph obtained shows the changing slope of the drain on the bog.

Blocking of drains on cutover bog

Drains on the cutover are often present around large sections of raised bogs in Ireland as they are designed to drain the facebank and spread grounds adjacent to the bog, thus facilitating turf-cutting and harvesting. The presence of these drains leads to an increased gradient between the water table in the margins of the bog and the water table in the high bog causing ongoing drying out of the bog to occur. Where marginal drains extend close to the mineral substrate underlying the peat, increased vertical water losses from the bog can occur, which can have significant impacts on raised bog habitats. I think this could be explained a little more clearly following on from Ray's talk at the last steering meeting. The idea of the limestone rock under the bog being an aquifer that is held in place by the sealing power of a thick layer (up to 1m) of silt and the weight of the overlying peat. Once the peat is removed the dynamic balance is upset and this can lead to water loss from the aquifer beneath the bog.

Raising the water table in cutover areas through drain blocking may also provide favourable hydrological conditions in areas with suitable topography to support the development of peat-forming vegetation, including ARB. The required conditions are for the water table to be maintained at or close to the surface, therefore large areas of standing water or deep pools are not desired.

The approach taken to block cutover drains is similar to that taken for high bog drains whereby drains are blocked using peat or plastic dams with one dam inserted into the drain at every 10cm drop in elevation (subject to a minimum of three and maximum of ten dams per 100m length of drain (Schouten et al., 1994) In some cases cutover drains have much greater dimensions than high bog drains. Therefore, individual dams are often more time consuming to create; however, this is often balanced through more favourable working conditions for machines on cutover bog. Risk of erosion is also typically higher on cutover as there are areas that receive significant flow from the high bog. In areas where significant flow is expected, it is recommended that peat dams reinforced with plastic sheet piling are used where necessary to minimise the risk of erosion.

Marginal dams

Marginal dams are used in combination with drain blocking to promote the retention of water on the cutover. These dams are most suitable for locations where the cutover is very flat, of low permeability and where there is a drain along the boundary of the cutover.

Fire Prevention

Sphagnum species are particularly sensitive to fire as their growing point is at the tip of the plant. Fire prevention is essential. Girley Bog Erecting warning signs of a peatland area prone to fire is a first step in prevention particularly if the careless disposal of cigarette butts from passing traffic or walkers on the loop walk is a cause of fire.

A second step is the construction of a fire break around the peatland site. This involves cutting the heather bushes, grasses and other shrubs with a strimmer down to the moss layer. The width of the clipped strip should be a minimum of 4-5m. The cut vegetation is removed from the site. This strip gives a base from which to fight a fire should one arise and in the event of fire it will slow down the rate at which the fire travels.

Tree clearance

Clearance of trees is typically combined with other restoration measures including drain blocking, and when both are applied to a suitable area they can be extremely effective in raising water levels in the peat and encouraging ARB development. The agency with the most experience in restoring former conifer plantation sites on peatlands in Ireland is Coillte and an example of their methods can be seen at Girley Bog. A number of different approaches can be taken for tree clearance depending on the age and commercial viability of the crop, site sensitivity and access.

These include felling and complete removal of trees or partial removal of felled material, as well as felling to waste (retention of all felled material on site). If the trees are immature/low yielding and not of commercial value then they can be cut down with a chain saw and left in windrows on site to decay naturally. However; if the trees are mature and have commercial value they will be clear felled and the timber removed from the site. The remaining brush is gathered in windrows to clear the peatland surface as much as possible. These windrows are left on site to decompose. Another practice is to remove all tree material associated with com-

merial forestry from the peatland site leaving a “clean” site with an open panoramic vista.

Natural regeneration of seedlings from the commercial crops, or from wind-borne seeds of downy birch occur on sites once the trees have been removed. It is likely that this will continue many years after the initial clearance has taken place, even after the water table has been raised through drain blocking. These are removed periodically by hand.

Please note a felling licence must be obtained from the Forest Service before trees are felled. Their contact address is: Forest Service, Johnstown Castle Estate, Co. Wexford, Tel: 053-9163400.

Hand Removal of Invasive Tree Species

A felling licence must be obtained from the Forest Service before trees greater than XXm are cut down or felled. Their contact address is: Forest Service, Johnstown Castle Estate, Co. Wexford, Tel: 053-9163400.

In the hand felling of trees, bow saws or chainsaws may be used. Trees should be cut down to as near to ground level as possible. Once cut, the stumps should be treated immediately with SBK Brushwood Killer which consists of 48g per litre of Triclopyr. The recommended dose rate is 1:1 water:triclopyr. A food dye should be added so that stumps that have been treated can be clearly seen. Felled trees should be removed from the site. Clearance of the individual conifer trees invading the surface of Girley Bog has been undertaken by IPCC.

Sphagnum Moss Restoration

In Canada peatland managers have successfully developed techniques to cultivate Sphagnum mosses on an industrial scale on bare peat surfaces over a time line of just ten years (Quinty and Rochefort 2003 - http://tourbehorticole.com/wp-content/uploads/2015/07/Peatland_Restoration-e.pdf). Peat formation is ensured by raising the water table through drain blocking and establishing a living layer of moss over a formerly dry, bare and eroding peat surface. Irish Peatland Conservation Council have been successfully trialing these methods in an Irish bog environment on our reserve – Lodge Bog since 2009 and have set up a number of transfers on the cutover bog at Girley.

The Canadian peatland restoration approach is based on the active reintroduction of peat bog plant species and hydrological management in order to raise and stabilise the water level. It consists of surface preparation, plant collection, plant spreading, straw spreading, fertilization and blocking drainage. The starting point for the restoration process is a relatively deep acidic peat substrate.

The surface dry crust of hard peat must be broken up so that plants introduced are in contact with a moist soft peat substrate. Harrowing machinery is used. Between 5 and 10cm of the surface may need to be milled depending on local conditions. In addition excessive loose peat should be removed.

Species	Ecology	Peat forming capacity
<i>Sphagnum austini</i>	Hummock species	High
<i>Sphagnum capillifolium</i>	Forms small hummocks and carpets	Moderate
<i>Sphagnum cuspidatum</i>	Pool and hollow species	Low
<i>Sphagnum denticulatum</i>	Pool and hollow species	Low
<i>Sphagnum fallax</i>	Occurs in lawns and carpets, shade tolerant, indicative of some nutrient enrichment (soaks and active flushes)	Low
<i>Sphagnum fuscum</i>	Forms dense low and wide, and occasionally high hummocks	High
<i>Sphagnum magellanicum</i>	Lawn species forming carpets and low hummocks	Moderate
<i>Sphagnum palustre</i>	Forms hummocks and dense carpets, often in shaded conditions. Indicative of nutrient enrichment (soaks and active flushes)	Low
<i>Sphagnum papillosum</i>	Lawn, hollow, and low hummock species	Moderate
<i>Sphagnum pulchrum</i>	Grows in lawns and hollows, more typical of western bogs	Moderate
<i>Sphagnum squarrosum</i>	Forms carpets and small mounds. Indicative of nutrient enrichment (soaks and active flushes)	Low
<i>Sphagnum subnitens</i>	Occurs as individual shoots or small cushions and lawns. Tolerant of minerotrophic conditions	Moderate
<i>Sphagnum tenellum</i>	Occurs as single shoots or weak cushions, typically in disturbed patches of the bog surface	Low

Sphagnum species typically associated with raised bog ecosystems in Ireland. (Patrick Crushell pers comm)

Dome shaped harvesting fields need to be reprofiled, i.e flattened. Ditches need to be filled in or blocked.

Sphagnum is harvested from a donor site. The top 10cm are removed using a rotovator to first break up plant fragments and facilitate collection. This material is then spread using a back mounted manure spreader. The recommended harvest area to spread area ratio is 1:10 harvest:spread.

Straw mulch needs to be spread over newly inoculated *Sphagnum* moss on the field surface using

a blower. A minimum quantity to use is 3000kg per hectare. This represents 25 to 30 four foot bales per hectare (10 to 12 per acre). A sideward straw spreader may be used to apply the straw. The advantage of using a blower is that heavy machinery does not have to pass over plant fragments during straw application.

Fertilization is carried out once all of the previous steps are complete. A weak dose of granulated rock phosphate fertiliser is used. Use of other types of phosphorus containing fertilisers is not recommended as the concentration phosphorus that they contain makes it difficult to get an even spread due to such a low application rate. Also, high doses of phosphorus promotes invasive species such as birch. Nitrogen fertilisers are not required as disturbed peatlands already contain enough nitrogen to support their native flora. Rock phosphate releases just enough phosphorus over a long enough period of time to help promote the growth of species such as *Polytrichum* moss. *Polytrichum* mosses act as nurse plants that in turn promote the growth of *Sphagnum* mosses. A dose of 150kg of rock phosphate per hectare is recommended. Care should be taken however when any phosphorus containing fertilizer is used near to a watercourse so as to avoid contamination.

Drain blocking is the final step in the restoration work.

Monitoring Methods

Peatland Restoration Monitoring – Water Level: Monitoring water levels in a peatland is essential following blocking of drains with dams. This gives valuable information on the effectiveness of drain blocking activity. Usually a series of dipwells or piezometers are inserted on the peatland so as to monitor the height of the water table. These can be purchased or constructed from 52mm internal diameter PVC pipe or 2" plastic waste pipe. To stop peat filling the tube from the base, cover the pipe with ladies' tights (or gauze) affixed with tape or a cap. The top of the well should also be capped. Wells should be located in parallel transects perpendicular to the drains and marked using canes so that they are easy to find. Water levels should be measured monthly using either a plover (which makes a particular sound when the water in the tube is reached) or a specially made dip stick that buzzes when it reaches the water. Measure the depth of the water in the well. Then subtract the distance between the top of the dipwell and the ground surface. This gives the depth of the water table below the surface of the bog.

Peatland Restoration Monitoring - Flora and Fauna: A useful monitoring technique is to record the wildlife occurring in a peatland. This needs to be carried out in the long term. In this way it can provide valuable information about changing species distributions in response to climate change. Indicator species might include *Sphagnum* mosses, amphibians, sundews or butterflies. All records should be sent to the National Biodiversity Data Centre in Waterford. Depending on how specific you want to be it may be necessary to have a professional scientist provide you with training on how to set up a species monitoring programme such as setting up a butterfly transect etc. Species monitoring programmes should be carried out annually on one occasion or over a number of seasons or weeks.

Peatland Restoration Monitoring - Vegetation

A peatland is considered to be in a healthy condition if it is actively accumulating peat. Certain plant communities and the locations in which they are found on the peatland are indicative of peat forming conditions. In Ireland this information has been determined through years of research commissioned by the National Parks and Wildlife Service. The work was undertaken by Dr Lara Kelly as part of her Doctoral Thesis in Trinity College Dublin (1995). A field key to help identify the raised bog ecotopes present on a raised bog has been developed by field workers and is available from the National Parks and Wildlife Service website. The peat forming communities of Irish acid raised bog peatlands include Central and Sub-Central Ecotope classes. Three other ecotopes found on raised bog peatlands and these are regarded of being indicative of degraded raised bog vegetation. These are face-bank, marginal and sub-marginal. It may be necessary to have a professional vegetation scientist undertake the survey of peat forming communities on a site and produce a map of their distribution. As a guideline such vegetation surveys should be repeated every 5 years depending on resources.

Permanent quadrats may be established on the bog and the % cover of plant species recorded as a simple way of monitoring vegetation change on an annual basis.

Peatland Restoration Monitoring - Photographic: A very useful technique is to set up a series of photographic points on a site where digital or print photographs are taken each year to gauge changes on a site such as: spread of invasive species, changing vegetation types etc. Points should be chosen from where photographs of the landscape can be taken without obstruction. At the photographic point, photographs should be taken in each direction as appropriate. It may be useful to automatically include the date on the photograph.

Girley Bog Management Actions 2016-2020

Habitat Location	Action	Timeline, Priority	Responsible Body
High Bog Habitat	Block all active drains	High	NPWS, IPCC
High Bog Habitat	Fell trees in superdrain, block this drain and all of its off shoot drains	High	NPWS
High Bog Habitat	Remove regenerating birch trees across the site to prevent drying out of the bog surface and to create open habitat for specialist bird species	High	NPWS, Coillte, IPCC
High Bog Habitat	Remove invasive pine across the site to prevent drying out of the bog surface and to create open habitat for specialist bird species	High	NPWS, Coillte, IPCC
High Bog Habitat	Monitor regeneration of invasive tree and shrub species including Laurel, birch, pine and willow in the Coillte land area and in the brush on the high bog, remove annually	High	NPWS, Coillte, IPCC
High Bog Habitat Hydrology	Monitor Water Levels in ?? piezometers across the site each month including groundwater levels, conductivity and surface water discharge. Obtain rainfall data from Mullingar met station and measure evaporation. Produce hydrographs for the site each year	High	NPWS, IPCC, Coillte, QUB
High Bog Habitat	Monitor the distribution and extent of raised bog ecotopes by survey every five years referring to Denyer Survey of 2014.	High	NPWS
High Bog Habitat	Establish a fire control zone by clipping vegetation in a belt in areas prone to fire	High	NPWS
Cutover Bog Birch Woodlands	Establish through natural regeneration	Medium	Coillte
Cutover Bog	Commission a vegetation survey and map of the habitats present in the cutover areas of the bog	Medium	NPWS
Cutover Bog	Drain blocking	Medium	IPCC
Cutover Bog	<i>Establish Sphagnum</i> restoration habitats in the cutover bog and monitor three areas set up in 2014 and 2015.	Medium	IPCC
Cutover Bog Orchid-rich Area	Remove biomass in selected areas using traditional sythe method annually	High	NWT
Cutover Bog Orchid-rich Area	Fence off habitat area. Arrange to graze area with cattle to poach ground one month after mowing	Annual	NWT in liaison with Causey Farm

Habitat Location	Action	Timeline, Priority	Responsible Body
Cutover Bog Orchid Rich Area	Plant hen rattle in meadows to control grass domination	Medium, Annual	NWT
Woodland	Plant alder, crab apple, willow and birch	Low, on-going for how long?	NWT
Orchard		Low	Annette, NPWS
Linnet Plot	Fence off and manage for skylark through grazing regime	Low	Annette, NPWS
Bog Woodlands	Remove <i>Rhododendron</i> and treat with herbicide	High	Coillte
Bog Woodland	Remove Laurel	High	Coillte
Bog Woodland	Survey	Medium	NPWS
Hydrology	Monitor piezometers monthly, quarterly	High,	IPCC, Coillte, QUB
Geological Data	obtain geological data on the site from cores and boreholes, to better understand the inter-relationship between the bog and its surroundings	Medium	NPWS, QUB
Butterfly Transect	Investigate potential to create a butterfly transect across the different habitats of the site	Medium	IPCC, NBDC, in liaison with Jesmond Harding of Butterfly Conservation Ireland
Butterfly Habitat Creation	Investigate creating suitable habitat on cutover bog for Marsh Fritillary - a combination of <i>Succisa</i> and <i>Molinia</i>	Low	IPCC
Species	Action	Timeline, Priority	Responsible Body
Birds	Survey by transect of the different habitats on site	Annual	Oliver Usher, Birdwatch Ireland
Bats	Contact Tina Aughney for Bat Data relating to site	Annual	IPCC
Bryophyte Survey	Survey	Annual	NPWS
Other Baseline surveys	Conduct as appropriate	Annual	All
Biodiversity Surveys	Conduct in orchid-rich areas	Annual	NWT
Moths	Annual monitoring survey across woodland, grassland and bogland habitats. Survey	Annual	Eamonn O'Donnell, Moths Ireland
Spiders	Obtain results from spider survey project 2015	High	Meath County Council, IPCC
Raised Bog Services	Action	Timeline	Responsible Body
Carbon Storage	Encourage reseracher to measure the carbon stored in the bog	Medium	Meath County Council, NPWS, IPCC
Water Reservoir	Encourage reseracher to measure the extent of the water reservoir in the bog	Medium	Meath County Council, NPWS, IPCC

Other Heritage	Action	Timeline, Priority	Responsible Body
Archaeology	Compile list of site and monuments records	Once off,	IPCC
Local History Study/Survey	Encourage Student Researcher	Once off	
Palaeological Studies	Encourage Student Researcher	Once off	
Ecosystem Services Study	Encourage Student researcher	Medium	All
Education and Amenity	Action	Timeline, Priority	Responsible Body
Loop Walk	Maintain and Repair in a safe condition for walkers annually	High	Meath County Council, NPWS
Loop Walk	Extend through NWT land	Medium, Once-off	NWT
Loop Walk	Remove invasive Japanese Knotweed from car park and monitor regeneration and spread	Annual	NPWS and all
Loop Walk	Walkers directional, timing and walk location signage needed to prevent visitors getting disorientated or lost on walk.	Once-off	NPWS, Meath EcoTours and Meath County Council
Loop Walk	Maintain overgrown, soft ground areas with bark chip or boardwalk	Annual	NPWS, Meath EcoTours and Meath County Council
Loop Walk	Erect warning signs regarding risk of fire	High	NPWS, Meath County Council
Loop Walk	Establish panoramic view point from the Coillte boardwalk over the high bog. Remove trees and brash blocking view	High	NPWS, IPCC, Coillte
Poem Stones	Maintain and promote	Annual	All
Dumping	Clean up litter and report incidents to Meath County Council litter warden	Annual	All
Dumping	Close and lock gate access to bog from Causey Farm side. Distribute keys to users	Annual	Causey Farm
Dumping	Erect no dumping signs at public access points to the bog	Annual	All
Commemorative Benches	Install a bench to dedicate to site VIPs	Annual	Meath County Council in liaison with Mens Shed group
Hay Festival June	Run 1 Event	Annual	All
International Bog Day	Run 1 Event	Annual	IPCC, Meath EcoTours
Heritage Week	Run 2 Events	Annual	IPCC, Meath EcoTours, NWT
Biodiversity Week	Run 2 Events	Annual	IPCC, Meath EcoTours, NWT

Education and Amenity	Action	Timeline, Priority	Responsible Body
Work Camps	Run one or more events	Annual	IPCC, NWT
Health and Safety	Conduct Audit and report to Girley Bog Meitheal	Annual	NPWS
Information Signs	Maintain existing level of signs and survey their condition once a year	Annual	NPWS
Information Signs	Install ?? signs on NWT land for the woodland and orchid habitats	Once-off	NWT
Site Access	Maintain brown finger sign on N52 and install another finger sign from Fordstown	Annual	Meath County Council
Fire Signs	Acquire and install alert signs regarding fire at the public entrances to the bog	Once off	Meath County Council
Car Parks	Survey each year to assess condition and report to Girley Bog Meitheal	Annual	Meath County Council
Gates	Repair gate posts at the Fordstown entrance and replace and maintain, install coded padlocks	Annual	
Girley Publications	Compile list of publications and maintain up to date	Annual	IPCC
Girley Site History	Compile and publish	Once Off	NPWS, Causey Farm, Oliver Usher and local community
Communication	Action	Timeline	Responsible Body
Press	Promote all events	Annual programme	Organsing body
Web Sites	Maintain and update	Monthly	IPCC, Meath EcoTours, Coillte
Web Sites	Encourage linking	Annual	IPCC, Meath EcoTours, Coillte
My Girley Communication	Investigate possibility based on My Tara	Once off	Meath County Council and Meath EcoTours
Group Name, email and identity	Establish name for management group and contact emails	Once off and monitor annually	All

Human Resources	Action	Timeline	Responsible Body
Reserve Warden	Employ	Annual	
Volunteers	Recruit, train and develop work programmes	Annual	IPCC, NWT
Management			
Management work	Keep annual records	Medium	IPCC
Management Plan	Monitor effectiveness	Annual	All
Coillte After Life Plan	Obtain in 2016 and monitor effectiveness	High	Coillte

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**Meath Biodiversity Action Plan what does it say about bogs, girley?
Hugh Cushnan Refs?**

Contacts?

**<http://iersevenen.eu/>
www.ipcc.ie**

Glossary & Acronyms

ACTIVE RAISED BOG: Where the conditions are right for peat to continue to form, and where species of plants and animals typical of raised bogs can thrive.

ANNEX I: Annex I of the EU Habitats Directive lists natural habitats types of Community interest whose conservation requires the designation of SACs.

ANNEX II: Annex II of the EU Habitats Directive lists animal and plant species of Community interest whose conservation requires the designation of SAC.

BIODIVERSITY: A general term used to describe all aspects of biological diversity including the number of species present in a given environment, the genetic diversity present within a species and the number of different ecosystems present within a given environment.

CARBON SEQUESTRATION: The capture and long-term storage of atmospheric carbon dioxide, for example, in peat bogs.

CATCHMENT: An area of land draining to a defined point. The term river catchment refers to the area of land that drains into a particular river system.

CUTOVER: An NPWS habitat classification that describes areas of bog which have been previously cut (by hand or by mechanical means), although not down to the marl layer or bedrock. Remaining peat can still be an economic reserve. Cut-over areas are normally a mosaic of cut areas, face banks, pools, drainage ditches, uncut areas of peat, scrub, grassland etc.

DEGRADED RAISED BOG: The area of high, uncut bog which has been damaged by human activities but which could be transformed into active raised bog again through restoration measures

ECOLOGY: The study of the interactions between organisms, and their physical, chemical and biological environment.

ECOSYSTEM SERVICES: Humankind benefits from a multitude of resources and processes that are supplied by ecosystems. Collectively, these benefits are known as ecosystem services and include products like clean drinking water and processes such as the decomposition of wastes.

EROSION: The processes whereby the materials of the earth's crust are dissolved, or worn away and simultaneously moved from one place to another by natural processes which include weathering, solution, corrosion and transportation.

EVAPOTRANSPIRATION: Water loss to the atmosphere from soil (evaporation) and vegetation (transpiration).

FACEBANK: Areas at the edge of the high bog where peat cutting has taken place. This is an ecotope that is highly degraded and absent of typical Sphagnum species.

FAUNA: Animal life.

FAVOURABLE CONSERVATION STATUS: The conservation status of a natural habitat will be taken as "favourable" when: its natural range and areas it covers within that range are stable or increasing, and the specific structure and functions which are necessary for its long term maintenance exist and are likely to continue to exist for the foreseeable future, and the conservation status of its typical species is favourable.

FLORA: Plant life.

FLOW ATTENUATION: Slowing flow of water from an area. This is a common method for reducing risk of flood in urban areas whereby diversion channels store water in attenuation ponds. Intact peatlands offer natural flow attenuation through slowing flow, while degraded peatlands are much less effective at attenuating flow as the peat is dried out encouraging overland flow.

HABITAT: Refers to the environment defined by specific abiotic and biotic factors, in which a species lives at any stage of its biological cycle. In general terms it is a species' home.

HABITATS DIRECTIVE: Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora.

HEAD: Hydrological term which is a measure of the height to which water can raise itself above an arbitrary given level or datum.

HIGH BOG: The area of bog which has not previously been cut.

HYDROLOGICAL PROCESSES: The movement of water through a catchment area including freshwater and seawater inputs, water level changes and drainage mechanisms which are all influenced by the underlying geology.

IPCC: Irish Peatland Conservation Council, a registered charity with the mission of conserving a representative sample of the peatlands of Ireland for future generations to enjoy.

LAGG: A term used to describe the area of transition from bog to mineral soil around a raised bog.

LIDAR: A remote sensing technology that measures vertical surface elevation by illuminating a target with a laser and analyzing the reflected light.

LIFE: The EU's financial instrument supporting environmental and nature conservation projects throughout the EU.

MICROTOPOGRAPHY: Variations in elevation at a relatively small scale. Generally the high spots are about a meter higher than the low spots, and only a couple of meters across.

MINEROTROPIC: Refers to soils and vegetation whose water supply comes mainly from streams or springs. This water has flowed over or through rocks or other minerals, often acquiring dissolved chemicals which raise the nutrient levels and reduce the acidity.

NPWS: National Parks and Wildlife Service.

NWT: Native Woodland Trust

PRIORITY HABITAT: A subset of the habitats listed in Annex I of the EU Habitats Directive. These are habitats which are in danger of disappearance and whose natural range mainly falls within the territory of the European Union. These habitats are of the highest conservation status and require measures to ensure that their favourable conservation status is maintained.

RAISED BOG: An NPWS habitat classification characterised by an elevated dome of peat, the surface of which is isolated.

SITE-SPECIFIC CONSERVATION OBJECTIVE: Objectives that are set at a site-specific level that document how a site can achieve favourable conservation status.

SPECIAL AREA OF CONSERVATION: Area designated for the conservation of habitats and/or species under the Habitats Directive.

SPREADGROUNDS: Area where turf is spread after cutting to dry out. Typically drained cutover bog or adjacent agricultural areas.

STATUTORY NATURE RESERVE: A Nature Reserve is an area of importance to wildlife, which is protected under Ministerial order. This designation is the protection of natural habitats, fauna and flora.

TOPOGRAPHY: The arrangement of the physical features of an area.