Ballynafagh Bog (SAC 000391), Co. Kildare

Executive Summary

This survey, carried out in September 2011, aimed to assess the conservation status of habitats listed on Annex I of the European Habitats Directive (92/43EEC) on the high bog at Ballynafagh Bog. Vegetation was described and mapped based on raised bog ecotope vegetation community complexes (Kelly and Schouten, 2002). The following Annex I habitats occur: Active Raised Bog, Degraded Raised Bog and Depressions on peat substrates of the Rhynchosporion.

Active Raised Bog covers 6.48ha (9.25%) of the high bog area. The highest quality example of Active Raised Bog consists of *Sphagnum* lawns, pools, hummocks and hollows. *Sphagnum* cover reaches 100% in certain locations.

Degraded Raised Bog covers 63.58ha (90.75%) of the high bog area. It is drier than Active Raised Bog and supports a lower density of *Sphagnum* mosses. It has a less developed micro-topography while permanent pools and *Sphagnum* lawns are generally absent.

Depressions on peat substrates of the Rhynchosporion are found in both Active and Degraded Raised Bog, but tended to be best developed and most stable in the wettest areas of Active Raised Bog.

Although no physical restoration management actions such as drain blocking have been carried out at the site, the NPWS has engaged in negotiation with landowners. Some turbary and ownership rights have been bought and this has contributed to the fact that peat cutting no longer takes places at Ballynafagh Bog.

The current conservation objective for Ballynafagh Bog is to restore the area of Active Raised Bog to the area present when the Habitats Directive came into force in 1994. In the case of Active Raised Bog, the objective also includes the restoration of all of the sub-marginal ecotope present at the time as this represents the area of Degraded Raised Bog most technically feasible to restore. The Area objective for Active Raised Bog is 42.16ha. The

objective in relation to Structure and Functions (S&Fs) is that at least half of the Active Raised Bog area should be made up of the central ecotope and active flush (i.e. the wetter vegetation communities). These values have been set as Favourable Reference Values or FRVs until more site specific values can be set based on hydrological and topographical studies. The objective for Degraded Raised Bog is for the sub-marginal area to be restored to active peat forming communities as stated above and that no loss or degradation of any kind occurs. Although FRVs could not be established for the Rhynchosporion depressions, the objectives are to increase its extent and improve its quality to values associated with a favourable conservation status of Active Raised Bog. Therefore, the habitat's objectives are indirectly associated with Active Raised Bog objectives.

There has been a slight increase in the area of Active Raised Bog (0.11ha) at Ballynafagh Bog in the 2004 to 2011 period. This appears to be the result of the expansion of active peat forming vegetation towards the conifer plantation as the drains in this area are becoming in-filled. This area seems to control drainage from the area of Active Raised Bog. Two new peat forming areas have been described at the site while one area has disappeared. These changes are likely to be the result of more comprehensive field mapping rather than actual changes.

A large block of a *Pinus contorta* plantation occurs on the north-west of the high bog. Cutover drains are present along the entire perimeter of the high bog and together with drains on the high bog, the majority of which are either functional (2.85km) or reduced functional (1.34km), are negatively impacting activity on Active Raised Bog at the site. A fire in May 2011 damaged 69% of the high bog area. Peat cutting no longer takes place at the site, but open face banks continue to drain the high bog.

Active Raised Bog has been given an overall **Unfavourable Bad-Improving** conservation status assessment. Habitat Area has slightly increased and quality remained Stable in the reporting period. However, both are below favourable reference values. Future Prospects are considered Unfavourable Bad-Stable as high bog and cutover drainage continue to hinder the restoration of peat forming communities.

Degraded Raised Bog has been given an overall **Unfavourable Bad-Declining** conservation status assessment.

Rhynchosporion depressions has been given an overall **Unfavourable Bad-Stable** conservation status assessment as there has been no further drying of the high bog.

The **overall raised bog** at Ballynafagh SAC has been given an **Unfavourable Bad-Improving** assessment**.**

A series of **recommendations** have been also given, these include: the removal of the conifer plantation, restoration works to block high bog (and possibly cutover) drains, further hydrological and topographical studies to ascertain more accurate FRVs; further botanical monitoring surveys on the high bog and an impact assessment of maintenance works on adjacent land drainage with a view to the potential of blocking these drains.

Site identification

SAC Site Code	000391	**6" Sheet:**	314
Grid Reference:	E 281500 / N 228000	**1:50,000 Sheet:**	49
High Bog area (ha)[1]:	70.06ha		
Dates of Visit:	09/09/11		
Townlands:	Ballynafagh and Downings North		

Site location

Ballynafagh Bog is located approximately 3 km north-northwest of the town of Prosperous, Co. Kildare. The site may be entered by road at the northeast, south and west of the bog. The main Clane to Allenwood road runs east/west by the southern side of the site.

Description of the survey

The survey was carried out in September 2011 and involved a vegetation survey of the high bog at Ballynafagh Bog and the recording of impacting activities affecting high bog vegetation. A similar survey was carried out in 2004 by Fernandez *et al*. (2005). High bog vegetation was described and mapped, based on raised bog ecotope vegetation community complexes developed by Kelly *et al*. (1995). Detailed notes were taken on each community complex and any flushed areas that were present. These included: species lists; estimation of % cover of dominant species; percentage *Sphagnum* cover; evidence of damage (due to burning, peat cutting or drainage); micro-topography; ground firmness; and presence of *Cladonia* species. A list of photographical records is given in Appendix II. The survey aimed to assess the conservation status of Habitats Directive (Council Directive 92/43/EEC) Annex I habitats on the high bog.

The entire high bog of Ballynafagh Bog was re-surveyed. Sections mapped as sub-marginal, sub-central and central ecotope in 2004 were surveyed in more detail. These are the areas where changes

1 This figure is slightly smaller than the one given in 2004, as a result of improvement on mapping accuracy; based on 2010 aerial photography.

were likely to have occurred. Quadrats, which describe the micro-topographical features and indicator species, recorded in the 2004 project (Fernandez *et al*. 2005) were re-surveyed and additional quadrats were recorded where necessary (see Appendix III). The size of quadrats was 4m x 4m.

A GeoExplorer handheld GPS minicomputer (Trimble GeoXT) was used in the field to record quadrats, ecotope boundaries, location of vegetation complexes and other points of interest. The GPS positions of these features were logged and stored on Terrasync software (Trimble). Additional comments were stored as text fields in the device. Post processing of data was carried out, based on the Active GPS Network from Ordnance Survey Ireland, to obtain sub-metre accuracy of the data.

A digital vector format ecotope vegetation map was produced based on the spatial data collected during the survey using ArcGIS 9.3 and 2010 aerial photography. The Irish National Grid was used as the co-ordinate reference system. Vegetation complex and ecotope maps are given in Appendix IV.

Description of the high bog

This bog has been classified as a small basin raised bog and as a Midland (eastern) type raised bog (Cross 1990). This bog has also been classified geomorphologically as a basin bog by Kelly *et al*. (1995) and is surrounded by hills on three sides. This bog has a regular oval shape with an additional lobe to the south-west and is surrounded by cutover bog. There is a block of conifer forestry on the high bog in the north-west section occupying about 20% of the main high bog area. The high bog is elongated in a west-east direction, where it is approximately 1km long, while it averages only 700m in a north-south direction.

Ecological information

Raised Bog Annex I (Habitats Directive (92/43/EEC)) habitats

The following Raised Bog EU Annex I habitats, are found in Ballynafagh Bog:

- Active Raised Bog (EU code 7110),
- Degraded Raised Bog (EU code 7120) and
- Depressions on peat substrates of the Rhynchosporion (EU code 7150).

Active Raised Bog (7110)

The current area of Active Raised Bog at Ballynafagh Bog is 6.48 ha (9.25% of the high bog), which is a decrease of 15.25ha since 1994.

Active Raised Bog includes central and sub-central ecotope.

Central ecotope was found in Ballynafagh Bog at one location (**C1**) and sub-central ecotope at four locations (**Sc1** to **Sc4**) (see Appendix IV, Map 1). The highest quality Active Raised Bog sections consist of central ecotope (vegetation community complex 10/15) in a depressed area featuring hummocks, lawns, hollows and pools (<10%). *Sphagnum* cover ranges from 91-100% and consists of *Sphagnum capillifolium* subsp. *rubellum* and *S. austinii* hummocks, *S. magellanicum* and occasionally *S. papillosum* in lawns and low hummocks and *S. cuspidatum* in pools. The presence of central ecotope here is related to subsidence, probably caused by the drain that runs through this area.

There are four areas of sub-central ecotope, one (**Sc1**) surrounding the central ecotope and three (**Sc2, Sc3** & **Sc4**) other small isolated patches. Complex 9/10 is the most widespread complex within sub-central ecotope and most of this was burnt in 2011. *Sphagnum papillosum* dominates the *Sphagnum* layer, with *S. cuspidatum*, *S. capillifolium* subsp. *rubellum*, *S. magellanicum*, *S. austinii* and *S. subnitens* also present.

Degraded Raised Bog (7120)

The current area of Degraded Raised Bog at Ballynafagh Bog is 63.58ha (90.75% of the high bog).

Degraded Raised Bog includes the sub-marginal, marginal and face bank ecotope, as well as the conifer plantation growing on the high bog. Although some areas of Degraded Raised Bog have a relatively well-developed raised bog flora, they are affected by water loss to varying degrees, and are usually devoid of permanent pools.

The sub-marginal ecotope features the most developed micro-topography within Degraded Raised Bog, with a higher presence of hummocks and hollows than marginal ecotope. Most of the Degraded Raised Bog was burned in May 2011 and thus large areas were dominated by *Narthecium ossifragum* at the time of the survey. *Sphagnum* cover reaches cover values of up to 40% and mostly consists of *S. capillifolium* subsp. *rubellum*. However, *S. papillosum*, *S. magellanicum*, *S. tenellum*, *S. subnitens* and *S. cuspidatum* are also present. Very occasionally *S. austinii* hummocks are found. *Calluna vulgaris*, *Erica tetralix*, *Eriophorum vaginatum*, *E. angustifolium*, *Rhynchospora alba* and *Trichophorum germanicum* are also common at various degrees of coverage.

Marginal ecotope is slightly drier than sub-marginal ecotope and mainly occurs as a narrow band near the margins of the high bog. The micro-topography consists of *Calluna vulgaris* hummocks, low *Sphagnum* hummocks, flats and very occasionally hollows. The *Sphagnum* cover is even lower here than in the sub-marginal ecotope (<10%) and the vegetation is characterised by higher cover of *N. ossifragum*, *T. germanicum* and *C. vulgaris*.

Face bank ecotope is characterised by firm ground, tall *C. vulgaris*, poor *Sphagnum* cover and flat micro-topography.

A relatively large section of the high bog has been planted with a *Pinus contorta* plantation.

Depressions on peat substrates of the Rhynchosporion (7150)

Rhynchosporion vegetation is widespread on Ballynafagh Bog. It is found in both Active and Degraded Raised Bog, but tends to be best developed and most stable in the wettest areas of Active Raised Bog. In these areas, the Rhynchosporion vegetation occurs along pool edges and on lawns underlain by deep, wet and quaking peat. Typical plant species include *Rhynchospora alba*, *Sphagnum cuspidatum, S. magellanicum, S. papillosum*, *Drosera intermedia* and *Eriophorum angustifolium*.

R. alba was also found within degraded raised bog, but always associated with wet features such as hollows.

Detailed vegetation description of the high bog

A detailed description of high bog vegetation recorded during the 2011 survey of Ballynafagh Bog is given in Appendix I. Vegetation is divided into a number of community complexes, which are listed and described based on the dominant species. These community complexes are grouped into ecotope types. The distribution of the ecotopes is shown on the ecotope map (Appendix IV, Map 1). The community complexes are shown on the community complex map (Appendix IV, Map 2) and the quadrat details are given in Appendix III and their location in Appendix IV (Map 1).

Impacting activities

Table 6.1 below provides a list of activities impacting high bog vegetation at Ballynafagh Bog, according to their occurrence on the high bog or adjacent to the high bog; area or length affected, and whether they influence negatively (i.e. drainage, peat extraction) or positively (i.e. restoration works):

Table 6.1 Impacting activities

Code	Activity	Ranking	Influence	Area (ha) /Length(km) affected	Location	Habitat affected
C01.03	Peat extraction	H	-1	0.77ha cut away	Approx. 25 different locations (plots); 2 of them within southern lobe	**7120**
C01.03	Peat extraction	L	-1	0.77ha cut away	""	**7110/7150**
J02.07	Drainage	M	-1	4.192km [1]	On HB	**7110/7120/7150**
J02.07	Drainage	M	-1	n/av	Adjacent to HB	**7110/7120/7150**
J01	Fire	M	-1	48.37ha	On HB	**7110/7120/7150**
I01	Invasive alien species	L	-1	<0.05ha	On HB	**7110/7120/7150**
B	Afforestation and forestry management	M	-1	10.84ha	On HB	**7110/7120/7150**
G01.03	Motorised vehicles	L	-1	<0.05ha	On HB	**7110/7120/7150**

HB: High Bog; Ranking: H: High importance/impact; M: Medium importance/impact; L: Low importance/impact.

[1] This figure only includes functional and reduce-functional drains.

n/a: not applicable, n/av: not available

Peat cutting

Although peat cutting has apparently ceased at Ballynafagh Bog recently, it has reduced the area of the high bog by 0.77ha in the 2005-2011 period. In addition, old face banks and drainage (both on the high bog and on the cutover) associated with past cutting continue to cause negative impacts on the high bog habitats. Information from the NPWS indicates that peat cutting has not taken place in 2011-13.

This activity is considered to have a high direct importance/impact on Degraded Raised Bog and a low indirect importance/ impact on Active Raised Bog and Rhynchosporion depressions.

Drainage

High bog drainage

The majority of drains on the high bog remain functional (2.85km) or reduced functional (1.34km). Running water (flowing sometimes rapidly off the high bog) was noted in the following drains: bA1, bA2, bA3, bA4; bE, bG1 (where water flow was particularly fast), bG3 & bG5. These drains are all classed as functional and are found along the north and north-east margin of the high bog. There are also numerous functional drains along the southern margin of the high bog and some of the reduced functional drains are also impacting on the high bog habitats and will continue to do so until they are blocked and/or become completely in-filled and thus non-functional.

The length of drains within the conifer plantation has not been estimated and therefore is not included in table 6.2 below. They also pose a serious threat to the high bog habitats and will hinder the recovery of Active Raised Bog. The decrease in the length of functional (98m) and reduced functional drains (17m) shown in Table 6.2 is due to peat cutting.

High bog drainage is considered to have medium importance/impact on high bog habitats and is hindering the recovery of Active Raised Bog.

Table 6.2 High bog drainage summary

Status	**2004 (km)** [1]	**2011 (km)**	**Change**
NB: functional	2.949	2.851	0.098
NB: reduced functional	1.358	1.341	0.017
NB: non- functional	0.972	0.972	0.000
B: functional	n/a	n/a	n/a
B: reduced functional	n/a	n/a	n/a
B: non- functional	n/a	n/a	n/a

B: Blocked; NB: Not blocked n/a: not applicable

[1] High bog drainage has been revised (e.g. re-digitised in cases) and figures above may vary slightly from those given by Fernandez *et al*. (2005)

Table 6.3 below provides a more detail description of the drainage present on the high bog at Ballynafagh including any change in their functionality in the 2004 – 2011 reporting period (see Map 3).

Table 6.3 High bog drainage detail

Drain Name	Length (km)	2004 status	2011 status	Change	Comment
bA1	0.075	NB: reduced functional	NB: functional	No	Wrongly classified as reduced-functional in 2004. Running water recorded.
bA2-bA5	0.455	NB: functional	NB: functional	No	Running water recorded at bA2,bA3&bA4
bB1-bB2	0.694	NB: reduced functional	NB: reduced functional	No	
bB3	0.346	NB: functional	NB: functional	No	
bB4	0.219	NB: reduced functional	NB: reduced functional	No	
bB4	0.136	NB: functional	NB: functional	No	Section near high bog edge functional
bC	0.146	NB: reduced functional	NB: reduced functional	No	
bC	0.123	NB: functional	NB: functional	No	Section near high bog edge functional
bD	0.111	NB: non-functional	NB: non-functional	No	
bD	0.069	NB: functional	NB: functional	No	Section near high bog edge functional
bE	0.206	NB: non-functional	NB: non-functional	No	
bE	0.112	NB: functional	NB: functional	No	Section near high bog edge functional; running water recorded

bF	0.282	NB: reduced functional	NB: reduced functional	No	Drain already present in 2004 but not mapped
bG1-bG5	0.244	NB: functional	NB: functional	No	Running water noted being particularly fast at bG1
bH1-bH7	0.868	NB: functional	NB: functional	No	
bJ	0.655	NB: non-functional	NB: non-functional	No	
D1-D7	0.423	NB: functional	NB: functional	No	

Bog margin drainage

The cutover areas were not surveyed for drains during 2011. Cutover drains are present along the entire perimeter of the high bog and are continuing to drain it, thus impacting on the high bog habitats.

The Slate River, which forms the south eastern boundary of the site, has been regularly maintained under notifiable action during 2004-2011 period. This has involved the removal of plant growth but no deepening or widening (Flynn, C., pers. comm., 2012).

Bog margin drainage is considered to have medium importance/impact on high bog habitats and is hindering the recovery of Active Raised Bog.

Fire history

A recent burn (2nd May 2011) damaged 69% of the high bog area (48.37ha) and almost the entire northern lobe. This fire event also damaged the edge of the high bog conifer plantation. It is also likely to have encouraged the germination of pine seeds as the abundance of pine seedlings at the edge of the plantation suggests.

Burning is considered to have medium importance/impact on high bog habitats.

Invasive species

Invasive species do not pose a serious threat to the high bog habitats apart from the conifer plantations described within 6.5.

Fernandez *et al*. (2005) described several *Ulex europaeus* bushes in marginal ecotope areas of the high bog. Some of these occur on large mounds (GR 281698/228131), which are man-made and associated with drainage works (Drain bA4). Fernandez *et al*. (2005) also mentioned a colony of *Sarracenia purpurea* on the cutover bog to the north-west of the high bog (GR 281623/228302). This was described as consisting of a large central colony 0.5 m wide surrounded by frequent small satellite plants in an area 10m in diameter. This area was not re-visited in 2011.

Invasive species are considered to have low intensity/impact on high bog habitats.

Afforestation and forestry management

A large (10.02ha) block of *Pinus contorta* forestry occurs on the northwest of high bog. Trees are approximately 7-9 m tall and primary thinning has not taken place yet. The high bog surface is particularly wet in certain location within the plantation, such as the area near the central ecotope, and *Sphagnum* growth here was good.

Another three smaller patches (0.82ha) of conifer stands are found on the high bog (see Map 1).

Conifer forestry also occurs on some of the cutover bog adjacent to the block of forestry on the high bog and in a large block to the north of the high bog.

This plantation and the drainage associated with it are considered to have a medium impact on the high bog habitats and are hindering the recovery of Active Raised Bog.

Other impacting activities

Motorised vehicles tracks were noted across the southern high bog section. Fernandez *et al*. (2005) mentioned that access is reached from the south-west corner of the high bog. These tracks and access points are used regularly and the high bog surface is compacted in places. This activity is considered to have low intensity/impact on high bog habitats.

Conservation activities

Although no physical management actions such as blocking of drains or the removal of the conifer plantation have been carried out at the site, the NPWS have engaged in negotiation with landowners. Turbary rights and ownership rights of various turf-cutting plots around the bog have been bought and this has contributed to the fact that peat cutting no longer takes place at Ballynafagh Bog.

Conservation status assessment

The assessment of the conservation status of Annex I Active and Degraded Raised Bog is based on the following(a more detailed description of conservation status assessment methods is given within the methods section of the project's Summary Report (Volume 1) :

AREA - comparison of current habitat area with favourable reference values and its change in the reporting period to assess trends.

STRUCTURE & FUNCTION - comparison of central ecotope and active flush area (i.e. the higher quality wetter vegetation communities) for Active Raised Bog, and marginal and face bank ecotope area (i.e. the lower quality and drier vegetation communities) for Degraded Raised Bog against favourable reference values to assess their status and changes in their area in the reporting period to assess their trend. Community complex descriptions were also taken into account to evaluate changes in ecotope quality together with an analysis of the indicators recorded in the quadrats.

FUTURE PROSPECTS - an assessment of the influence of current and future activities both negative and positive (e.g. restoration works) affecting these habitats. Future Prospects for Active and Degraded Raised Bog are assessed at status and trend level based on the prospects for the habitat to reach favourable reference values in a two reporting period (12 years).

Active Raised Bog (7110)

Area

Table 8.1 indicates that there has been a slight increase (0.11ha) in the area of Active Raised Bog.

Central ecotope area is considered not to have changed in the reporting period and the discrepancy (0.12ha) between the 2004 (not amended) and the 2011 figures is due to the fact that a more comprehensive survey was completed in 2011, which resulted in more accurate mapping and thus an improved ecotope map.

Sub-central ecotope has expanded in the western section of **Sc1** to the south of the conifer plantation. The drains in the conifer plantation are blocking up (i.e. infilling) (Ryan pers. comm., 2011) and as a result some of the adjacent sections are re-wetting, encouraging the development of sub-central ecotope at **Sc1** (see Map 1).

Former **Sc3** (recorded in 2004) is now considered to be sub-marginal ecotope but this is the result of a reinterpretation of vegetation data rather than an actual change (only one sub-central dot was recorded there in 2004).

A new **Sc3** has been reported in 2011, in a depression along the southern section of high bog. This is likely to be the result of a more comprehensive survey (rather than an actual change on the ground), which resulted in a more accurate mapping.

Another new area of sub-central (**Sc4**) was also recorded in 2011 in the north of the site. This too is located in a depression and is also likely to have already been present in 2004. It is thus considered to be the result of a more comprehensive survey rather than an actual change on the ground.

The favourable reference value (FRV) for Area is considered to be the sum of Active Raised Bog (central, sub-central ecotopes and active flush) plus sub-marginal ecotope when the Habitats Directive came into force in 1994 (see table 8.4). In the particular case of Ballynafagh 10ha of conifer plantation have also been included (some of the ground under the conifer plantation is very wet and features a high *Sphagnum* cover) within the FRV. On the other hand, and the sub-marginal ecotope (2.38ha) within the southern lobe has not been included. Therefore, Active Raised Bog Area FRV is 42.16ha (based on 1994 Kelly (1995) figures amended by Fernandez *et al.* (2005), see tables 8.1 and 8.3 below). This FRV is only approximate until further hydrological and topographical studies are carried out in order to assess the maximum potential capacity of the high bog to support Active Raised Bog. The current habitat Area value (6.48ha) is 84.63% below the FRV. A current Area value more than 15% below FRV falls into the **Unfavourable Bad** assessment category.

Active Raised Bog would not reach a favourable assessment until its area reaches the FRV. The current characteristics of the high bog at Ballynafagh Bog (i.e. steep slopes caused by peat cutting and drainage) make the development of the targeted Active Raised Bog FRV on the high bog difficult. Active Raised Bog has little possibilities of developing on the southern lobe. Thus, the cutover would need to play an essential role in the development and expansion of Active Raised Bog at the site.

A long term (1994/5-2011) trend indicates a reduction on the area of Active Raised Bog at the site (15.24ha) (see table 8.1). A more recent and short term trend analysis (7 years; 2004-2011) gives a more optimistic result with a slight increase (0.11ha) in its area. Therefore, the habitat Area is given an **Increasing** trend assessment.

The Area of Active Raised Bog at Ballynafagh Bog is assessed as Unfavourable Bad-Increasing (see table 8.5).

Structure & Functions

The FRV for S&Fs is for at least half of the Active Raised Bog area to be made up of central and active flush, i.e. the higher quality wetter vegetation communities. This value is 3.24ha (half of 6.28ha, the current area of ARB). The current value is 1.77ha which is 45.37% below the FRV. A current value more than 25% below FRV falls into the **Unfavourable Bad** assessment category.

A long term (1994/5-2011) trend indicates a decrease of the area of central ecotope at the site (3.23ha) (see table 8.1). A more recent and short term trend analysis (7 years; 2004-2011) shows no change. Therefore, S&Fs are given a **Stable** trend assessment.

Quadrats analysis (**Qc1, Qsc1** and **Qsc2**) indicates the following:

Qc1: The total *Sphagnum* cover (76-90%) has not changed from 2004-2011 and overall the quadrats appear very similar. Neither has the *Sphagnum* composition changed with *S. magellanicum* still the dominant *Sphagnum* (at 51-75% cover). There has though been a slight decrease in the cover of *S. papillosum* (from 11-25% in 2004 to 4-10% in 2011). Other differences include a slight decrease in the pool cover (11-25% in 2004 compared to 4-10% in 2011). Further slight differences, which are likely to have occurred as a result of the fire in May 2011 include an increase in the cover of *Narthecium ossifragum* ('absent' in 2004 to 1-3% in 2011)and *Rhynchospora alba* (4-10% in 2004 to 11-25% in 2011) and a decrease in the height of *Calluna vulgaris* (11-20cm in 2004 to 0-10cm in 2011). However, overall these quadrats are very similar and any differences may merely be the result of lack of precision in relocating of the quadrat (up to 2m) between both year surveys, rather than an actual change.

Qsc1: Although the total *Sphagnum* cover has increased from 51-75% in 2004 to 76-90% in 2011, the quadrats appear quite similar overall. This increase has occurred in *Sphagnum* hummocks (from 51-75% in 2004 to 76-90% in 2011) while *Sphagnum* pools have decreased (4-10% in 2004 to 'absent' in 2011). In term of species, *S. papillosum* (26-33% in 2004 to 51-75% in 2011) and *S. subnitens* ('absent' in 2004 to 1-3% in 2011) have increased in cover, while there has been a slight decrease in the cover of *S. capillifolium* subsp. *rubellum* (11-25% in 2005 to 4-10% in 2011), *S. magellanicum* (11-25% in 2004 to 1-3% in 2011) and *S. austinii* (4-10% in 2004 to 'absent' in 2011). In addition because of the fire, there has been a decrease in the height of *Calluna vulgaris* (11-20cm in 2004 to 0-10cm in 2011). However, overall these quadrats are similar and any differences may merely be the result of lack of precision in relocating of the quadrat (up to 2m) between both year surveys, rather than an actual change.

Qsc2: Although the total *Sphagnum* cover has increased from 51-75% in 2004 to 76-90% in 2011, the quadrats appear quite similar overall. This increase has occurred in *Sphagnum* hummocks (from 34-50% in 2004 to 51-75% in 2011) and *Sphagnum* hollows (4-10% in 2004 to 11-25% in 2011) while *Sphagnum* pools have decreased (4-10% in 2004 to 'absent' in 2011). In term of species, *S. papillosum* has increased in cover (26-33% in 2004 to 34-50% in 2011) while there has been a slight decrease in the cover of *S. capillifolium* subsp. *rubellum* (11-25% in 2005 to 4-10% in 2011) and *S. magellanicum* (4-10% in 2004 to 1-3% in 2011). Further differences include an increase in the cover of *Rhynchospora alba* (4-10% in 2004 to 11-25% in 2011) and a decrease in the cover (34-50% in 2004 to 4-10% in 2011) and height (21-30cm in 2004 to 0-10cm in 2011) of *Calluna vulgaris*. However, overall these quadrats are similar and any differences may merely be the result of lack of precision in relocating of the quadrat (up to 2m) between both year surveys, rather than an actual change.

Typical good quality indicators and typical plant species are still found in sub-central and central ecotopes throughout the entire bog. No major changes of their occurrence within quadrats (**Qc1**, **Qsc1** & **Qsc2**) have taken place (see Appendix III).

The Structure & Functions of Active Raised Bog at Ballynafagh Bog are assessed as Unfavourable Bad-Stable (see table 8.5).

Future Prospects

Impacting activities such as drainage, forestry plantations and peat cutting (face banks remain open and draining the high bog, despite the cessation of cutting) continue to negatively impact on the habitat. Ballynafagh Bog features a high proportion of Active Raised Bog for its overall high bog area. The habitat, mostly located a depression in the middle of the high bog, seems to have been protected from major damage from the impacting activities listed above by the presence of mineral ridges under the high bog surface and surrounding the Active Raised Bog (see Map 1).

Habitat **Area** is currently 84.63% below FRV (see table 8.4). Impacting activities continue to have a negative influence on the habitat and hinder the development of further Active Raised Bog. The slight increase in the 2004-2011 period is considered to be the result of the natural infilling of drains under the conifer plantation. Therefore a Stable trend is foreseen. The habitat Area is expected to be more than 15% below FRV in the following two reporting periods (12 years). Thus, habitat's **Area Future Prospects** are assessed as **Unfavourable Bad-Stable**. Habitat's **S&Fs** are currently 45.37% below FRV (see table 8.4) and a Stable trend is also foreseen. Therefore S&Fs are expected to more than 25% below FRV in the following two reporting periods. Thus, **S&Fs Future Prospects** are

assessed as **Unfavourable Bad-Stable**. **The overall habitat's Future Prospects are Unfavourable Bad-Stable** (see table 8.5).

Blocking of the remaining functional and reduced-functional drains (including those under the conifer plantation), as well as removal of the conifer plantation both on the high bog and the cutover, is essential to reach FRV. Cutover areas (particularly the western and northern) will play a major role in the restoration of the habitat as current characteristics of the high bog (i.e. small size, steep slopes caused by cutting and drainage) may make it difficult to regenerate Active Raised Bog on the remainder of the high bog.

The overall conservation status of Active Raised Bog at Ballynafagh Bog is assessed as Unfavourable Bad-Stable (see table 8.5).

Table 8.1 Changes in Active Raised Bog area

Active Ecotopes	**1994/5** [1]	**2004** [2]	**2004 (amended)**	**2011**	**Change (2004-2011)**	
	Area (ha)	**Area (ha)**	**Area (ha)**	**Area (ha)**	**Area (ha)**	**%**
Central	5.00	1.65	1.77	1.77	0.00	0.00
Sub-central	16.73	4.78	4.60	4.71	(+)0.11	(+)2.39
Total	**21.72**	**6.43**	**6.37**	**6.48**	**(+)0.11**	**(+)1.73**

[1] These are the figures calculated from the vegetation map drawn by Kelly *et al*., (1995) that was geo-referenced and digitised as part of Fernandez *et al*. (2005) project.

[2] 2004 figures have been slightly modified based on a more accurately mapped high bog boundary undertaken as part of this project. This has mostly affected face bank ecotope figures.

Note: Table 8.1 includes 2004 figures and 2004 amended figures. The latter shows the ecotope area believed to be present in 2004 after surveying improvements in 2011. The comparison between 2004 (amended) and 2011 illustrates the actual changes in ecotope area in the 2004-2011 period. Any change in ecotope area between the 2004 and the 2004 (amended) values is due to improvement in mapping accuracy and/or the result of a more comprehensive survey in 2011 (see table 8.2 for further detail).

Table 8.2 Assessment of changes in individual Active Raised Bog areas

Area	**Quadrats**	**Trend**	**Comment**	**Quadrats analysis**
C1	Qc1	Stable	Slight changes as a result of more comprehensive surveying in 2011 which resulted in a more accurate mapping.	**Qc1**: The 2004 and 2011 quadrats are very similar with the total *Sphagnum* cover not changing from 2004 to 2011.

				Neither has the *Sphagnum* composition changed with *S. magellanicum* still the dominant *Sphagnum* although there has been a slight decrease in the cover of *S. papillosum*.
Sc1	Qsc1,Qsc2	Stable (expanding in the west)	Slight changes as a result of more comprehensive surveying in 2011 which resulted in a more accurate mapping. However, the western section (south of conifer plantation) has expanded due to re-wetting associated with infilling of drains within conifer plantation.	**Qsc1 & Qsc2**: The 2004 and 2011 quadrats are similar although the slight increase in the total *Sphagnum* cover suggests that there may have been a slight improvement in the quality of the Active Raised Bog. There was a slight increase in the cover of *S. papillosum* and *S. subnitens* and a slight decrease in the cover of *S. capillifolium* subsp. *rubellum*, *S. magellanicum* and *S. austinii.*
Sc2	None	Stable	Slightly smaller than mapped in 2004. This change is the result of more comprehensive surveying in 2011 which resulted in a more accurate mapping.	
Sc3	None	Unknown	This specific area was not surveyed in 2004. This is likely to be the result of more comprehensive surveying in 2011 which resulted in a more accurate mapping.	
Sc4	None	Unknown (possibly getting wetter)	Only one sub-marginal dot was recorded within this complex in 2004. This was complex 9/7 (borderline sub-marginal/sub-central complex). Thus, although this is a 'new' area of sub-central, it is likely to be the result of more comprehensive surveying in 2011 which resulted in a more accurate mapping rather than an actual change on the ground.	

Degraded Raised Bog (7120)

Area

The Degraded Raised Bog FRV for Area is 27.90ha at Ballynafagh Bog. This value corresponds with the difference between the current high bog area (70.6ha) and Active Raised Bog FRV (42.16ha) for area. Degraded Raised Bog is a particular habitat type, for which FRV smaller than the current value, may be desirable in many sites. However any decrease in habitat area would only be considered positive, when it is the result of restoration to Active Raised Bog. Current habitat area is 127.89% bigger than FRV and therefore the habitat Area is given an **Unfavourable Bad** assessment (see table 8.5).

Table 8.3 indicates that there has been a reduction on the area of Degraded Raised Bog of 1.02ha. 0.77ha have been lost as a result of peat cutting. Therefore the habitat is given a **Decreasing** trend.

The Area of Degraded Raised Bog at Ballynafagh Bog is assessed as Unfavourable Bad-Decreasing (see table 8.5).

Structure & Functions

The FRV for S&Fs is for a maximum 25% of the Degraded Raised Bog area to be made up of marginal and face bank, i.e. the lower quality and drier vegetation communities. This value is 15.90ha (25% of 63.58ha, the current area of Degraded Raised Bog). The current marginal and face bank ecotopes area value (27.96ha) is 75.90% above the FRV (in the particular case of Degraded Raised Bog a current area value equal or smaller than FRV is desirable) (see Table 8.4). A current value more than 25% above FRV falls into the **Unfavourable Bad** assessment category.

As table 8.3 indicates, the area of sub-marginal, marginal and face bank ecotope have slightly decreased. A small portion of these changes are due to improvement to sub-central ecotope. However, some of the changes are due to losses caused by peat cutting. S&Fs trend is assessed based on actual changes within marginal and face banks ecotope (e.g. decreases due to rewetting processes or increases as a result of further drying out). Thus, the DRB's S&Fs at Ballynafagh Bog are given a **Stable** trend.

The mapping of boundary between marginal and sub marginal is difficult and decreases are only recorded where major changes in the vegetation are evident. Therefore, where no changes are shown, more subtle negative effects cannot be ruled out, and therefore negative changes may have

been underestimated. The basic assumption is that were peat cutting has taken place subsidence will occur and will continue for some decades and this will dry out the adjacent areas of the bog

The new ecotopes map (Map I) shows a few new marginal ecotope ridges along the southern section of high bog. These ridges were not mapped in 2004. This is the result of a more comprehensive surveying in 2011.

Sub-marginal ecotope stretches as far as high bog edge at GR 228059 / 281199 to the west of the conifer plantation. This indicates some sort of water runoff coming from the western section of the high bog towards the western cutover.

The Structure & functions of Degraded Raised Bog at Ballynafagh Bog are assessed as Unfavourable Bad-Stable (see table 8.5).

Future Prospects

Impacting activities such as drainage, forestry plantations and peat cutting (face banks remain open and draining the high bog, despite the cessation of cutting) continue to negatively impact the habitat. However, no major changes have taken place in the reporting period and peat cutting is no longer taking place. Habitat **Area** is currently 127.89% above FRV (see table 8.4) and a Stable trend is expected in the following two reporting periods (12 years). As a result habitat Area is expected to remain more than 15% above FRV. Thus, habitat's **Area Future Prospects** are assessed as **Unfavourable Bad-Stable**. Habitat's **S&Fs** are currently 75.90% above FRV (see table 8.4). A Stable trend is foreseen in the following two reporting periods, **S&Fs** are expected to remain more than 25% above FRV. Thus, habitat's **S&Fs Future Prospects** are assessed as **Unfavourable Bad-Stable**.

Therefore the Future Prospects for Degraded Raised Bog are considered Unfavourable Bad-Stable (see table 8.5) until restoration works are undertaken.

The overall conservation status of Degraded Raised Bog at Ballynafagh Bog is assessed as Unfavourable Bad-Declining (see table 8.5).

Table 8.3 Changes in Degraded Raised Bog area

Inactive Ecotopes	**1994/5** [1]	**2004** [2]	**2004 (amended)**	**2011**	**Change (2004-2011)**	
	Area (ha)	**Area (ha)**	**Area (ha)**	**Area (ha)**	**Area (ha)**	**%**
Sub-marginal	12.81	23.84	24.89	24.78	(-)0.11	(-)0.44
Marginal	16.85	24.57	23.90	23.26	(-)0.64	(-)2.68

Face bank	na	5.29	4.97	4.70	(-)0.27	(-)5.43
Conifer plantation	13.10	10.70	10.84	10.84	0.00	0.00
Total	**42.76**	**64.4**	**64.6**	**63.58**	**(-)1.02**	**(-)1.58**

[1] These are the figures calculated from the vegetation map drawn by Kelly *et al.,* (1995) that was geo-referenced and digitised as part of Fernandez *et al*. (2005) project.

[2] 2004 figures have been slightly modified based on a more accurately mapped high bog boundary undertaken as part of this project. This has mostly affected face bank ecotope figures.

Note: Table 8.1 includes 2004 figures and 2004 amended figures. The latter shows the ecotope area believed to be present in 2004 after surveying improvements in 2011. The comparison between 2004 (amended) and 2011 illustrates the actual changes in ecotope area in the 2004-2011 period. Any change in ecotope area between the 2004 and the 2004 (amended) values is due to improvement in mapping accuracy and/or the result of a more comprehensive survey in 2011.

Depressions on peat substrates of the Rhynchosporion (7150)

Rhynchospora alba depressions are found across the entire bog in both Active and Degraded Raised Bog. The species is more frequently found and reaches its finest quality associated within wet features (*Sphagnum* pools, lawns and hollows) on Active Raised Bog.

The physical structure and distribution of the habitat across large sections of the high bog makes the process of calculating its area unfeasible and as a consequence makes the process of calculating realistic FRVs unfeasible. Thus, the assessment of the habitat's Area conservation status is indirectly based on the assessment of Active Raised Bog habitat Area (a favourable assessment indicates that all sub-marginal ecotope has turned Active Raised Bog). The habitat Area is given an **Unfavourable Bad** assessment.

The Area trend assessment is based on the variation on Active Raised Bog and sub-marginal ecotope within Degraded Raised Bog in the reporting period. The combined area of Active Raised Bog and sub-marginal ecotope has remained Stable in the reporting period. As result habitat Area is given a **Stable** trend.

The habitat's Area Future Prospects status is equally based on the Active Raised Bog Area Future Prospects status assessment and the Area Future Prospects trend is based on the trend expected for Active Raised Bog and sub-marginal ecotope in the following two reporting periods. Impacting activities (e.g. high bog and cutover drainage) continue to negatively impact on associated habitats (i.e. Active and Degraded Raised Bog) and although no further losses are expected no improvements are expected unless restoration works take place. As a result as Stable trend is given

to the Area Future Prospects. The habitat's Area Future Prospects are given an **Unfavourable Bad-Stable** assessment.

The S&Fs conservation assessment is also indirectly based on the Active Raised Bog S&Fs status and trend assessments, as Active Raised Bog supports the finest habitat quality type. Therefore, the habitat's S&Fs are given an **Unfavourable Bad-Stable** assessment.

The habitat's S&Fs Future Prospects status and trend are equally based on the Active Raised Bog S&Fs Future Prospects status and trend assessments in the following two reporting periods. Therefore, the habitat's S&Fs Future Prospects are given an **Unfavourable Bad-Stable** assessment.

The overall habitat's Future Prospects assessment is Unfavourable Bad-Stable.

The conservation status of depressions on peat substrates of the Rhynchosporion at Ballynafagh Bog is assessed as Unfavourable Bad-Stable (see table 8.5).

Table 8.4 Habitats favourable reference values

Habitat	Area Assessment			Structure & Functions Assessment		
	FRV Target (ha) [1]	**2011 value (ha) [2]**	**% below target**	**FRV Target 2011 (ha)[3]**	**2011 value (ha) [4]**	**% below target**
7110	42.16	6.48	84.63	3.24	1.77	45.37

[1] 1992 central, sub-central, active flush, bog woodland and sub-marginal ecotope area.
[2] 2011 central, sub-central ecotope, active flush and bog woodland area.
[3] Half of the current central, sub-central ecotope and active flush area. The target is that the area of the highest vegetation quality (i.e. central ecotope and active flush) should be at least this figure.
[4] 2011 central ecotope and active flush area.

	FRV Target (ha) [5]	**2011 value (ha) [6]**	**% above target**	**FRV 2011 Target (ha) [7]**	**2011 value (ha) [8]**	**% above target**
7120	27.90	63.58	127.89	15.90	27.96	75.90

[5] 1992 high bog area minus 7110 area FRV.
[6] 2011 Degraded Raised Bog area.
[7] 25% of the current Degraded Raised Bog habitat area. The target is that the extent of marginal and face bank ecotopes should not be larger than 25% of the current Degraded Raised Bog habitat area.
[8] Current marginal and face bank ecotopes area.

As table 8.5 below indicates, each individual EU habitat present on the high bog has been given the following overall conservation status assessment based on the three main parameters (Area, S&Fs and future prospects) individual assessments:

- **Active Raised Bog is assessed as being Unfavourable Bad-Improving.**
- **Degraded Raised Bog is assessed as being Unfavourable Bad-Declining.**
- **Rhynchosporion depressions is assessed as being Unfavourable Bad-Stable**

Table 8.5 Habitats conservation status assessments

Habitat	Area Assessment	Structure & Functions Assessment	Future Prospects Assessment	Overall Assessment
7110	Unfavourable Bad-Increasing	Unfavourable Bad-Stable	Unfavourable Bad-Stable	Unfavourable Bad-Improving
7120	Unfavourable Bad-Decreasing	Unfavourable Bad-Stable	Unfavourable Bad-Stable	Unfavourable Bad-Declining
7150	Unfavourable Bad-Stable	Unfavourable Bad-Stable	Unfavourable Bad-Stable	Unfavourable Bad-Stable

Conclusions

Summary of impacting activities

There have been no major changes in the intensity or influence of impacting activities:

- Peat cutting is no longer present at the site. However, open face banks may still continue to drain the high bog.
- The majority of drains on the high bog remain functional (2.85km) or reduced functional (1.34km) and these are considered to be having a high impact on the high bog habitats.
- Cutover drains are present along the entire perimeter of the high bog and are continuing to drain the high bog habitats
- A fire in May 2011 damaged 69% of the high bog area.
- A large block of *Pinus contorta* forestry occurs on the northwest of high bog.

Changes in active peat forming areas

- Two new peat forming areas (**Sc3** and **Sc4**) have been described at the site (see table 8.2). These are likely to be the result of improvements of mapping accuracy rather than actual changes in Active Raised Bog.
- One area of sub-central ecotope (**Sc3**) has disappeared, but again this is likely to be the result of improvements of mapping accuracy rather than actual changes in Active Raised Bog.
- The main area of Active Raised Bog (**Sc1** and **C1**) may be expanding towards the conifer plantation in the west due to infilling within the high bog conifer plantation drains, which controls drainage from the area of Active Raised Bog.

- It is believed that underlying mineral ridges have prevented drainage effects from peat cutting and drainage elsewhere on the bog from impacting on the central area of Active Raised Bog.

Other changes

- There have been no other major changes.

Quadrats analysis

- No major changes in vegetation have taken place within those quadrats recorded in 2004 that were re-surveyed in 2011 (see Appendix III).
- Although high accuracy GPS equipment was used during the 2004 and 2011 surveys, the devises still only allow up to 0.5m accuracy. The lack of precision in relocating of the quadrat may justify certain differences in the vegetation described. Permanent markers were inserted into quadrats recorded in 2011.

Restoration works

- No physical management actions such as blocking of drainage have been carried out at the site. However, the NPWS has engaged in negotiation with landowners in order to gain turbary and ownership rights of various turf-cutting plots around the bog and this has contributed to the fact that peat cutting no longer takes place at Kilcarren bog.

Summary of conservation status

- **Active Raised Bog** has been given an overall **Unfavourable Bad-Improving** conservation status at Ballynafagh Bog. Habitat Area has slightly increased and quality (S&Fs) remained Stable in the reporting period. However both values are below the FRVs. Future Prospects are considered Unfavourable Bad-Stable as high bog and cutover drainage continues to hinder the restoration to active peat forming communities.
- **Degraded Raised Bog** has been given an overall **Unfavourable Bad-Declining** conservation status at Ballynafagh Bog. Habitat Area has slightly decreased due to an increase of Active Raised Bog and a loss to peat cutting, while quality (S&Fs) has not changed in the reporting period. Habitat Area is above the FRV. Future Prospects are considered Unfavourable Bad-Stable.
- **Depressions on peat substrates of the Rhynchosporion** has been given an overall **Unfavourable Bad-Stable** conservation status at Ballynafagh Bog. Habitat Area and quality (S&Fs) are considered to have remained Stable in the reporting period. Future prospects are considered Unfavourable Bad-Stable.

The conservation status of the **overall raised bog** at **Ballynafagh bog** is assessed as being **Unfavourable Bad-Improving**.

Recommendations

- **Removal of the conifer plantation** on the cutover, but especially on the high bog
- **Further restoration works** including the blocking of any high bog functional and reduced functional drains, and possibly the cutover drains.
- **Further hydrological and topographical studies** to ascertain the capacity of the high bog to support Active Raised Bog and thus estimate a more accurate favourable reference value.
- **Further botanical monitoring surveys** on the high bog.
- An **Impact assessment of maintenance works** on adjacent land drainage with a view to the potential of blocking these drains.

References

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Kelly, L. & Schouten, M.G.C. (2002) Vegetation. In: M. G. C. Schouten (Ed.), *Conservation and Restoration of Raised Bogs: Geological, Hydrological and Ecological Studies*, pp.110-169, Department of Environment and Local Government, Dublin, Ireland/Staatabosbeheer, The Netherlands.

Appendix I Detailed vegetation description of the high bog

Active Raised Bog (7110)

Central Ecotope Complexes

COMPLEX 10/15

- **Location**: this complex dominates **C1** in the middle section of high bog.
- **Ground**: quaking
- **Physical indicators**: vegetation suffered a light burn
- ***Calluna* height**: 11-20cm
- ***Cladonia* cover**: absent
- **Macro-topography**: depression
- **Pools**: regular pools (<10%)
- ***Sphagnum* cover**: 91-100%
- ***Narthecium* cover**: <4%
- **Micro- topography**: high and low hummocks/*Sphagnum* lawns/ pools
- **Tussocks**: absent
- **Degradation or regeneration evidence**: large sections recently burnt
- **Species cover**: *Calluna vulgaris* (4-10%), *Erica tetralix* (<4%), *Eriophorum vaginatum* (<4%), *E. angustifolium* (<4%), *Narthecium ossifragum* (<4%), *Rhynchospora alba* (11-25%), *Andromeda polifolia* (<1%), *Menyanthes trifoliate* (<1%), *Drosera rotundifolia* (<1%), *D. intermedia* (<1%), *Sphagnum capillifolium subsp. rubellum* (H; 4-10%), *S. papillosum* (H; 11-25%), *S. austinii* (H;<1%), *S. magellanicum* (H& L; 50-75%), *S. cuspidatum* (P; 4-10%).
- **Additional comments**: *Sphagnum cuspidatum* pools cover increases towards the western section of this central ecotope. They become hollows at the edges of the complex, where it grades into sub-central ecotope

Quadrats **Qc1** was recorded within this complex.

Sub-Central Ecotope Complexes

COMPLEX 9/10

- **Location**: this complex dominates **Sc1, Sc2** and **Sc3**.
- **Ground**: very soft

- **Physical indicators**: bare peat (<4%), most of this complex was recently burnt.
- ***Calluna* height**: <10cm
- ***Cladonia* cover**: absent
- **Macro-topography**: depression
- **Pools**: absent
- ***Sphagnum* cover**: 51-75%
- ***Narthecium* cover**: <4%
- **Micro- topography**: low hummocks/hollows
- **Tussocks**: *Eriophorum vaginatum* (4-10%)
- **Degradation or regeneration evidence**: large sections recently burnt.
- **Species cover**: *Calluna vulgaris* (11-25%), *Erica tetralix* (<4%), *Eriophorum vaginatum* (11-25%), *E. angustifolium* (<4%), *Narthecium ossifragum* (4-10%), *Rhynchospora alba* (<4%), *Andromeda polifolia* (<1%), *Drosera rotundifolia* (<1%), *Sphagnum capillifolium subsp. rubellum* (H; <4%), *S. papillosum* (H; 26-33%), *S. magellanicum* (H; 4-10%), *S. subnitens* (H;<4%), *S. austinii* (H;<1%),*S. cuspidatum* (Hl;<4%), *Leucobryum glaucum* (<1%)
- **Additional comments**: where **Sc2** is found, *S. capillifolium subsp. rubellum, S. subnitens, S. papillosum* and *S. magellanicum* hummocks and *S. cuspidatum* hollows characterise the complex. *Leucobryum glaucum* also recorded. The area is between drains bC and bD, and it area is slightly smaller than mapped in 2004. This is likely to be the result of improvement on mapping accuracy.

Quadrats **Qsc1** and **Qsc**2 were recorded within this complex within **Sc1**.

COMPLEX 9/7/10

- **Location**: this complex dominates **Sc4**.
- **Ground**: very soft
- **Physical indicators**: bare peat (<4%)
- ***Calluna* height**: 21-30cm
- ***Cladonia* cover**: <4%
- **Macro-topography**: depression
- **Pools**: absent
- ***Sphagnum* cover**: 34-50%
- ***Narthecium* cover**: <4%
- **Micro- topography**: tall and low hummocks/hollows
- **Tussocks**: *Eriophorum vaginatum* (<4%), *Trichophorum germanicum* (<4%)

- **Degradation or regeneration evidence**: absent
- **Species cover**: *Calluna vulgaris* (11-25%), *Erica tetralix* (11-25%), *Eriophorum vaginatum* (4-10%), *E. angustifolium* (<4%), *Narthecium ossifragum* (<4%), *Trichophorum germanicum* (<4%), *Rhynchospora alba* (<4%), *Andromeda polifolia* (<1%), *Drosera rotundifolia* (<1%), *Sphagnum capillifolium subsp. rubellum* (H; 11-25%), *S. papillosum* (H; 11-25%), *S. magellanicum* (H; 4-10%), *S. subnitens* (H;<4%), *S. austinii* (H;<1%),*S. cuspidatum* (Hl;<4%).
- **Additional comments:** none.

Degraded Raised Bog (7120)

Sub-Marginal Ecotope Complexes

COMPLEX 9/7

- **Location**: this complex is found across the entire high bog and dominates the western sub-marginal ecotope areas.
- **Ground**: firm to soft
- **Physical indicators**: bare peat (11-25%), large sections of complex were recently burnt.
- ***Calluna* height**: <5cm
- ***Cladonia* cover**: absent
- **Macro-topography**: gentle to steep slope
- **Pools**: absent
- ***Sphagnum* cover**: 26-33%
- ***Narthecium* cover**: <4%
- **Micro- topography**: low hummocks/hollows
- **Tussocks**: *Eriophorum vaginatum* (4-10%)
- **Degradation or regeneration evidence**: large sections recently burnt
- **Species cover**: *Calluna vulgaris* (11-25%), *Erica tetralix* (<4%), *Eriophorum vaginatum* (4-10%), *E. angustifolium* (<4%), *Narthecium ossifragum* (<4%), *Andromeda polifolia* (<1%), *Drosera rotundifolia* (<1%), *Sphagnum capillifolium subsp. rubellum* (H; 4-10%), *S. papillosum* (H; 4-10%), *S. austinii* (H<1%), S. *magellanicum* (H;<4%), *S. tenellum* (H; <4%), *S. subnitens* (H; <4%), *S. cuspidatum* (Hl;<4%), *Leucobryum glaucum* (<1%).
- **Additional comments**: where *Narthecium ossifragum* becomes frequent the complex is named **9/7/6**.

Where this complex has not been burnt *Erica tetralix* dominates (33-50%), along with *Eriophorum vaginatum* (11-25%). *Sphagnum papillosum* and *S. magellanicum* hummocks and *S. cuspidatum* hollows characterise the complex. The overall *Sphagnum* cover is 11-25%.

Complex **9/7/6** un-burnt feature *C. vulgaris* (11-25%), *E. tetralix* (4-10%), *E. vaginatum* (25-33%), *T. germanicum* (<4%), *N. ossifragum* (4-10%) and R. alba (<4%), *S. capillifolium subsp. rubellum, S. papillosum* and *S. magellanicum* hummocks and *S. cuspidatum* hollows. Overall *Sphagnum* cover is 25-33%.

This complex is also found along the western section of high bog, to the west of the conifer plantation (GR 228059 / 281199), in an area previously mapped as face bank, but not thoroughly surveyed. *Eriophorum vaginatum* and *Calluna vulgaris* dominate the complex. The area was also recently burnt. But Sphagnum cover is relatively high (34-50%). Narrow drains inserted on the High Bog as part of the conifer plantation are now invaded by *Sphagnum*.

COMPLEX 7/6

- **Location**: this complex is found between **Sc1** and **Sc2**.
- **Ground**: firm to soft
- **Physical indicators**: bare peat (11-25%), large sections of complex were recently burnt.
- ***Calluna* height**: <5cm
- ***Cladonia* cover**: absent
- **Macro-topography**: flat
- **Pools**: absent
- ***Sphagnum* cover**: 11-25%
- ***Narthecium* cover**: 51-75%
- **Micro- topography**: low hummocks/*Narthecium ossifragum* flats/hollows
- **Tussocks**: *Eriophorum vaginatum* (<4%)
- **Degradation or regeneration evidence**: large sections recently burnt
- **Species cover**: *Calluna vulgaris* (11-25%), *Erica tetralix* (<4%), *Eriophorum vaginatum* (<4%), *E. angustifolium* (<4%), *Narthecium ossifragum* (51-75%), *Andromeda polifolia* (<1%), *Drosera rotundifolia* (<1%), *Sphagnum capillifolium subsp. rubellum* (H; 4-10%), *S. papillosum* (H; 4-10%), *S. tenellum* (H; <4%), *S. subnitens* (H; <4%), *S. cuspidatum* (Hl;<4%).
- **Additional comments**: None.

Marginal Ecotope Complexes

COMPLEX 6/7

- **Location**: this complex is found dominating vegetation at mineral ridges along the southern high bog as well as the northern marginal ecotope section.
- **Ground**: firm
- **Physical indicators**: bare peat (<4%), large sections of complex were recently burnt
- ***Calluna* height**: <5cm
- ***Cladonia* cover**: absent, where burnt
- **Macro-topography**: gentle slope
- **Pools**: absent
- ***Sphagnum* cover**: 4-10%
- ***Narthecium* cover**: 11-25%
- **Micro- topography**: low hummocks/*Narthecium ossifragum* flats/hollows
- **Tussocks**: *Trichophorum germanicum* <4%
- **Degradation or regeneration evidence**: large sections recently burnt
- **Species cover**: *Calluna vulgaris* (4-10%), *Erica tetralix* (<4%), *Eriophorum vaginatum* (<4%), *E. angustifolium* (<4%), *Narthecium ossifragum* (11-25%), *Trichophorum germanicum* (4-10%), *Rhynchospora alba* (<4%), *Andromeda polifolia* (<1%), *Sphagnum capillifolium subsp. rubellum* (H; <4%), *S. papillosum* (H;<4%), *S. tenellum* (H; <4%), *S. subnitens* (H; <4%).
- **Additional comments**: None.

COMPLEX 7/2

- **Location**: this is the most widespread marginal ecotope complex on the site, thus it is found across the entire high bog marginal ecotope.
- **Ground**: firm
- **Physical indicators**: bare peat (25-33%), large sections of complex were recently burnt
- ***Calluna* height**: <5cm
- ***Cladonia* cover**: absent, where burnt
- **Macro-topography**: steep slope
- **Pools**: absent
- ***Sphagnum* cover**: 4-10%
- ***Narthecium* cover**: <4%
- **Micro- topography**: low hummocks/hollows

- **Tussocks**: *Trichophorum germanicum* (4-10%)
- **Degradation or regeneration evidence**: large sections recently burnt
- **Species cover**: *Calluna vulgaris* (11-25%), *Erica tetralix* (<4%), *Eriophorum vaginatum* (4-10%), *Narthecium ossifragum* (<4%), *Trichophorum germanicum* (4-10%), *Andromeda polifolia* (<1%), *Sphagnum capillifolium subsp. rubellum* (H; <4%), *S. papillosum* (H;<4%), *S. tenellum* (H; <4%), *S. subnitens* (H; <4%).
- **Additional comments**: where this complex was not burnt *Erica tetralix* becomes dominant (11-25%) along with *Eriophorum vaginatum* (11-25%) and *Narthecium ossifragum* (4-10%). The ground is firm and *Campylopus introflexus* is abundant (11-25%).The overall *Sphagnu*m cover is low (<4%).

Face bank Complexes

COMPLEX 1

- **Location**: this complex was found along the bog margin
- **Ground**: firm
- **Physical indicators**: bare peat variable
- ***Calluna* height**: <50cm
- ***Cladonia* cover**: <10%
- **Macro-topography**: steep slope
- **Pools**: absent
- ***Sphagnum* cover**: <5%
- ***Narthecium* cover**: absent
- **Micro- topography**: absent
- **Tussocks**: absent
- **Degradation or regeneration evidence**: absent
- **Species cover**: *Calluna vulgaris* (76-90%), *Erica tetralix* (4-10%), *Eriophorum vaginatum* (<4%), *E. angustifolium* (<4%), *Trichophorum germanicum* (<1%), *Myrica gale* (<4%), *Hypnum jutlandicum* (<4%), *Hylocomium* splendens (<1%).
- **Additional comments**: this complex was not thoroughly surveyed and was mapped mainly based on the 2010 aerial photographs and previous 2004 survey map.

Depressions on peat substrates of the Rhynchosporion (7150)

The habitat occurs at Ballynafagh Bog in both Active and Degraded Raised Bog, but it is only occasional found on degraded habitat. Only *Rhynchospora alba* was recorded within the 2011 survey at this site.

R. alba is found in all ecotopes except the face bank in Ballynafagh Bog, such as: central ecotope (complex 10/15); sub-central ecotope (9/10; 9/7/10); sub-marginal ecotope (9/7) and marginal ecotope (6/7).

The species becomes very frequent within complex 10/15 (central ecotope).

The species is always found associated with wet features such as *Sphagnum* pools, *Sphagnum* lawns and hollows, along with *Sphagnum magellanicum*, *S. papillosum*, *S. cuspidatum*. It was also found within *Narthecium ossifragum* dominated hollows in sub-marginal and marginal ecotope complexes. *R. alba* was also recorded in more degraded areas of the bog such as steep slope sections at the edge of the bog where bare peat and erosion channels are found.

Appendix II Photographical records

Photograph Number	Aspect	Type	Feature	Date
102-0441	NW	Overview	Qsc2	09/09/2011
102-0442	N	Overview	Qc1	09/09/2011
102-0443	SE	Overview	Qsc1	09/09/2011

Appendix III Quadrats

Ecotope type	Central	Central	Sub-central	Sub-central
Complex Name	**10/15**	**10/15**	**9/10**	**9/10**
Quadrat Name	Qc 1	Qc1	Qsc1	Qsc1
Easting	281587	281589	281608	281608
Northing	277986	227983	228004	228006
Firmness	Quaking	Quaking	Very soft	Very soft
Burnt	No	No	No	Severe
Algae in hollows %	Absent	Absent	Absent	Absent
Algae in pools %	Absent	Absent	Absent	Absent
Bare peat %	Absent	Absent	Absent	1-3 (many indiv)
High hummocks %	Na	Absent	Na	4-10
Low hummocks %	51-75	51-75	51-75	51-75
Hollows %	4-10	Absent	4-10	4-10
Lawns %	Na	11-25	Absent	Absent
Pools %	11-25	4-10	Absent	Absent
Pool type	Regular	Regular	Absent	Absent
S.austinii hum type	Absent	Absent	Na	Absent
S.austinii hum %	Absent	Absent	4-10	Absent
S.austinii height(cm)	Na	Absent	Na	Absent
S.fuscum hum type	Absent	Absent	Absent	Absent
S.fuscum hum %	Absent	Absent	Absent	Absent
S.fuscum height(cm)	Absent	Absent	Absent	Absent
Leucobryum glaucum	Absent	Absent	Absent	Absent
Trichophorum type	Absent	Absent	Tussocks	Absent
Trichophorum %	Absent	Absent	4-10	Absent
S.magellanicum %	51-75	51-75	11-25	1-3 (many indiv)
S.cuspidatum %	4-10	4-10	4-10	4-10
S.papillosum %	11-25	4-10	26-33	51-75
S.denticulatum %	Absent	Absent	Absent	Absent
S.capillifolium%	4-10	4-10	11-25	4-10

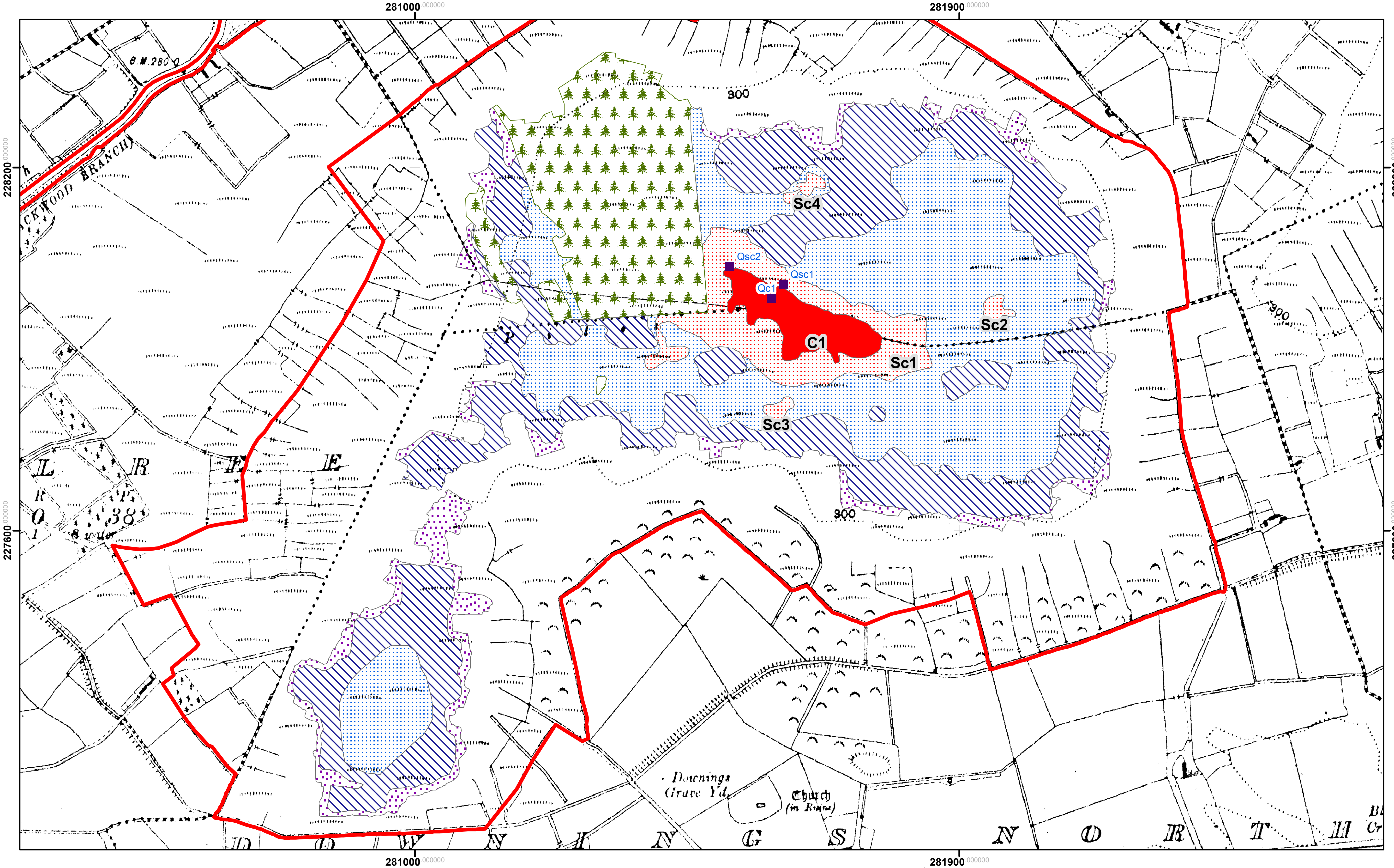
S.tenellum %	Na	Absent	na	Absent
S.subnitens %	Absent	Absent	Absent	1-3 (many indiv)
R.fusca %	Absent	Absent	Absent	Absent
R.alba %	4-10	11-25	Absent	Absent
N.ossifragum %	Absent	1-3 (many indiv)	Absent	Absent
Sphag pools %	4-10	4-10	4-10	Absent
Dominant pool Sphag	S.cuspidatum	S.cuspidatum		
Sphag lawns %	Na	11-25	Absent	Absent
Sphag humm %	51-75	51-75	51-75	76-90
Sphag holl %	4-10	Absent	4-10	4-10
Total Sphag %	76-90	76-90	51-75	76-90
Hummocks indicators	Absent	Absent	S.austinii	Absent
Cladonia portent %	Absent	Absent	Absent	Absent
Other Cladonia sp	Absent		Absent	
C. panicea %	Absent	Absent	Absent	Absent
Calluna cover %	4-10	4-10	4-10	4-10
Calluna height(cm)	11-20	0-10	11-20	0-10
Other NotableSpecies		Vaccinium oxycoccos		
Other comment				
Date	**02/09/2004**	**09/09/2011**	**02/09/2004**	**09/09/2011**

Ecotope type	**Sub-central**	**Sub-central**
Complex Name	**10/7/9**	**9/10**
Quadrat Name	Qsc2	Qsc2
Easting	281516	281520
Northing	228039	228036
Firmness	Soft	Very soft
Burnt	No	Severe
Algae in hollows %	4-10	Absent
Algae in pools %	4-10	Absent
Bare peat %	Absent	Absent
High hummocks %	na	4-10

Low hummocks %	34-50	34-50
Hollows %	4-10	11-25
Lawns %	Absent	Absent
Pools %	11-25	Absent
Pool type	Regular	Absent
S.austinii hum type	Absent	Active
S.austinii hum %	Absent	1-3 (many indiv)
S.austinii height(cm)	na	0-10
S.fuscum hum type	Absent	Absent
S.fuscum hum %	Absent	Absent
S.fuscum height(cm)	Absent	Absent
Leucobryum glaucum	Absent	Absent
Trichophorum type	Absent	Absent
Trichophorum %	Absent	Absent
S.magellanicum %	4-10	1-3 (many indiv)
S.cuspidatum %	11-25	11-25
S.papillosum %	26-33	34-50
S.denticulatum %	Absent	Absent
S.capillifolium%	11-25	4-10
S.tenellum %	na	Absent
S.subnitens %	Absent	Absent
R.fusca %	Absent	Absent
R.alba %	4-10	11-25
N.ossifragum %	Absent	Absent
Sphag pools %	4-10	Absent
Dominant pool Sphag	S.cuspidatum	
Sphag lawns %	Absent	Absent
Sphag humm %	34-50	51-75
Sphag holl %	4-10	11-25
Total Sphag %	51-75	76-90
Hummocks indicators	Absent	S.austinii
Cladonia portent %	4-10	Absent
Other Cladonia sp		

C. panicea %	Absent	Absent
Calluna cover %	34-50	4-10
Calluna height(cm)	21-30	0-10
Other NotableSpecies		
Other comment		Burned March 2011
Date	**02/09/2004**	**09/09/2011**

Appendix IV Survey maps



Raised Bog Monitoring Survey 2011

Map 1: Ecotopes Map and Quadrats

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Ecologic Environmental & Ecological Consultants Ltd.

Ballynafagh Bog SAC (000391)
Co. Kildare

1:6,000

281000.000000 281900.000000

228200.000000 227600.000000

Raised Bog Monitoring Survey 2011

Map 2: Vegetation community complexes

Ecologic Environmental & Ecological Consultants Ltd.

Ballynafagh Bog SAC (000391)
Co. Kildare

N

1:6,000

0 85 170 340 510 680 Meters

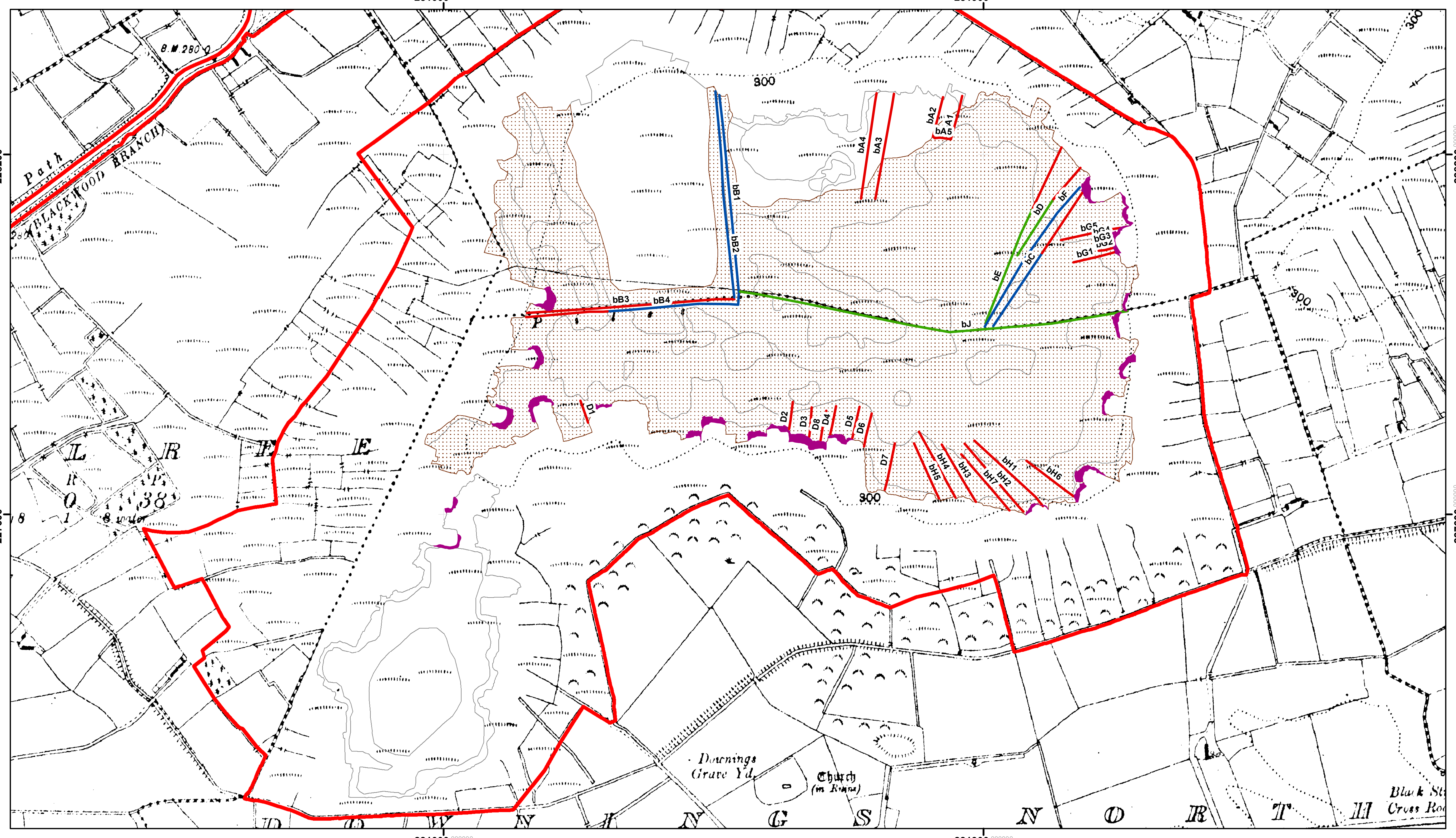
Legend

Ecotope type

- Central ecotope complex
- Sub-central ecotope complex
- Sub-marginal ecotope complex
- Marginal ecotope complex
- Face bank ecotope complex
- Flush

Boundary type

- SC/C
- F/C
- SM/C
- M/C
- F/SC
- SM/SC
- M/SC
- FB/SC
- F/SM
- M/SM
- SM/FB
- F/M
- M/FB
- F/FB
- Other
- SAC



Raised Bog Monitoring Survey 2011

Map 3: Impacts (High Bog drainage; Turf cutting;Fire events)

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Ballynafagh Bog SAC (000391)
Co. Kildare

N

1:6,000

0 80 160 320 480 640 Meters

Legend

- High bog cut away 2005-2011
- **High Bog drainage**
- Blocked:non-functional
- Blocked:reduced functional
- Not blocked:functional
- Not blocked:non-functional
- Not blocked:reduced functional
- Recently burnt
- Ecotopes
- SAC