Carrownagappul Bog (SAC 001242), Co.Galway

Executive Summary

This survey, carried out in October 2012, aimed to assess the conservation status of habitats listed on Annex I of the European Habitats Directive (92/43EEC) on the high bog at Carrownagappul 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 28.07ha (8.68%) of the high bog area. High quality Active Raised Bog consists of both central ecotope and active flush.

High quality Active Raised Bog comprises only 4.12ha, consisting of both central ecotope (2.74ha) and active flushes (1.38ha).

The micro-topography of central ecotope consists of pools, low hummocks, high hummocks, hollows and lawns, and the wet ground is mostly very soft to quaking. The pools are generally large and interconnecting, with substantial *S. cuspidatum* cover and only occasional algae, and they cover in the range of 11-25% of the ecotope. *S. papillosum* and *S. magellanicum* are frequent at pool edges, while *S. capillifolium* dominates the interpool hummocks. Hummocks of *S. austinii* and *S. fuscum* are also present, though rare. Total *Sphagnum* cover is in the range of 76-90%. In common with much of the high bog, the central ecotope was showing the effects of a recent fire event, with dead *Sphagnum* hummocks, dead *Calluna vulgaris* stems, bare peat and an almost total absence of *Cladonia* species all current features. Active flushes at the site consist of pools, low hummocks and hollows. Hummocks of *Aulacomnium palustre* are common throughout, while other flush indicators include *Vaccinium oxycoccos*, *Empetrum nigrum* and *Andromeda polifolia*. One of the two active flush areas mapped includes a substantial cover of scrub and small trees. The species here include *Betula pubescens*, *Ulex europaeus*, *Salix* sp., *Pinus* (*contorta*?), *Rubus fruticosus* and *Juncus effusus*. Total *Sphagnum* cover is in the range of 34-50%.

Degraded Raised Bog covers 295.41ha (91.32%) of the high bog area. It is drier than Active Raised Bog and supports a lower density of *Sphagnum* mosses, although *Sphagnum* cover is in the range of 30-40% in the wettest of the sub-marginal community complexes recorded, and between 26-33% in some of the other wetter complexes. Degraded Raised Bog has a less developed micro-topography, and permanent pools and *Sphagnum* lawns are generally absent. Some good quality pools are present, however (in the range of 11-25% cover) in one of the wetter community complexes, while in other complexes most of the pools are tears, occupying less than 5% of the complex area.

Depressions on peat substrates of the Rhynchosporion are found in both Active and Degraded Raised Bog, but tend to be best developed and most stable in the wettest areas of Active Raised Bog. At Carrownagappul Bog, this habitat was most common in the sub-central community complex 10/4.

Restoration works, in the form of drain blocking on the high bog, has taken place at the site, although the high bog is extensively drained and the greater part of the drainage network remains unblocked.

The current conservation objective for Carrownagappul 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 143.57ha. 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 to 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 substantial increase in the area of Active Raised Bog (+9.87ha) at Carrownagappul Bog in the 2004 to 2012 period. This has taken place in the southern section of the site (below the bH drains and associated track) and includes the expansion of central and sub-central ecotope and active flush over a significant part of the high bog. Increases in extent have been recorded in **C2**,

Sc1, **Sc2**, **Sc4**, **Sc5**, and in the active flush **A**, and these are all attributed to rewetting of the habitats associated with drainage blocking.

Some new peat forming areas have been described at the site, which are the result of a more comprehensive field mapping rather than actual changes. The location of one of these new areas was very sparsely surveyed in 2004, while another new area resulted from the splitting of one former sub-central area into two distinct entities. A former sub-central area was also incorporated into an adjacent expanding sub-central area, and, therefore, no longer exists as a separate entity. Other areas of Active Raised Bog saw boundary changes that resulted from more comprehensive surveying and accurate mapping and/or re-interpretation of vegetation.

Peat cutting and drainage have been the most threatening activities at the site in the current reporting period. 3.10ha of high bog have been lost in the reporting period due to peat cutting, which has taken place at 51 locations around the high bog margin. Information from the NPWS suggests that there were no active turf plots in 2012, but one plot actively cut in 2013. Although the activity intensity has been considerably reduced at least partly due to the strategy of re-locating turf cutters to other local bogs, it cannot be ruled out that turf cutting is re-initiated in other locations or intensified where it currently takes place.

12.115km of drains remain functional and 3.890km reduced functional. A significant recent fire event, which probably occurred in the last 1-2 years, affected 185ha of the high bog, with damage ranging from slight to severe, noted in all habitats and ecotopes.

Active Raised Bog has been given an overall **Unfavourable Bad–Declining** conservation status assessment. Habitat Area has Increased and quality (S&Fs) Improved in the reporting period. However, current Area value, and S&Fs value are below favourable reference values. Future Prospects are considered Unfavourable Bad-Declining as although habitat Area and S&Fs could increase and improve associated with restoration works, peat cutting which has been effectively reduced in intensity (i.e. number of turf plots cut away) in the reporting period, continues at the site and habitat losses cannot be ruled out.

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

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

A series of **recommendations** have been also given, these include: cessation of peat cutting; further restoration works on the high bog and cutover areas, further hydrological and topographical studies to ascertain more accurate FRVs; further botanical monitoring surveys on the high bog, and also in the cutover areas should they become the focus of restoration works.

Site identification

SAC Site Code	001242	**6" Sheet:**	GA 46
Grid Reference:	M 670 500	**1:50,000 Sheet:**	12
High Bog area (ha):	323.48ha		
Dates of Visit:	01, 02 & 04 October 2012		
Townlands:	Carrownagappul, Gunnode, Carrownagannive, Springlawn and Ballynalahy.		

[1]The current extent of the high bog is 323.48ha, while that reported in 2004 was 322.49ha (Fernandez *et al.*, 2005). This discrepancy is the result of more accurate mapping of the high bog edge by using the higher resolution 2010 aerial images compared to those used in 2004, rather than any actual increase in high bog extent. High bog area has in fact decreased in the 2004-2012 period due to peat cutting. The actual high bog extent in 2004 was 326.58ha (see tables 8.1 and 8.3 2004 (amended) figures).

Site location

Carrownagappul Bog is approximately 1km north-northwest of Mountbellew (Mountbellew Bridge), Co. Galway. Shankill West Bog (SAC 000326) is approximately 3km to the northwest, while Curraghlehanagh Bog (SAC 2350) is 4km to the north. Carrownagappul Bog can be readily accessed from tracks along much of the bog perimeter.

Description of the survey

The survey was carried out in October 2012 and involved a vegetation survey of the high bog at Carrownagappul 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 and Schouten (2002). 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 Carrownagappul 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 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 (see Appendix III). The size of quadrats was 4m x 4m for Active Raised Bog.

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

Carrownagappul Bog has been classified as a Western Raised Bog (Cross, 1990) and morphologically as a Ridge Basin Bog type. Kelly *et al*. (1995) grouped the bog with the raised bogs of East Galway. The bog has an approximately triangular shape and is somewhat fragmented in places by tracks that cross the high bog.

The bog has been extensively cutaway around much of the margin and there are face banks of varying height around the site. An extensive drainage network covers much of the high bog.

Ecological Information

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

The following Raised Bog EU Annex I habitats, are found in Carrownagappul 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 Carrownagappul Bog is 28.07ha (8.68% of the high bog), which is an increase of 0.10ha since 1994.

Active Raised Bog includes central and sub-central ecotope, and active flushes.

Central ecotope was found at three locations (**C1** to **C3**) (see Appendix IV, Map 1). A single community complex – complex 15 – accounted for all of the central ecotope recorded at the site. This wet community complex is generally very soft to quaking underfoot. Interconnecting pools - which generally have a significant cover of *Sphagnum cuspidatum* and are devoid of algae - cover between 11-25% of the complex. *S. papillosum* is common at pool edges and in lawns, while *S. capillifolium* hummocks are also common around pools and throughout the interpool areas. Other significant *Sphagnum* species are *S. magellanicum* (around pool edges) and *S. tenellum* (mostly in low hummocks). Small hummocks of *S. austinii* and *S. fuscum* are present, but rare. Total *Sphagnum* cover in the complex is 76-90%. *Narthecium ossifragum* is notably frequent in the interpool areas, where other common species include *Eriophorum vaginatum*, *Erica tetralix* and *Carex panicea*. The effects of recent burn damage, which were observed over much of the site, were also evident in the central ecotope, most obviously in the almost total absence of *Cladonia* species, the presence of charred *Calluna vulgaris* stems, and damaged *Sphagnum* hummocks.

Sub-central ecotope was found at eleven locations (**Sc1** to **Sc11**). Five community complex types (and an additional variant of one of these five) were recorded. Complex 10/4 is wet, with quaking ground and consists of low hummocks, hollows, pools and lawns. The complex is dominated by quaking *Sphagnum papillosum* and *S. magellanicum* lawns. *Sphagnum* cover, which is generally in the range of 50-75%, is as high as 80-90% in places. Small pools, which vary in character, from *S. cuspidatum*-dominated, to shallow and open, or algal-dominated, cover between 4-10% of the total complex area. *S. capillifolium* hummocks, which are mostly found in interpool areas are small and

cover between 4-10% of the complex area. *Rhynchospora alba* and *Narthecium ossifragum* characterise flats, with the former quite abundant, although with a typically low overall cover due to its scattered distribution and slender growth form. Most of this complex has, like much of the high bog, been recently burnt. Small parts that are unaffected support taller (10-20 cm) *Calluna vulgaris* on hummocks, and greater *Eriophorum vaginatum* cover.

Sub-central complex 9/10 has soft to very soft ground, consists of low hummocks, hollows and pools and has a total *Sphagnum* cover of 34-50%. Small pools are rare, and sparsely colonised by *S. cuspidatum*. The complex is generally very wet, and *Sphagnum* cover rose above 50% in places. The area in which the complex was recorded may be undergoing re-wetting/regeneration due to drain blocking to the north, although currently it may not be a particularly fine example of the complex, as *Narthecium ossifragum* cover (5-10%) was often higher than may be expected, while *Eriophorum vaginatum* cover was on the low side of the 11-25% range recorded.

Sub-central complex 9/7+P has low hummocks, hollows, pools and lawns. The pools, which cover between 11-25% of the total complex area, are tear pools, and have an overall *S. cuspidatum* cover of approximately 75%. *Menyanthes trifoliata* and *Drosera anglica* are present in pools, while *S. papillosum* and *S. magellanicum* were common at pool edges. Hummocks of *S. fuscum* and *Leucobryum* glaucum were occasional in the interpool flats. Total *Sphagnum* cover was 34-50%. Other common species included *Calluna vulgaris*, *Eriophorum vaginatum*, *E. angustifolium*, *Narthecium ossifragum*, *Carex panicea* and *Trichophorum germanicum*.

Sub-central complex 9/7/6+P is similar to 9/7+P, but is of somewhat lesser quality, and is partly characterised by the presence of *Narthecium ossifragum*, with a typical cover value in the range of 11-25%. Tear pools are also less frequent, with an overall cover of 10%, although total *Sphagnum* cover is, like that of 9/7+P, in the range 34-50%.

Complex 6/4+P has soft to very soft ground and consists of low hummocks, hollows and pools. Regular (non-interconnecting) pools cover 10% of the complex area and the total *Sphagnum* cover is in the range of 30-40%. *S. capillifolium* dominates low hummocks, while *S. cuspidatum* (in pools), *S. papillosum* (in hollows and pool edges) and *S. tenellum* (mostly on low hummocks), are the other significant *Sphagnum* species. This complex is similar to the sub-central complex 10/4 (see above). *Narthecium ossifragum* and *Rhynchospora alba* form a dominant element of the interpool flats in both complexes, while the microtopography and characteristics of pools are also similar within each complex. The *Sphagnum* cover of 50-75% in 10/4 illustrates the wetter nature of that complex.

Due to their basic similarities, 6+P was described as a variant of 6/4+P, rather than as a separate community complex. While quite similar to 6/4+P, this complex variant was of lesser quality and

was somewhat transitional between sub-central and sub-marginal ecotopes. A low cover of *Rhynchospora alba* accounted for the different community complex assignation. The pools in 6+P had a variable (though rarely high) cover of *S. cuspidatum*, but a high cover of *S. papillosum* in low hummocks at pool edges. *Campylopus atrovirens* was also present at pool edges.

Two active peat forming flushed areas are also present at Carrownagappul Bog (**FA** and **FY**). Flush **A**, in addition to several of the typical herbaceous flush species, such as *Aulacomnium* palustre, *Vaccinium oxycoccos*, *Empetrum nigrum*, and *Andromeda polifolia*, has a significant scrub element, with *Betula pubescens* occasional throughout, while a small scrub patch in the north of the flush also contains *Ulex europaeus* (3m tall) and *Pinus contorta*. *Rubus fruticosus* and *Juncus* effusus are also present here. In the south end of the flush, there are scattered small (<1m) *Salix* sp. shrubs, and two small *Picea* sp.

Flush **Y** (**FY**) is a wet, quaking area that differs only slightly from the surrounding sub-central area, **Sc1**. The flush boundary is defined by the extent of scattered *Phragmites australis*.

Degraded Raised Bog (7120)

The current area of Degraded Raised Bog at Carrownagappul Bog is 295.41ha (91.32% of the high bog).

Degraded Raised Bog includes the sub-marginal, marginal and face bank ecotope, as well as inactive flushes. 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. Although pools are mostly absent from the high bog, they are found within one of the wetter sub-marginal ecotope community complex (6+P). Total pool cover in this complex, comprising both interconnected and tear pools is in the range of 11-25%. The interconnected pools have a variable cover of *Sphagnum cuspidatum*, ranging from 25-50%, and frequently contain algae too. The micro-topography of this complex is otherwise quite poorly developed, with only very low hummocks present. The interpool areas are dominated by *Narthecium ossifragum* and the total *Sphagnum* cover – mostly consisting of *Sphagnum capillifolium*, *S. cuspidatum*, *S. papillosum* and *S. austinii* - is in the range of 10-25%. Burn damage is evident throughout, with dead *Calluna* stems highly visible, as are charred, regenerating tussocks of *Trichophorum germanicum* and *Eriophorum vaginatum*. Pools are also found within two other sub-marginal community complexes, 6/3 and 9/7, although these are mostly small tear pools and in each case have a total cover of less than 5%.

Marginal ecotope is slightly drier than sub-marginal ecotope and mainly occurs as a narrow band near the margins of the high bog, although there are some quite extensive tracts in the north and west of the site. The micro-topography consists of *Calluna vulgaris* hummocks, low *Sphagnum* hummocks, flats, hollows and tear pools. The *Sphagnum* cover is even lower here than in the sub-marginal ecotope (1-4%), although this is partly due to the severe recent burn damage evident throughout much of the ecotope. The vegetation is characterised by a higher cover of *Carex panicea, Narthecium ossifragum* and *Calluna vulgaris*.

Face bank ecotope is characterised by firm ground, tall *Calluna vulgaris*, poor *Sphagnum* cover and a flat micro-topography. This ecotope is scattered intermittently around the margins of the high bog, and is commonest in the north and east of the site.

The high bog also has a number of inactive flushes (**U, U1, V, W, W1, W2, X, Z** and **Z1).** Most of these are quite small, although W and Z occupy substantial areas. A number of the flushes have a scrub element with species such as *Betula pubescens*, *Salix aurita* and *Ulex europaeus*. *Molinia caerulea* and tall *Calluna vulgaris* are also typically present in the inactive flushes.

Depressions on peat substrates of the Rhynchosporion (7150)

Rhynchosporion vegetation is widespread on Carrownagappul 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, particularly those in the sub-central complex 10/4, where it is most frequent. In these areas, the Rhynchosporion vegetation occurs within *Sphagnum* hollows and along *Sphagnum* pool edges and on lawns. Typical plant species include *Rhynchospora alba*, *Sphagnum cuspidatum, S. papillosum*, *S. magellanicum* and *S. capillifolium*.

R. alba was also found within degraded raised bog, but was generally uncommon and always associated with wet features such as hollows and run off channels.

Detailed vegetation description of the high bog

A detailed description of high bog vegetation recorded during the 2012 survey of Carrownagappul 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 Carrownagappul 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)	Location	Habitat affected
C01.03	Peat extraction	H	-1	3.10ha of the high bog cut away	Inside High Bog: 51 locations along high bog margin: 35 in the east/northeast, 9 in the north and 7 in the northwest	**7120**
C01.03	Peat extraction	L	-1	3.10ha of the high bog cut away	""	**7110/7150**
J02.07	Drainage	M	-1	16.005km [1]	Inside High Bog	**7110/7120/7150**
J02.07	Drainage	M	-1	n/av	Outside High Bog	**7110/7120/7150**
J01	Fire	H	-1	185ha in total, of high bog habitats	Inside High Bog	**7120**
J01	Fire	M	-1	185ha in total, of high bog habitats	Inside High Bog	**7110/7150**
B01.02	Artificial planting on open ground (non-native trees)	L	-1	59ha	Outside High Bog	**7110/7120/7150**
4.2	Restoring/Improving the hydrological regime	H	+1	4.560km²	Inside High Bog	**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 reduced-functional drains.

[2] This figure includes blocked drains on high bog.

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

Peat cutting

This activity has taken place at 51 locations along the northwest (7 locations (plots)), north (9 locations) and east/northeast (35 locations) sections of high bog in the 2004-2010 period. This has reduced the area of high bog by 3.10ha. However, 3.10ha should be considered as a minimum value, as the loss of high bog is calculated using GIS techniques on aerial photography from 2004/05 and 2010, and information received from the NPWS indicates that peat cutting continued post-2010, with the number of peat cutters in 2010/2011 put at 38. As of September 2012, there were no active plots identified at the site. More recent NPWS data indicates that one plot was cut in 2013. Thus, peat cutting has not been completely ceased at the site although significant reduction on its intensity is obvious.

No losses of Active Raised Bog have been recorded in the present survey, as the 3.10ha of habitat lost to peat cutting relates to marginal and face bank ecotope and inactive flush. Nevertheless, the negative effects of peat cutting may have prevented the development of further Active Raised Bog habitat and/or an improvement in the quality of existing habitat. This activity is considered to have a high importance/impact on Degraded Raised Bog, while the impact on Active Raised Bog and Rhynchosporion depressions is rated as being of low importance. In addition to the direct habitat losses associated with turf cutting, old face banks and high bog and cutover drainage associated with cutting continue to cause negative impacts on the high bog habitats.

The continuation of these peat cutting will prevent the recovery of the high bog, and the recovery of ARB towards FRVs as restoration works cannot be employed until such activities stop. It should also be borne in mind that peat cutting has already had a serious negative impact over a long period at this site, indicated by the fact that ARB covers only a very small area (28.07ha or 8.68% of the high bog) and is 80.45% below the FRV target.

Peat cutting has been carried out extensively over a long period at the site, and there are substantial cutover areas around much of the high bog margin. Fernandez *et al*. (2005) estimated 1.46km (8.31%) of the high bog margin was being actively exploited for turf production at the time of that survey, which represented a substantial decrease from the 4.96km (38.6% of the high bog margin) reported by Kelly *et al*. (1994). Peat cutting was seen to have decreased in the northwest and southeast of the high bog by the time of the 2005 survey, although 2.1ha of high bog, mostly along the north, northeast, northwest and eastern margins, were thought to have been lost to cutaway in the interim period.

Drainage

High bog drainage

Table 6.2 shows a decrease in functional drainage, although the majority of drains in the high bog remain functional (12.115km) or reduced functional (3.890km), while 1.054km of drains are non-functional (Table 6.2). The change in status of a number of previously functional drains to either reduced-functional or non-functional status (Table 6.3), accounts for the increases in the total lengths of those two drain categories (Table 6.2). The status of blocked drains has remained unchanged, with 4.560km of reduced-functional drains representing no change in status from 2004 (Table 6.2).

Reduced functional drains are also still impacting on high bog habitats and will continue to do so until they are blocked and become completely in-filled and thus non-functional.

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

Table 6.2 High bog drainage summary

Status	2004 (km) [1]	2012 (km)	Change
NB: functional	14.794	12.115	(-)2.679
NB: reduced functional	1.721	3.890	(+/)2.169
NB: non- functional	0.924	1.054	(+)0.130
B: functional	0.000	0.000	0.000
B: reduced functional	4.560	4.560	0.000
B: non- functional	0.000	0.000	0.000

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)

The discrepancy between the decrease in functional drain length (-2.679km) and the corresponding increase in reduced functional and non-functional drains (2.169km + 0.130km) is accounted for by the direct loss of 0.380km of drainage due to peat cutting.

Table 6.3 below provides a more detail description of the drainage present on the high bog at Carrownagappul Bog including any change in their functionality in the 2004 – 2012 reporting period (see Map 3).

Table 6.3 High bog drainage detail

Drain Name	Length (km)	2004 status	2012 status	Change	Comment
bA	0.979	B: reduced	B: reduced functional	No	Middle section of bA

		functional			
bA	0.443	NB: functional	NB: functional	No	Northern and southern sections of bA
b2A	0.130	NB: functional	NB: non- functional	Yes	
bB	0.708	NB: functional	NB: functional	No	
b2B	0.067	NB: non-functional	NB: non- functional	No	Drain already present in 2004 but not mapped
bC	0.354	B: reduced functional	B: reduced functional	No	
bD1-5;7-13	1.780	B: reduced functional	B: reduced functional	No	
bE	0.947	B: reduced functional	B: reduced functional	No	
b2D	0.243	NB: reduced functional	NB: reduced functional	No	This drain was wrongly classified as non-functional in 2004
bF1-6	0.600	NB: functional	NB: functional	No	
bG1-3	0.330	NB: functional	NB: functional	No	
bG4	0.074	NB: functional	NB: reduced functional	Yes	
b2G	0.128	NB: functional	NB: reduced functional	Yes	
bH1;2	3.402	NB: functional	NB: functional	No	Some sections reduced-functional
b2J	0.581	NB: functional	NB: functional	No	Some sections wrongly classified as non-functional in 2004
b2K	0.134	B: reduced functional	B: reduced functional	No	Northern section of b2K
b2K	0.299	NB: non-functional	NB: non- functional	No	Southern section of b2K
bL1-3	1.168	NB: functional	NB: reduced functional	Yes	
bL4	0.277	NB: functional	NB: functional	No	Drain already present in 2004 but not mapped
b2L	0.158	B: reduced functional	B: reduced functional	No	Western section of b2L
b2L	0.296	NB: functional	NB: functional	No	Eastern section of b2L
bM	0.103	B: reduced functional	B: reduced functional	No	Western section of bM
bM	0.309	NB: functional	NB: functional	No	Eastern section of bM
bM1	0.034	NB: functional	NB: functional	No	Drain already present in 2004 but not mapped
bM2	0.066	NB: functional	NB: functional	No	
bM3	0.068	NB: functional	NB: functional	No	

bN1	0.888	NB: functional	NB: functional	No	
b2N	0.212	NB: functional	NB: functional	No	
bO	0.306	NB: functional	NB: functional	No	
b2O	0.105	B: reduced functional	B: reduced functional	No	
bP	0.302	NB: functional	NB: functional	No	
bR	0.423	NB: functional	NB: functional	No	Drain complex
bR1-6;8-13	1.396	NB: functional	NB: functional	No	
bR7;14;15	0.255	NB: functional	NB: reduced functional	Yes	
bR16	0.088	NB: reduced functional	NB: reduced functional	No	Drain already present in 2004 but not mapped
bS1-3	0.195	NB: non-functional	NB: non- functional	No	
bT1-3	0.333	NB: functional	NB: reduced functional	Yes	
bT4-10	0.789	NB: functional	NB: functional	No	
bV	0.239	NB: functional	NB: reduced functional	Yes	
bW	0.306	NB: reduced functional	NB: reduced functional	No	Drain already present in 2004 but not mapped
bX	0.134	NB: non-functional	NB: non- functional	No	
D1;3;6;9;12-14	0.685	NB: functional	NB: functional	No	
D2;8;10;11;16	1.010	NB: reduced functional	NB: reduced functional	No	D2 was wrongly classified as non-functional in 2004
D5	0.049	NB: functional	NB: reduced functional	Yes	
D7	0.229	NB: non-functional	NB: non- functional	No	This drain was wrongly classified as reduced functional in 2004

Bog margin drainage

The cutover areas were not surveyed for drains during 2012.

Drains associated with either currently active or no longer active peat cutting are present along the entire cutover. These drains continue to drain the high bog and impacting on high bog habitats.

There is no obvious drainage maintenance on adjacent agriculture land that can be seen on the 2010 aerial photograph of the site, although there is likely to have been some maintenance of cutover drains associated with peat cutting in the reporting period.

Bog margin drainage is considered to have a medium importance/impact on high bog habitats.

Fire history

Much of the high bog vegetation showed evidence of recent burning, believed to have occurred in the last 2 years. Damage ranged from moderate to severe, and was most clearly evident in the damage caused to hummocks, on which significant amounts of *Sphagnum* were often dead and unrecognisable to species level. Charred tussocks of species such as *Eriophorum vaginatum* and *Trichophorum germanicum* were also frequent, and *Cladonia* spp., which are susceptible to fire damage, were absent over much of the high bog. Most of the taller *Calluna vulgaris* in the affected areas had been burnt and short, regenerating shoots accounted for much of the cover of this species. Damage was often more severe in Degraded Raised Bog habitats and the impact is rated as having a high influence/importance there, whereas that in Active Raised Bog (and by inference Rhynchosporion depressions) is rated as being of medium importance.

Fernandez *et al*. (2005) reported evidence of burning in the east and northeast of the high bog that was thought to reflect a fire event within the previous ten years. Douglas and Mooney (1984) had previously reported burning in the southwest of the bog (covering 15-20% of the total bog area). Thus, it appears that burning has been a regularly occurrence at the site in recent years and has contributed to the degradation of high bog habitats.

Invasive species

There was no significant presence of invasive species noted during the present survey. Fernandez *et al*. (2005) recorded the presence of a single *Rhododendron ponticum* bush, and several *Pinus sylvestris* trees (potentially 'a problematic native species', rather than an invasive species) in the northeast of the high bog.

Afforestation and forestry management

There are no forestry plantations on the high bog, although there are conifer plantations adjacent to high bog; both in the northeast where a plantation of approximately 43ha is immediately adjacent to high bog, and also in the north where a plantation of 16ha is some 200m from the high bog margin. There is likely to be drainage associated with these plantations, although the overall impact on high bog habitats is rated as being of low importance.

Other impacting activities

No other significant impacting activities were noted or recorded in 2012 impacting high bog habitats in the 2005-2012 reporting period.

The Natura 2000 Standard Data form for Carrownagappul Bog SAC refers to a number of other impacts, such as grazing (code 140) and fertilisation (code 120), within and around the site, but these were not recorded or assessed in the current survey.

Conservation activities

Drainage blocking has been carried out at the site, in order to improve the conservation status of the high bog habitats. Several drains in the southern section of the high bog, such as bA, bC, bD1-5, bD7-13 and bE, have been dammed, and the positive effects of this action have been recorded in the present survey, with a 9.87ha increase in Active Raised Bog habitats, at the expense of former sub-marginal ecotope. These improvements were recorded over a substantial part of the southern section of the bog, with **C2**, **Sc1**, **Sc2**, **Sc4**, **Sc5** and active flush **A**, all increasing in area. Improvements were also seen in the mapping of some wetter community complexes in the areas concerned.

In addition to these physical management actions, the NPWS has also engaged in negotiation with landowners in relation to the cessation of peat cutting at the site. Part of the strategy to end peat cutting at the site has involved the re-location of turf cutters to other local bogs, while other turf cutters have accepted financial compensation packages. The intensity of turf cutting has declined in recent years, to the point where there were apparently no plots cut in 2012, as of September of that year.

High bog drainage blocking is reported as a positive management action under Restoring/Improving the hydrological regime (4.2) in table 6.1.

Conservation status assessment

The assessment of the conservation status of Annex I Active and Degraded Raised Bog and Bog Woodland 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 an overall increase of 9.87ha in the area of Active Raised Bog. This is the net result of several distinct changes to the individual ARB areas, including the expansion of a number of areas as a result of rewetting associated with drainage blocking. Other changes to individual ARB areas are attributed to the greater mapping accuracy resulting from more comprehensive surveying in the present project and/or the re-interpretation of vegetation (Table 8.2).

C1, near the centre of the high bog, and **C3**, in the northeast have undergone boundary changes, with the former now slightly smaller, and the latter slightly larger, than was previously the case. In both cases, the changes are attributed to greater mapping accuracy from more comprehensive surveying and also, in the case of **C1**, of the re-interpretation of some of the vegetation in the area.

C2, to the west of **C1** near the centre of the high bog, has reduced in area as a result of greater mapping accuracy brought about by more comprehensive surveying. However, this net loss of area masks an expansion in the southern part of **C2** that is believed to be the result of rewetting associated with drainage blocking. This southward expansion is in keeping with an apparent pattern of water movement to the south in this part of bog. This change is therefore believed to represent a real increase in the area of Active Raised Bog. A series of drains around the centre of the site (including bA, bC, bD1-5, bD7-13 and bE) have been blocked and are now all reduced functional, leading to rewetting over a substantial part of the southern section of the bog.

Sc1, in the southwest of the high bog, has expanded along its southern side, in a change attributed to rewetting associated with drain blocking. This is in keeping with other similar expansions in Active Raised Bog areas alongside or near drain bA, where the effects of drain blocking have become apparent.

Sc2, also closely adjacent to drain bA, has seen a southward expansion in its area, and this change, like that observed in **Sc1**, is believed to have resulted from rewetting associated with drainage blocking. A small part of the northwest corner of Sc2 has now been excluded from the area and re-classified as sub-marginal ecotope, in what is a re-interpretation of vegetation, rather than an actual change in habitat quality. The previous description of the area (Fernandez *et al.*, 2005) was of relatively poor quality sub-central ecotope, so it is quite likely that at least some of this area was only of sub-marginal quality when that survey was carried out.

Sc3 has seen some boundary changes and is now slightly smaller than was previously the case. This change is the result of more comprehensive surveying in 2012 which resulted in more accurate mapping, and also re-interpretation of vegetation. Most of the area is borderline sub-marginal/sub-central, and therefore, quite open to interpretation. Part of this re-interpretation has resulted in the former **Sc3** being split into two sub-central areas, with the newly named **Sc11** now comprising some of the western extreme of the former area.

Sc4 has expanded markedly along the southern side of its former boundary and the newly re-mapped area now also encompasses the former **Sc7**. This expanded sub-central habitat now also extends along the sides of Flush A and along a substantial part of the western boundary of the central ecotope, **C2** area. These changes are believed to be the result of rewetting associated with drainage blocking. The total area of former sub-marginal habitat that has improved to sub-central quality in this area is calculated as 6.0ha.

Sc5 has also seen a substantial increase in area, particularly to the west and northeast of its former boundaries. The increase in area is the result of rewetting associated with drainage blocking and is in keeping with similar changes seen in this part of the high bog, such as those in C2, Sc1, Sc2 and Sc4. The new Sc5 boundary now intersects drain bA, and interestingly, the north-western edge of Sc5 now coincides almost exactly with the northernmost drain dam on drain bA, providing an apparently clear illustration of the positive effects that have resulted from the blocking of this drain.

Sc6 has seen slight changes to its former boundary and is now slightly larger than was formerly the case. An extension to the northwest side of this sub-central area is the most obvious change, although the previous paucity of mapping points in this region supports the designation of this

change as one resulting from more comprehensive surveying, rather than an actual change in habitat quality.

The former **Sc7** area is no longer present, as it has been incorporated into the adjacent Sc4, which has greatly expanded as a result of the rewetting of habitat associated with drainage blocking.

Sc8, in the northeast of the high bog, and **Sc9**, to the east of track 2 in the southeast of the bog, have undergone minor boundary revisions and are now both slightly larger than was formerly the case. However, there are no indications of any real change in habitat quality, and the changes are attributed to the more comprehensive surveying in 2012 which resulted in more accurate mapping.

Sc10, to the west of Sc8 in the northern section of the high bog, was not mapped during the 2004 survey (Fernandez *et al.*, 2005). However, the area occupied by this new sub-central area was formerly entirely lacking in mapping points, as was considerably more of the surrounding sub-marginal habitat, so it must be assumed that the addition of this area is the result of more comprehensive surveying in the present project which resulted in more accurate mapping.

Sc11 is a newly named sub-central area, but its inclusion here is due to the more comprehensive mapping which resulted in the division of the former Sc3 (see Sc3 description above) into two distinct areas.

Flush **A**, adjacent to marginal ecotope alongside track 2 in the southeast section of the bog has expanded as a result of rewetting associated with drain blocking. The expansion is mostly to the north-eastern side of the flush, and the change is in keeping with the general trend in this part of the bog, where a number of Active Raised Bog areas have expanded due to the blocking of drains. The flush is also mostly surrounded by the expanded sub-central **Sc4** that was formerly separated from flush A by a substantial expanse of sub-marginal ecotope.

Flush **Y**, surrounded by the sub-central, **Sc1** area, is now slightly smaller due to boundary revisions that reflect the more comprehensive surveying in 2012 which resulted in more accurate mapping.

In summary, there has been an overall increase of 9.87ha in Active Raised Bog, all of which is accounted for by improvements to former sub-marginal ecotope. The expanded Active Raised Bog areas, with the estimated increase in extent of each in parentheses are; C2 (0.26ha), Sc1 (0.30ha), Sc2 (0.46ha), Sc4 (6ha), Sc5 (2.62ha), active flush A (0.23ha). There appears to be a general pattern of water movement to the south or southeast in this part of the bog, as the expanded Active Raised Bog areas have mostly increased in area along their southern sides.

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). Therefore, Active Raised Bog Area FRV is 143.57ha (based on 1994/5 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 (28.07ha) is 80.45% below the FRV. A current Area value more than 15% below FRV falls into the **Unfavourable Bad** assessment category.

Although a long term (1994/5-2012) trend indicates an increase in the Area of Active Raised Bog at the site of 0.10ha (see table 8.1), a more recent and short term trend analysis (8 years; 2004-2012) gives a more optimistic result with a 9.87ha (54.23%) increase of Active Raised Bog. Therefore, the habitat Area is given an **Increasing** trend assessment.

The Area of Active Raised Bog at Carrownagappul 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 13.98ha (half of 27.79ha, the current area of Active Raised Bog. The current value is 4.12ha which is 70.610% below the FRV. A current central ecotope and active flush area value more than 25% below FRV falls into the **Unfavourable Bad** assessment category, and this is, therefore, the assessment that applies here to S&Fs.

A long term (1994/5-2012) trend indicates a decrease in the combined area of central ecotope and active flush. However, the 1994/5 figures are not directly comparable with the current data due to the widely different survey methods used. A more relevant and short term trend (8 years; 2004-2012) indicates an increase in the area of both central ecotope and active flush and therefore the S&Fs are given an **Improving** trend.

Quadrats analysis (**Qc1, Qsc1, Qsc3** and **Qsc4**) indicates the following:

Qc1: this quadrat was previously classified as central ecotope, complex 9/14, but was recorded as central ecotope, complex 15, in the present survey. A number of changes were noted: the total cover and height of *Calluna vulgaris* were lower in 2012, a probable reflection of the recent fire at the site, the effects of which were adjudged to be light in the quadrat; total *Sphagnum* cover was 51-75% in 2012 and 34-50% in 2004, which may be at least partly explained by the greater cover of both pools and low hummocks in 2012; *S. cuspidatum* and *S. papillosum* were both more common in 2012, probably reflecting the greater pool and hummock cover. The changes are likely to be due to a

minor discrepancy in the quadrat location, as the previous description of C1 (Fernandez *et al*., 2005), the central ecotope area in which the quadrat was recorded, suggests that the 2004 quadrat was not representative of the finest quality habitat within the area.

Qsc1: this quadrat was classified as sub-central ecotope, complex 4/6 in 2004 and as sub-central complex 10/4 in 2012. A number of differences were noted: although total *Sphagnum* cover was 51-75% in both 2004 and 2012, the cover of pools, low hummocks and lawns were all greater in 2012, although there was, however, a greater cover of *Sphagnum* hummocks in 2005; *Rhynchospora alba* was more common in 2004. The changes appeared to be symptomatic of somewhat wetter conditions in 2012, and the quadrat is within Sc1, one of the Active Raised Bog areas that have seen an expansion as a result of rewetting associated with drainage blocking. The influence of a recent fire, which may have had the effect of causing deterioration in habitat quality, was noted in the 2012 quadrat.

Qsc3: this sub-central quadrat was classified as 6/3+P in 2004, but as 9/7+P in 2012. A number of differences between the quadrats were noted: although total *Sphagnum* cover was 26-33% in both quadrats, the cover of both *Sphagnum* hummocks and lawns was greater in 2012; *Calluna vulgaris* was more common in 2012; other differences were relatively minor, and those that were noted can probably be attributed to slight variation in the quadrat location.

Qsc4: this sub-central quadrat was classified as 6/3+P in 2004, but as 9/7+P in 2012. A number of differences between the quadrats were noted: the cover of pools and low hummocks was greater in 2012, while the cover of hollows was greater in 2004; total *Sphagnum* cover was greater in 2012, which is at least partly due to the greater cover of *S. capillifolium* that probably mirrors the greater cover of low hummocks. Differences are probably due to variation in the quadrat location, particularly as the quadrat is located near the sub-central/sub-marginal boundary (of Sc6), where the vegetation becomes quite transitional in nature between the two ecotopes, and tends to vary considerably over short distances. Indeed, the 2012 quadrat was re-located slightly towards the interior of Sc6, as the original location was thought to be too close to the ecotope boundary, following the minor boundary revisions that took place in the current survey.

Typical good quality indicators and typical plant species are still found in sub-central and active flush throughout the entire bog.

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

Future Prospects

Habitat Area has increased, and S&Fs have been given an improving trend in the reporting period, reflecting the expansion of high quality ARB at the site. This is largely due to the blocking of high bog drains. Peat cutting continued at the site during the reporting period, with 51 active plots identified, although current information suggests that the activity has declined to the point where there were no turf plots cut in 2012 and one plot was cut away in 2013. Nevertheless, this activity continues to pose a threat to the habitat and its possibility to reach FRVs.

Habitat **Area** is currently 80.45% below FRV (see table 8.4). Although an Increasing trend in habitat Area and Improving trend in S&Fs would be expected in the following two reporting periods (12 years) as a result of restoration works, peat cutting continues at the site despite a reduction on its intensity (i.e. number of turf plots actively cut away) in the reporting period. It cannot be ruled out habitat losses in the future if the activity is re-initiated in other locations or intensified within current ones. As a result a negative Future Prospects are expected unless peat cutting is completely phased out at the site. It should also be mentioned that is possible that peat cutting to the north of Sc6 and Sc8 could have local negative effects due to subsidence in the longer term, even though negative effects on these areas were not seen in this reporting period. Habitat Area is expected to remain more than 15% below FRV. Thus, habitat's **Area Future Prospects** are assessed as **Unfavourable Bad-Decreasing**. Habitat's **S&Fs** are currently 70.61% below FRV (see table 8.4). A Declining trend is foreseen and the **S&Fs** are expected to be more than 25% below FRV in the following two reporting periods. Thus **S&Fs Future Prospects** are assessed as **Unfavourable Bad-Declining**. **The overall habitat's Future Prospects are Unfavourable Bad-Declining** (see table 8.5).

Blocking of remaining reduced-functional and functional drains both on the high bog and cutover and complete cessation of peat cutting is necessary. Cutover areas may play a major role in the restoration of the habitat if it proves unfeasible to regenerate previous Active Raised Bog values on the high bog.

It will be important to reduce the frequency and intensity of fire events to minimise the impact on the area of Active Raised bog.

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

Table 8.1 Changes in Active Raised Bog area

Active Ecotopes	1994[1]	2004	2004 (amended)	2012	Change (2004-2012)	
	Area (ha)	Area (ha)	Area (ha)	Area (ha)	Area (ha)	%
Central	4.46	3.24	2.48	2.74	(+)0.26	(+)10.48
Sub-central	23.22	11.35	14.57	23.95	(+)9.38	(+)64.38
Active flush	0.29	1.30	1.15	1.38	(+)0.23	(+)20.00
Total	**27.97**	**15.89**	**18.2**	**28.07**	**(+)9.87**	**(+)54.23**

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

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 2012. The comparison between 2004 (amended) and 2012 illustrates the actual changes in ecotope area in the 2004-2012 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 2012 (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 in boundary (slightly smaller). This change is the result of more comprehensive surveying in 2012 which resulted in more accurate mapping. However also re-interpretation of vegetation.	Total *Sphagnum* cover 51-75% in 2012, 34-50% in 2004; greater pool and low hummock cover in 2012; *S. cuspidatum* and *S. papillosum* also more common in 2012. Differences likely due to minor variation in quadrat location
C2	None	Increasing	Slight changes in boundary. This change is the result of more comprehensive surveying in 2012 which resulted in more accurate mapping. However, expansion of central ecotope has taken place along the northern and southern sections as a result of rewetting associated with drainage blocking.	
C3	None	Stable	Slight changes in boundary (slightly larger). This change is the result of more comprehensive surveying in 2012 which resulted in more accurate mapping.	
Sc1	Qsc1	Increasing	Southern section of this sub-central ecotope area expanding as a result of rewetting associated with drainage blocking.	Complex 4/6 in 2004, 10/4 in 2012; greater cover of pools, lawns and low hummocks in 2012. Changes likely due to wetter conditions and habitat improvement due to drain

				blocking
Sc2	None	Increasing	Sub-central ecotope area expanding as a result of rewetting associated with drainage blocking.	
Sc3	None	Stable	Slight changes in boundary (slightly smaller). Former Sc3 now consists of two separate areas (Sc3 and Sc11). This change is the result of more comprehensive surveying in 2012 which resulted in more accurate mapping. However also re-interpretation of vegetation.	
Sc4	None	Increasing	Southern and middle sections of this sub-central ecotope area expanding as a result of rewetting associated with drainage blocking. Now also includes former Sc5 and Sc6.	
Sc5	None	Increasing	Sub-central ecotope area expanding as a result of rewetting associated with drainage blocking.	
Sc6	Qsc4	Stable	Slight changes in boundary (slightly larger). This change is the result of more comprehensive surveying in 2012 which resulted in more accurate mapping.	Complex 6/3+P in 2004, 9/7+P in 2012; pool cover, low hummocks and total *Sphagnum* greater in 2012. Difference likely due to variation in quadrat location. 2012 quadrat re-located away from ecotope boundary.
Sc7	None	No longer present	This former sub-central section is now part of Sc4 which has expanded as a result of rewetting associated with drainage blocking	
Sc8	Qsc3	Stable	Slight changes in boundary (slightly larger). This change is the result of more comprehensive surveying in 2012 which resulted in more accurate mapping.	Complex 6/3+P in 2004, 9/7+P in 2012; total *Sphagnum* 26-33% in both quadrats; greater cover of *Sphagnum* lawns and hummocks in 2012. Differences minor and attributed to variation in quadrat location.
Sc9	None	Stable	Slight changes in boundary (slightly larger). This change is the result of more comprehensive surveying in 2012 which resulted in more accurate mapping.	
Sc10	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 more accurate mapping.	
Sc11	None	Stable	Slight changes in boundary (slightly smaller). Former Sc3 now consists of two separate areas (Sc3 and Sc11). This change is the result of more comprehensive surveying in 2012 which resulted in more accurate mapping. However also	

			re-interpretation of vegetation.
A	None	Increasing	Active flush area expanding as a result of rewetting associated with drainage blocking.
Y	None	Stable	Slight changes in boundary (slightly smaller). This change is the result of more comprehensive surveying in 2012 which resulted in more accurate mapping.

Degraded Raised Bog (7120)

Area

The Degraded Raised Bog FRV for Area is 179.91ha at Carrownagappul Bog. This value corresponds with the difference between the current high bog area (323.48ha) and the Active Raised Bog FRV (143.57ha) for area. Degraded Raised Bog is a particular habitat type, for which a 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 64.20% bigger than FRV (see table 8.4). Any current habitat Area value more than 15% above FRV falls into the **Unfavourable Bad** assessment category.

Table 8.3 shows a decrease in the area of Degraded Raised Bog in the reporting period, and also a decrease in the area of each of the individual Degraded Raised Bog ecotopes. The changes are due to a combination of the direct loss of habitat from peat cutting, and the re-classification of former Degraded Raised Bog habitat as Active Raised Bog habitats, mostly as a result of re-wetting of the habitats following drainage blocking. Sc1, Sc2, Sc4 and Sc5 have all expanded, by a combined area of 9.38ha, in the reporting period. All of this additional area is accounted for by former sub-marginal habitat and this 9.38ha has, therefore, been subtracted from the previous sub-marginal area value. An additional 0.23ha of former sub-marginal habitat has been re-classified as active flush (in flush A), while the central C2 area has expanded by 0.26ha, also from improvement of former sub-marginal habitat.

On the negative side, there have been direct losses of Degraded Raised Bog habitats resulting from peat cutting during the reporting period. These losses amount to 3.10ha in total, a figure that is comprised of 2.8ha of marginal ecotope, 0.25ha of face bank and 0.05ha of inactive flush. As a result the habitat is given a **Decreasing** trend.

The Area of Degraded Raised Bog at Carrownagappul Bog is assessed as Unfavourable Bad-Decreasing (see table 8.5). In this instance, the greater part of the decrease in area should be regarded as positive, as it has resulted in an increase in Active Raised Bog area.

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 73.85ha (25% of 295.41ha, the current area of Degraded Raised Bog). The current marginal and face bank ecotopes area value (147.38ha) is 99.56% 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.

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). Table 8.3 shows a decrease in both marginal and face bank ecotopes of (-) 2.8ha and (-) 0.25ha, respectively. These losses are due to the destruction of habitat through turf cutting. Thus, the DRB's S&Fs at Carrownagappul Bog are given a **Stable** trend.

The mapping of boundary between marginal and sub marginal is difficult and increases/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 associated with negatively impacting activities (e.g. peat cutting, drainage) or positive associated with drainage blocking 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. As well as drainage blocking would encourage rewetting processes and thus improvements in habitat quality.

Typical good quality indicators and typical plant species are still found throughout the entire bog on sub-marginal ecotope.

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

Future Prospects

The area of Degraded Raised Bog has decreased as a result of peat cutting. This activity although reduced in intensity and extent still continues at the site. Drainage on the high bog and cutover continues to damage the habitat and hindering its recovery to FRVs, as well as minimising the

chances to convert face bank and marginal ecotope into sub-marginal and/or Active Raised bog. There is also a history of fire events at the site, including a very recent one which was evident in the light to severe damage seen over much of the site.

Although restoration works in the form of drainage blocking on the high bog have resulted in improvements in Active Raised Bog habitat. The continuation of the above negatively impacting activities and the possibility of re-initiation of peat cutting in other sections of the high bog and thus further decreases and declines in Degraded Raised Bog cannot be ruled out.

Habitat **Area** is currently 64.20% above FRV (see table 8.4) and a Decreasing trend is expected in the following two reporting periods (12 years) due to the ongoing high bog losses associated with peat cutting, which overrides losses associated with expansion of Active Raised Bog habitat. 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-Decreasing**, as a result of further high bog losses to peat cutting. Habitat's **S&Fs** are currently 99.56% above FRV (see table 8.4). A Declining trend in the following two reporting periods although uncertainty cannot be ruled out. **S&Fs** are expected to remain more than 25% above FRV. Thus, habitat's **S&Fs Future Prospects** are assessed as **Unfavourable Bad-Declining**.

As the Future Prospects appear somewhat positive, but cannot currently be guaranteed, **the Future Prospects for Degraded Raised Bog are considered Unfavourable Bad-Declining** (see table 8.5).

Table 8.3 Changes in Degraded Raised Bog area

Inactive Ecotopes	**1994**[1]	**2004**	**2004 (amended)**	**2012**	**Change (2004-2012)**	
	Area (ha)	**Area (ha)**	**Area (ha)**	**Area (ha)**	**Area (ha)**	**%**
Sub-marginal	115.60	143.39	149.63	139.76	(-)9.87	(-)6.60
Marginal[2]	169.15	149.30	139.51	136.71	(-)2.80	(-)2.01
Face bank[2]	n/a	7.41	10.92	10.67	(-)0.25	(-)2.29
Inactive flush	14.51	6.50	8.32	8.27	(-)0.05	(-)0.60
Total	**299.26**	**306.60**	**308.38**	**295.41**	**(-)12.97**	**(-)4.21**

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

[2] Any 2012 marginal and face bank ecotope value given within the report should be taken as a maximum value. Their extent is based in the 2012 habitat survey and 2010 aerial photographs. It cannot be ruled out that further marginal and/or face bank ecotope losses may have taken place at the margin of the high bog in the 2011-2012 period associated with peat cutting.

Note: Table 8.3 includes 2004 figures and 2004 amended figures. The latter shows the ecotope area believed to be present in 2004 after surveying improvements in 2012. The comparison between 2004 (amended) and 2012 illustrates the actual changes in ecotope area in the 2004-2012 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 2012.

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

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 area of Active Raised Bog has increased substantially in the reporting period and most of the increase has taken place within sub-central ecotope, where the habitat is frequently found. However, all of the increase in the sub-central ecotope was due to the improvement of former sub-marginal habitat, with the result that the combined area of ARB and sub-marginal ecotope is unchanged 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 such as peat cutting and drainage have damaged the habitat, although direct losses of habitat from peat cutting have been in marginal and face bank ecotope and inactive flush. Restoration works, in the form of drain blocking, is likely to have a continuing positive effect on Active Raised Bog habitats and also on sub-marginal ecotope (in which the habitat is commonly found) in the reporting period. Nevertheless peat cutting continue to threat both Active and

Degraded Raised Bog at the site. Habitat losses cannot be ruled out if peat cutting continues at the site. Therefore, the habitat's Area Future Prospects are given an **Unfavourable Bad-Decreasing** 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-Improving** 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-Declining** assessment.

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

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

Table 8.4 Habitats favourable reference values

Habitat	Area Assessment			Structure & Functions Assessment		
	FRV Target (ha) [1]	2012 value (ha) [2]	% below target	FRV 2012 Target (ha) [3]	2012 value (ha) [4]	% below target
7110	143.57	28.07	80.45	14.02	4.12	70.61

[1] 1994 central, sub-central, active flush, bog woodland and sub-marginal ecotope area.

[2] 2012 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] 2012 central ecotope and active flush area.

	FRV Target (ha) [5]	2012 value (ha) [6]	% above target	FRV 2011 Target (ha) [7]	2011 value (ha) [8]	% above target
7120	179.91	295.41	64.20	73.85	147.38	99.56

[5] Current high bog area minus 7110 area FRV.

[6] 2012 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–Declining.**
- **Degraded Raised Bog is assessed as being Unfavourable Bad–Declining.**
- **Rhynchosporion depressions is assessed as being Unfavourable Bad–Declining.**

Table 8.5 Habitats conservation status assessments

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

Conclusions

Summary of impacting activities

- Peat cutting has continued at the site and took place at 51 locations during the reporting period. 3.10ha of high bog have been lost in this period due to peat cutting. Current information indicates that there were no turf plots cut as of September 2012, but one plot was cut in 2013. Although the activity intensity has been considerably reduced at least partly due to the strategy of re-locating turf cutters to other local bogs, it cannot be ruled out that turf cutting is re-initiated in other locations.
- 12.115km of unblocked drains on the high bog remain functional, while a further 3.890km are reduced functional. Several high bog drains have been blocked and these drains, amounting to 4.560km in total length, all now have reduced functional status.
- Cutover drainage (peripheral drainage) associated with either currently active or no longer active peat cutting continues to impact on the high bog habitats. No maintenance works on drains in adjacent agriculture land could be clearly discerned on the 2010 aerial photograph of the site, although it is likely that maintenance of the cutover drains associated with peat cutting took place in the reporting period.

- A recent fire event, thought to have occurred within the last two years, caused light to severe damage on 185ha of the 323ha of high bog.

Changes in active peat forming areas

- Figures indicate a 9.87ha (+ 54.23%) increase in Active Raised Bog (all within the larger southern section of the bog) in the reporting period. The distribution of the habitat has changed considerably and a number of new peat forming areas have been mapped and labelled.
- Two new peat forming areas (**Sc10** and **Sc11)** have been described at the site. **Sc10** has been mapped in a part of the northern section of the bog that was previously unsurveyed, and its addition to the total Active Raised Bog area is, therefore, attributed to the more comprehensive survey in 2012 rather than actual changes in Active Raised Bog. **Sc11** was part of the former **Sc3**, which has now been split into two distinct areas (**Sc3** and **Sc11**) as a result of more comprehensive mapping.
- Active raised Bog habitat has expanded across the southern section of the high bog at **C2**, **Sc1**, **Sc2**, **Sc4**, **Sc5** and active flush **A**. This is thought to be due to the blocking of drains in this part of the high bog, which has led to the re-wetting of habitats and subsequently to an improvement in the quality of habitats. All of the increased extent in central and sub-central ecotope and active flush is due to the improvement of former sub-marginal habitat.
- The former **Sc7** no longer exists, as it has been incorporated into the adjacent **Sc4**, which has greatly expanded and now encompasses all of the area previously occupied by Sc7.

Other changes

- A number of small areas of inactive flush (**U**, **U1**, **V** and **W2**) that were not previously mapped, have been added here. The addition of these inactive flushes can be attributed to the more comprehensive surveying and mapping that took place in the present survey.

Quadrats analysis

- **Qc1**: previously classified as central ecotope, complex 9/14, but recorded as central ecotope, complex 15, in the present survey. A number of changes were noted, most likely due to a minor discrepancy in the quadrat location. There are, however, some indications of wetter conditions in 2012, although the previous description of C1, the central ecotope area in which the quadrat was recorded, suggests that the 2004 quadrat was not representative of the finest quality habitat within the area (Fernandez *et al.*, 2005).

- **Qsc1**: this quadrat was classified as sub-central ecotope, complex 4/6 in 2004 and as sub-central complex 10/4 in 2012. A number of differences were noted, some of which were indicative of wetter conditions on 2012, in keeping with the trend of re-wetting of habitats in this part of the high bog, following the blocking of a number of drains.
- **Qsc3**: this sub-central quadrat was classified as 6/3+P in 2004, but as 9/7+P in 2012. A number of differences between the quadrats were noted, including greater cover of both *Sphagnum* hummocks and lawns in 2012. These and other minor changes can probably be attributed to slight variation in the quadrat location.
- **Qsc4**: this sub-central quadrat was classified as 6/3+P in 2004, but as 9/7+P in 2012. A number of differences were noted, which can probably be attributed to variation in the quadrat location, particularly as the quadrat is located near the sub-central/sub-marginal boundary (of Sc6), where the vegetation is somewhat transitional in nature. The 2012 quadrat was re-located slightly towards the interior of Sc6, as the original location was thought to be too close to the new ecotope boundary, and therefore in habitat that was not satisfactorily representative of the area.

Restoration works

- Restoration works, in the form of drainage blocking, have been undertaken at the site. A series of drains, mostly in the southern section of the high bog, including the long bA drain that crosses this whole section of bog, and the adjacent bD complex of drains, have been blocked, and now have reduced functional status.
- NPWS has engaged in negotiation with landowners in relation to the cessation of peat cutting at the site and this activity has declined to the point where no active plots were identified as of September 2012. Part of the strategy for ending turf cutting has involved the re-location of turf cutters to adjacent local bogs.

Summary of conservation status

- **Active Raised Bog** has been given an **Unfavourable Bad–Declining** conservation status at Carrownagappul Bog. Habitat Area has increased and quality (S&Fs) improved in the reporting period. However both values are below the FRVs. The increase in area is associated with the re-wetting of habitats resulting from drainage blocking on the high bog. Although an Increasing trend in habitat Area and Improving trend in S&Fs would be expected in the following two reporting periods (12 years) as a result of restoration works, peat cutting continues at the site despite a reduction on its intensity (i.e. number of turf

plots actively cut away) in the reporting period. It cannot be ruled out habitat losses in the future if the activity is re-initiated in other locations or intensified within current ones. As a result a negative Future Prospects (**Unfavourable Bad-Declining**) are expected unless peat cutting is completely phased out at the site.

- **Degraded Raised Bog** has been given an **Unfavourable Bad-Declining** conservation status at Carrownagappul Bog. Habitat Area has slightly decreased due to an increase in Active raised Bog, but also due to losses associated with peat cutting. Habitat's S&Fs have remained stable. Habitat Area and S&Fs are above the FRV, which is considered negative as regards the habitat status. Future Prospects are considered Unfavourable Bad-Declining due to the ongoing threat from impacting activities (i.e. peat cutting and drainage).
- **Depressions on peat substrates of the Rhynchosporion** has been given a **Unfavourable Bad-Declining** conservation status at Carrownagappul Bog. Habitat Area is considered to be unchanged and quality (S&Fs) Improved in the reporting period. However, Future Prospects are considered Unfavourable Bad-Declining due to the ongoing threat from negatively impacting activities.

The **conservation status** of the **overall raised bog** at **Carrownagappul SAC** is assessed as being **Unfavourable Bad-Declining**.

Recommendations

- **Cessation of peat cutting.**
- **Further restoration works** including the blocking of any remaining high bog functional and reduced functional drains, and possibly the cutover drains. There is an extensive drainage network on the high bog and a considerable extent of unblocked functional and reduced functional drains remaining. This would suggest a significant potential for further recovery of high bog habitats.

  There is potential for the restoration of cutover bog along the entire site cutover. This may be particularly important if it proves unfeasible to reach the ARB target only on the high bog.
- **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 in order to assess change in habitat's conservation status, and potentially also on cutover areas if they were to be restored, in order to assess the effectiveness of restoration works.

References

Cross, J. R. 1990. *The Raised Bogs of Ireland: their Ecology, Status and Conservation*. Report to the Minister of State at the Department of Finance.

Fernandez, F., Fanning, M., McCorry, M. and Crowley, W. 2005. *Raised Bog Monitoring Project 2004-05*. Unpublished report, National Parks & Wildlife Service, Department of Environment, Heritage and Local Government, Dublin.

Kelly, L., Doak, M. and Dromey, M. 1995. *Raised Bog Restoration Project: An Investigation into the Conservation and Restoration of Selected Raised Bog Sites in Ireland*. Unpublished report, National Parks & Wildlife, Department of Environment, Heritage and Local Government, Dublin.

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 Complex

COMPLEX 15

- **Location**: this complex characterizes **C1**, **C2** and **C3**
- **Ground**: very soft to quaking
- **Physical indicators**: burnt, dead *Calluna* stems, bare peat 1-4%
- ***Calluna* height**: 11-20cm
- ***Cladonia* cover**: <1% (burn damaged)
- **Macro-topography**: gentle slope to north east/partial depression
- **Pools**: large, interconnecting, 11-25%
- ***Sphagnum* cover**: 76-90%
- ***Narthecium* cover**: 26-33
- **Micro-topography:** low hummocks/hollows/pools/lawns
- **Tussocks:** *Trichophorum germanicum* 1-4%
- **Degradation or regeneration evidence**: absent
- **Species cover**: *Sphagnum capillifolium* (26-33%), *S. cuspidatum* (5-10%), *S. papillosum* (34-50%), *S. tenellum* (1-4%), *S. fuscum* (<1%), *S. austinii* (<1%), *S. magellanicum* (5-10%), *Narthecium ossifragum* (26-33%), *Carex panicea* (1-4%), *Erica tetralix* (5-10%), *Eriophorum vaginatum* (5-10%), *E. angustifolium* (1-4%), *Trichophorum germanicum* 1-4%, *Menyanthes trifoliata* (1-4%), *Leucobryum glaucum* (<1%), *Campylopus atrovirens* (<1%).
- **Additional comments**: Effects of recent (estimated 1 – 2 years ago) severe burn seen on dead *Sphagnum* - mostly *S. capillifolium* – on hummocks, and burnt, dead *Calluna vulgaris* stems. Hummocks of *S. austinii* and *S. fuscum* were quite uncommon in this complex. Pools were generally devoid of algae, while *Campylopus atrovirens* was only rare at pool edges.

Sub-Central Ecotope Complexes

COMPLEX 10/4

- **Location**: this complex is found within **Sc1** and **Sc4**
- **Ground**: quaking
- **Physical indicators**: dead burnt *Calluna* stems
- ***Calluna* height**: 0-10 cm
- ***Cladonia* cover**: <4%
- **Macro-topography**: flat
- **Pools**: regular shaped, 4-10%
- ***Sphagnum* cover**: 50-75% (usually 70%+, sometimes 80-90%)
- ***Narthecium* cover**: 4-10%
- **Micro- topography**: Low hummocks, hollows, pools & lawns
- **Tussocks**: absent
- **Degradation or regeneration evidence**: absent
- **Species cover**: *Calluna vulgaris* (4-10%, frequent), *Carex panicea* (1-3%, occasional), *Trichophorum germanicum* (1-3%, occasional), *Rhynchospora alba* (4-10%, abundant), *Sphagnum capillifolium* (4-10%), *S. papillosum* (33-50%), *S. magellanicum* (10-25%), *S. austinii* (<4%, occasional), *S. cuspidatum* (10-25%).
- **Additional comments:** Dominated by quaking *Sphagnum papillosum* and *S. magellanicum* lawns. *Rhynchospora alba* abundant, but typically occupies a low cover overall due to its scattered distribution and slender growth form. *R. alba* and *Narthecium ossifragum* characterise flats. *S. capillifolium* hummocks are small. The small pools are a mixture of very shallow and open, algal, and *S. cuspidatum* dominated. The presence of *Aulacomnium palustre* suggests that the wider complex outside flush Y may also be flushed to some extent. Most of this complex has been recently burnt. Small parts that have escaped support taller (10-20 cm) *Calluna* on hummocks and greater *Eriophorum vaginatum* cover.

COMPLEX 9/10

- **Location**: this complex is found within **Sc4** and **Sc5**
- **Ground**: soft to very soft
- **Physical indicators**: burn damage - burnt dead *Calluna vulgaris*, bare peat 1-4%
- ***Calluna* height**: 11-20cm
- ***Cladonia* cover**: absent (some burnt dead material)
- **Macro-topography**: gentle slope to east
- **Pools**: regular, 1-4%
- ***Sphagnum* cover**: 34-50%

- ***Narthecium* cover**: 5-10%
- **Micro-topography:** low hummocks/hollows/pools
- **Tussocks:** *Trichophorum germanicum* <1%; *Eriophorum vaginatum* 1-4%
- **Degradation or regeneration evidence**: possibly regenerating after drain-blocking elsewhere in the site
- **Species cover**: *Sphagnum capillifolium* (11-25%), *S. cuspidatum* (1-4%), *S. papillosum* (5-10%), *S. tenellum* (1-4%), *S. austinii* (1-4%), *Narthecium ossifragum* (5-10%), *Eriophorum vaginatum* (11-25%), *E. angustifolium* (1-4%), *Carex panicea* (5-10%), *Calluna vulgaris* (11-25%).
- **Additional comments**: This 9/10 sub-central was probably not a particularly fine example of the complex, as *Narthecium ossifragum* cover was often higher than may be expected, while *Eriophorum vaginatum* cover was on the low side of the 11-25% cover recorded above. Pools were rare, and sparsely colonised by *S. cuspidatum*. However, the complex was generally very wet, and *Sphagnum* cover was over 50% in places. The area may be undergoing re-wetting/regeneration due to drain blocking to the north. The sub-central complex 9/10 was mapped beside flush A.

COMPLEX 9/7+P

- **Location**: this complex is found within **Sc5**, **Sc6** and **Sc8**
- **Ground**: soft to very soft
- **Physical indicators**: absent (no burn damage)
- ***Calluna* height**: 21-40cm
- ***Cladonia* cover**: 1-4%
- **Macro-topography**: gentle slope to south-east
- **Pools**: tear pools, 11-25%
- ***Sphagnum* cover**: 34-50%
- ***Narthecium* cover**: 5-10%
- **Micro-topography:** low hummocks/hollows/pools/lawns
- **Tussocks:** *Trichophorum germanicum* 1-4%
- **Degradation or regeneration evidence**: absent
- **Species cover**: *Sphagnum capillifolium* (5-10%), *S. cuspidatum* (11-25%), *S. papillosum* (5-10%), *S. magellanicum* (5-10%), *Calluna vulgaris* (11-25%), *Narthecium ossifragum* (5-10%), *Eriophorum vaginatum* (5-10%), *Eriophorum angustifolium* (1-4%), *Trichophorum germanicum* 5-10%, *Carex panicea* (5-10%), *Rhynchospora alba* (1-4%).

- **Additional comments**: Overall cover of *S. cuspidatum* in pools was approximately 75%. *Menyanthes trifoliata* and *Drosera anglica* were present in pools, while *S. papillosum* and *S. magellanicum* were common at pool edges. Hummocks of *S. fuscum* and *Leucobryum glaucum* were occasional in the interpool flats.

COMPLEX 9/7/6+P

- **Location**: this complex is found within **Sc5** and **Sc10**
- **Ground**: soft to very soft
- **Physical indicators**: burn damage: dead *Calluna* stems; damaged *Sphagnum* hummocks; bare peat c.1%
- ***Calluna* height**: 11-20cm
- ***Cladonia* cover**: <1%
- **Macro-topography**: flat
- **Pools**: tears, 10%
- ***Sphagnum* cover**: 34-50%
- ***Narthecium* cover**: 11-25%
- **Micro-topography:** low hummocks/hollows/pools
- **Tussocks:** absent
- **Degradation or regeneration evidence**: absent
- **Species cover**: *Sphagnum capillifolium* (11-25%), *S. magellanicum* (1-4%), *S. papillosum* (5-10%), *S. tenellum* (1-4%), *S. fuscum* (1-4%), *S. subnitens* (1-4%), *S. austinii* (1-4%), *Calluna vulgaris* (11-25%), *Narthecium ossifragum* (11-25%), *Eriophorum vaginatum* (5-10%), *Eriophorum angustifolium* (1-4%), *Carex panicea* (5-10%), *Erica tetralix* (1-4%).
- **Additional comments**: This complex is similar to 9/7+Pools, but is of somewhat lesser quality, and is partly characterised by the presence of *Narthecium ossifragum*, with a typical cover value of 15%.

COMPLEX 6+P

- **Location**: this complex is found within **Sc2**, **Sc3**, **Sc4**, **Sc5**, **Sc6** and **Sc9**
- **Ground**: soft to very soft
- **Physical indicators**: burn damage: burnt *Calluna*; damaged *Sphagnum* hummocks
- ***Calluna* height**: 11-20cm
- ***Cladonia* cover**: <1%
- **Macro-topography**: gentle slope to south-east

- **Pools**: regular, 5-10% (c.10%)
- ***Sphagnum* cover**: 30-40%
- ***Narthecium* cover**: 11-25%
- **Micro-topography:** low hummocks/hollows/pools
- **Tussocks:** *Trichophorum germanicum* <1%
- **Degradation or regeneration evidence**: may be regenerating after drain blocking
- **Species cover**: *Sphagnum capillifolium* (11-25%), *S. cuspidatum* (1-5%), *S. papillosum* (11-25%), *S. tenellum* (1-4%), *Calluna vulgaris* (11-25%), *Narthecium ossifragum* (11-25%), *Eriophorum vaginatum* (5-10%), *Eriophorum angustifolium* (1-4%), *Carex panicea* (5-10), *Rhynchospora alba* (5-10%).
- **Additional comments**: In some places within this complex, *Rhynchospora alba* formed a more significant part of the vegetation, and in these areas, the complex 6/4+P would have been an equally appropriate classification to use. However, all of this habitat was classified within 6+P, as it consisted of only small, isolated patches, and with the exception of more frequent *R. alba*, was broadly similar to the more typical vegetation of the complex. Those parts of the complex with greater abundance of *R. alba*, were similar to the sub-central complex 10/4 (above). The combination of *Narthecium ossifragum* and *Rhynchospora alba* forms a dominant element of the interpool flats in both cases, while the micro-topography and characteristics of pools are also similar within each complex. The greater *Sphagnum* cover of 50-75% in 10/4 illustrates the wetter nature of that complex. Some parts of 6+P were of lesser quality and somewhat transitional between sub-central sub-marginal ecotopes. The pools in 6+P had a variable (though rarely high) cover of *S. cuspidatum*, but a high cover of *S. papillosum* in low hummocks at pool edges. *Campylopus atrovirens* was also present at pool edges. 6+P was also used here as a sub-marginal community complex (see below).
- Variant 1: 6/9+P (Pools): this very rarely recorded complex variant was used to reflect the presence of *Eriophorum vaginatum* as a characteristic element of the vegetation.

Active flushes

FLUSH A

- **Location**: south-east of bog, to the east of wide track
- **Ground**: soft
- **Physical indicators**: absent
- ***Calluna* height**: 21-40

- ***Cladonia* cover**: 1-4%
- **Macro-topography**: slope to bog margin
- **Pools**: large, 10%
- ***Sphagnum* cover**: 34-50%
- ***Narthecium* cover**: 1-4%
- **Micro-topography:** low hummocks/hollows/
- **Tussocks:** absent
- **Degradation or regeneration evidence**: absent
- **Species cover**: *Sphagnum capillifolium* (11-25%), *S. cuspidatum* (5-10%), *S. papillosum* (11-25%), *Calluna vulgaris* (11-25%), *Narthecium ossifragum* (1-4%), *Eriophorum vaginatum* (5-10%), *Aulacomnium* palustre (1-4%), *Vaccinium oxycoccos* (1-4%), *Empetrum nigrum* (1-4%), and *Andromeda polifolia* (<1%).
- **Additional comments**: *Betula pubescens* was occasional throughout the flush, while *Ulex europaeus* (3m tall), *Betula*, and *Pinus* (*contorta*?) composed a small patch of scrub in the north end of the flush. *Rubus fruticosus* and *Juncus* effusus were also present here. In the south end of the flush, there were scattered small (<1m) *Salix* sp. shrubs, and two small *Picea* sp. (1m and 2m tall). Hummocks of *Aulacomnium palustre* were present throughout, while other flush species recorded included *Vaccinium oxycoccos*, *Empetrum nigrum* and *Andromeda polifolia*.

FLUSH Y

This flush is very much as described in the 2004/5 report, apart from the recent burning of the eastern part of the flush. The western part remains unburnt and supports *Calluna* cover of 10-25% and 10-20 cm height. This is a wet, quaking area that differs only slightly from the surrounding sub-central area **SC1**. The flush was remapped to correspond with the extent of scattered *Phragmites australis* cover. The *Rhododendron ponticum* bush noted in 1994 and 2004/5 was not found and thus may have been killed in the fire.

Degraded Raised Bog (7120)

Sub-Marginal Ecotope Complexes

COMPLEX 9/7/6

- **Location**: south west corner of the high bog, and surrounding **Sc8** in the northeast corner of the bog

- **Ground**: soft
- **Physical indicators**: bare peat 5%; burnt *Calluna* stems; fire-damaged *Sphagnum* hummocks
- ***Calluna* height**: 11-20cm
- ***Cladonia* cover**: absent
- **Macro-topography**: slope to south east
- **Pools**: absent
- ***Sphagnum* cover**: 26-33%
- ***Narthecium* cover**: 11-25%
- **Micro-topography:** low hummocks/hollows
- **Tussocks:** *Eriophorum vaginatum* 10%
- **Degradation or regeneration evidence**: Complex may be getting wetter – indications of water movement into this area included presence of flush species
- **Species cover**: *Sphagnum capillifolium* (11-25%), *S. magellanicum* (5-10%), *S. papillosum* (1-4%), *S. tenellum* (1-4%), S. *austinii* (<1%), *Calluna vulgaris* (26-33%), *Eriophorum vaginatum* (11-25%), *Eriophorum angustifolium* (5-10%), *Carex panicea* (5-10%)
- **Additional comments**: The presence (albeit at very low cover values) of the flush species, *Vaccinium oxycoccos* and *Aulacomnium palustre*, may indicate some movement of water through this complex and suggests the possibility of the area becoming active in the future. Flush species were less common within the complex near the western edge of the site, although *V. oxycoccos* was still occasional in this area. *Sphagnum* hummocks in this complex were frequently fire-damaged; the more healthy *Sphagnum* material was that in hollows (mostly *S. papillosum* & *S. magellanicum*), although some *S. capillifolium* hummocks in the west of the site were somewhat healthier than those in the south west. The cover of *Narthecium ossifragum* and *Eriophorum angustifolium* varied somewhat within the complex, such that some parts of it could justifiably have been assigned to other community complexes. However, these were mostly only very small pockets of vegetation, and these areas were included within 9/7/6.

COMPLEX 6+P

- **Location**: west and south of **Sc2** and surrounding **Sc5**,**Sc6** and **Sc8**
- **Ground**: very soft
- **Physical indicators**: burnt *Calluna* stems
- ***Calluna* height**: 0-10cm
- ***Cladonia* cover**: <4%
- **Macro-topography**: gentle slope to flat

- **Pools**: 11-25% interconnected & tear pools
- ***Sphagnum* cover**: 10-25%
- ***Narthecium* cover**: 25-33%
- **Micro- topography**: Low hummocks, flats, hollows & pools
- **Tussocks**: *Trichophorum germanicum* & *Eriophorum vaginatum* <4% each
- **Degradation or regeneration evidence**: absent
- **Species cover**: *Calluna vulgaris* (4-10%, regenerating on hummocks), *Eriophorum vaginatum* (4-10%), *Carex panicea* (4-10%, frequent), *Erica tetralix* (<4%, frequent), *Trichophorum germanicum* (<4%, frequent), *Sphagnum capillifolium* (4-10%), *S. cuspidatum* (4-10%), *S. papillosum* (usually <4%, sometimes 4-10%), *S. austinii* (<4%, rare).
- **Additional comments:** Burnt 1-2 years ago. Micro-topography poorly developed with very low hummocks. Nice pools with variable 25-50% cover of *Sphagnum cuspidatum* and algae. *Narthecium ossifragum* flats dominate. Dead *Calluna* stems highly visible, as are charred, regenerating tussocks of *Trichophorum germanicum* and *Eriophorum vaginatum.* Often grades gradually into sub-central complex 6+P, differentiated by higher cover of *Sphagna* (especially *S. papillosum*) and higher quality pools, with the boundary difficult to place.

COMPLEX 9/7

- **Location**: this complex is found across the entire high bog
- **Ground**: soft
- **Physical indicators**: mainly burnt with leggy dead *Calluna* stems; dead *Sphagna* & bare peat cover 26-33%
- ***Calluna* height**: 0-10cm
- ***Cladonia* cover**: 1-4%
- **Macro-topography**: gentle slope
- **Pools**: tears, 1-4%
- ***Sphagnum* cover**: 5-10%
- ***Narthecium* cover**: 5-10%, patchy
- **Micro- topography**: Low hummocks, hollows, flats
- **Tussocks**: *Eriophorum vaginatum* 1-3%
- **Degradation or regeneration evidence**: absent
- **Species cover**: *Calluna vulgaris* (34-50%), *Eriophorum vaginatum* (10-25%), *Carex panicea* (5-10%, locally abundant), *Erica tetralix* (1-4%), *Sphagnum capillifolium* (5-10%), *S. subnitens* (1-4%) and occasional *Betula pubescens*.

- **Additional comments:** Burnt 1-2 yr ago. Leggy, dead *Calluna* are prominent with low regeneration forming carpets. *Eriophorum vaginatum* was the most prominent species. *Sphagnum* cover was formerly 25%+, but was now mostly dead except for some *S. capillifolium* hummocks. An extreme example of this occurs in the southeast corner of the site on the east side of the trackway, classed as Marginal complex 7/9(B). This is described separately below. Some 9/7 sub-marginal in the north of the site had not been burnt and had 20% cover of *Cladonia portentosa* and total *Sphagnum* cover of 20%. *Calluna vulgaris* and *Eriophorum vaginatum* were present here at 20% and 15%, respectively, while low hollows supported *S. capillifolium*, *S. papillosum* and *S. subnitens*. Small tear pools had varying amounts of *S. cuspidatum*. There were occasional (1-4% total cover) small pools in the complex, but these were generally devoid of any significant *Sphagnum* cover.

  To the southeast of flush Z is a very soft, wet area of sub-Marginal complex 9/7 that appears to be receiving water flow from northwest to southeast. This area is borderline sub-central 9/7/10 and may become active in the future.

  Some of complex 9/7 in the south-west of the site tended towards 9/10 sub-central, where *Sphagnum* cover was high, and good *S. austinii* hummocks were present. However, a high proportion of *S. capillifolium* hummocks here were fire-damaged and not included in the assessment of *Sphagnum* cover, which had the effect of pushing this vegetation towards a sub-marginal assessment.

COMPLEX 9A/7/3

- **Location**: around **Sc1**
- **Ground**: soft
- **Physical indicators**: burnt
- ***Calluna* height**: 0-10cm
- ***Cladonia* cover**: absent
- **Macro-topography**: gentle slope
- **Pools**: absent
- ***Sphagnum* cover**: 25-33%
- ***Narthecium* cover**: 4-10%
- **Micro- topography**: Low hummocks, lawns
- **Tussocks**: absent
- **Degradation or regeneration evidence**: absent

- **Species cover**: *Calluna vulgaris* (25-33%), *E. angustifolium* (4-10%, abundant), *Carex panicea* (4-10%, frequent), *Trichophorum germanicum* (1-3%, occasional-rare), *Eriophorum vaginatum* (1-3%, occasional-rare), *Sphagnum capillifolium* (11-25%), *S. subnitens* (4-10%), *S. papillosum* (1-3%, occasional-rare).
- **Additional comments:** Burnt 1-2 yr ago. Fairly flat and soft. Regenerating *Calluna* forms low, dense carpets. *E. angustifolium* was prominent, suggesting some degree of water movement. *S. capillifolium* and *S. subnitens* hummocks were frequent, but other *Sphagna* were rare.

COMPLEX 6/3

- **Location**: this complex is found throughout the marginal ecotope on the high bog
- **Ground**: soft
- **Physical indicators**: bare peat <5%; burnt *Calluna*
- ***Calluna* height**: 11-20cm
- ***Cladonia* cover**: <1%
- **Macro-topography**: gentle slope to east
- **Pools**: tear pools/some regular pools; 1-4%
- ***Sphagnum* cover**: 30-40%
- ***Narthecium* cover**: 11-25%
- **Micro-topography:** low hummocks/hollows/pools
- **Tussocks:** *Trichophorum germanicum* 5%
- **Degradation or regeneration evidence**:
- **Species cover**: *Sphagnum capillifolium* (11-25%), *S. papillosum* (5-10%), *S. subnitens* (1-4%), *S. tenellum* (<1%), *S. fuscum* (<1%), *Carex panicea* (11-25%), *Narthecium ossifragum* (11-25%), *Calluna vulgaris* (26-33%), *Eriophorum vaginatum* (5-10%), *E. angustifolium* (1-4%), *Erica tetralix* (1-4%), *Trichophorum germanicum* (5-10%).
- **Additional comments**: *Trichophorum germanicum* was more common near the sub-marginal/marginal boundary in this complex. *Sphagnum subnitens* was locally frequent on a number of small hummocks, adjacent to blocked drains. *Eriophorum vaginatum* was also locally frequent in the complex, such that another complex (e.g. 6/3/9) could justifiably have been described. However, these were small, isolated pockets of vegetation and were therefore retained in complex 6/3. This sub-marginal complex graded into the marginal complex 3/6+B in the north-east of the bog. The sub-marginal complex is wetter and has a greater cover of *Sphagnum*. In the north of the site, sub-marginal 6/3 has some small pools (<5% cover) and is transitional to the sub-central 9/7+Pools complex.

Marginal Ecotope Complexes

COMPLEX 3/6B (BURNT)

- **Location**: complex 3/6, both burnt and unburnt, is found across entire high bog margin
- **Ground**: firm
- **Physical indicators**: burn damage (1-2 years old?) – tall *Calluna* stems burnt & dead, dead *Sphagnum* (especially hummocks), charred tussocks, bare peat 26-33;
- ***Calluna* height**: 0-10cm
- ***Cladonia* cover**: absent
- **Macro-topography**: gentle slope to north east
- **Pools**: shallow tears, 5-10%
- ***Sphagnum* cover**: 1-4%
- ***Narthecium* cover**: 11-25%
- **Micro-topography:** low hummocks/hollows
- **Tussocks:** *Eriophorum vaginatum* (1-4%),
- **Degradation or regeneration evidence**: absent
- **Species cover**: *Sphagnum capillifolium* (1-4%), *Calluna vulgaris* (26-33%), *Narthecium ossifragum* (11-25%), *Carex panicea* (5-10%), *Erica tetralix* (5-10%), *Eriophorum vaginatum* (5-10%), *E. angustifolium* (1-4%), *Rhynchospora alba* (1-4%).
- **Additional comments**: Severely burnt 1-2 years ago; *Sphagnum* hummocks mostly dead. *Cladonia portentosa* was absent where the complex description was initiated and over much of the site, but was present at 1-5% cover in a few places. There were occasional large *Leucobryum glaucum* hummocks in the complex, although they had been severely damaged by fire, and had mostly disintegrated.

COMPLEX 7/9(B) (BURNT)

- **Location**: SE corner of site on east side of main track
- **Ground**: firm
- **Physical indicators**: mainly burnt with leggy dead *Calluna* stems; dead *Sphagna* & bare peat cover 25-33%
- ***Calluna* height**: 0-10cm
- ***Cladonia* cover**: absent
- **Macro-topography**: gentle slope
- **Pools**: absent

- ***Sphagnum* cover**: 1-4%, only occasional remnants
- ***Narthecium* cover**: 1-3%
- **Micro- topography**: Low hummocks, hollows
- **Tussocks**: *Eriophorum vaginatum* 4-10%
- **Degradation or regeneration evidence**: absent
- **Species cover**: *Calluna vulgaris* (10-25%), *Eriophorum vaginatum* (10-25%), *Carex panicea* (4-10%, frequent), *Erica tetralix* (4-10%, frequent), *Sphagnum capillifolium* (<4%).
- **Additional comments:** Severely burnt 1-2 yr. ago. This complex was thought to have formerly been within the sub-marginal complex 9/7. However, *Sphagnum capillifolium* hummocks that appeared to have been formerly abundant, were now nearly all dead, and healthy *Sphagnum* was all but absent from the complex. Occasional *Leucobryum glaucum* hummocks, some over 0.5m tall, were also damaged by fire.

Inactive flushes

FLUSH U

This area, newly mapped as flush, occupied nearly all of a remnant pier of high bog surrounded on three sides by cutover. The area was formerly used for drying and stacking turf. It had been badly burnt. It was occupied by abundant *Molinia caerulea*, *Carex panicea* and bare peat. Patches of the thallose liverwort *Pellia epiphylla* were locally abundant. *Calluna* was frequent and occasional *Salix* saplings were found. At the margins, the former facebank vegetation has been burnt and replaced by dense, young *Calluna* regeneration.

FLUSH W

As with the majority of the site, flush W has been burnt 1-2 years previously. *Molinia caerulea* is abundant, re-sprouting from tussocks. Several *Betula pubescens* trees have been killed by the fire, but more have survived. The tallest tree was approximately 10m tall. *Salix aurita* bushes have mainly survived, re-sprouting from the base and from larger stems. *Ulex europaeus* bushes have been burnt entirely, with much bare peat at their bases, in which *Calluna* is regenerating abundantly. There is a deep stream channel within the flush, approximately 1.5 m wide and 1 m deep with flowing water. It is mainly occupied by open water, with some *Sphagnum palustre* at the edges. The channel is largely shaded, however, by bankside vegetation, including *Molinia caerulea*, *Rubus fruticosus, Athyrium filix-femina, Succisa pratensis*, *Comarum palustre* and *Potentilla erecta*.

The upper (NW) part of the flush was much the same as described above. *Molinia* was dominant with some small *Calluna* regenerating on drier hummocks. The flush is apparently a natural drainage feature, with natural looking clefts often without flowing water.

West of the main track, the flush was mainly dominated by *Molinia* bordering a dry, 1.5 m deep, 3 m wide channel. The channel was full of *Pteridium aquilinum* and occasional *Athyrium filix-femina, Osmunda regalis, Crataegus monogyna, Rubus fruticosus* and *Lonicera periclymenum.*

FLUSH W1

This small flush was a pocket at the head of a drain, burnt in the past 1-2 years. *Molinia caerulea* was dominant. Several birch saplings were present, some of which were dead and others which have survived and were resprouting from the base.

FLUSH W2

This newly identified area of inactive flush was a small area falling southeast towards the track and drains. The flush appeared to have been formerly actively peat-forming, but was now inactive as a result of the fire having killed off most of the *Sphagnum*. Many low *Salix aurita* and *S. x multinervis* bushes have been burnt, but some were resprouting. Otherwise, *Eriophorum vaginatum* and low *Calluna vulgaris* were abundant, with frequent *Erica tetralix* and *Carex panicea*. *Molinia caerulea, Andromeda polifolia, Betula pubescens* saplings, *Chamerion angustifolium* and *Sphagnum capillifolium* were occasional. Vegetation was transitional to the nearby sub-marginal complex 9/7. The ground was very hummocky and may be very old, lightly cutover bog.

FLUSH Z

This area of inactive flush occurred in association with unblocked, functional drain bB (mapped as functional in 2004/5, but erroneously referred to as blocked in the 2004/5 report). *Calluna* was formerly tall and leggy here and *Molinia* was dense, so the recent fire damaged the flush badly. Tussocky *Molinia* was dominant, with abundant young *Calluna*, dead *Sphagnum* and bare peat. *Phragmites australis* and *Erica tetralix* were frequent. To the southeast, the flush graded into a more open, wet flush with frequent but scattered *Phragmites* and frequent to locally abundant *Sphagnum capillifolium* hummocks. An additional area of open flush similar to this has been mapped to the southeast and may have expanded since the 2004/5 survey.

As noted above, to the southeast of flush Z was a very soft, wet area of sub-marginal complex 9/7 that appeared to be receiving water flow from northwest to southeast. This area was borderline sub-central 9/7/10 and may become active in the future.

Face bank Complexes

COMPLEX 1

- **Location**: present intermittently around much of the high bog margin
- **Ground**: firm
- **Physical indicators**: some burnt tall *Calluna vulgaris*
- ***Calluna* height**: 21-40cm
- ***Cladonia* cover**: 1-4%
- **Macro-topography**: slope to bog margin
- **Pools**: absent
- ***Sphagnum* cover**: 1-4%
- ***Narthecium* cover**: 1-4%
- **Micro-topography:** low hummocks/tall *Calluna vulgaris*
- **Tussocks:** *Trichophorum germanicum* 1-4%
- **Degradation or regeneration evidence**: absent
- **Species cover**: *Sphagnum capillifolium* (1-4%), *Calluna vulgaris* (76-90%), *Rhynchospora alba* (11-25%), *Narthecium ossifragum* (5-10%), *Eriophorum vaginatum* (1-4%), *Eriophorum angustifolium* (1-4%), *Trichophorum germanicum* (1-4%).
- **Additional comments**: none

Depressions on peat substrates of the Rhynchosporion (7150)

The habitat occurs at Carrownagappul Bog in both Active and Degraded Raised Bog, but it is only occasionally found on degraded habitat. Only *Rhynchospora alba* was recorded in the 2012 survey at this site.

R. alba is found in all ecotopes in Carrownagappul Bog, such as: central ecotope (15); sub-central ecotope (10/4; 6/4+P; 9/7+P); sub-marginal ecotope (6+P), marginal ecotope (3/6) and face bank ecotope (1).

The species becomes very frequent within complexes 10/4 and 6/4+P (sub-central); it is occasionally frequent in marginal and face bank ecotope, but only in erosion channels or tear pools, in these cases.

The species is always found associated with wet features such as *Sphagnum* pools, *Sphagnum* lawns and hollows, along with species such as *Sphagnum magellanicum*, *S. papillosum*, *S. cuspidatum*. It was also found within hollows in sub-marginal and marginal ecotope complexes.

Appendix II Photographical records

Photograph Number	Aspect	Type	Feature	Date
DSC00342	NE	Overview	Qc1	02/10/2012
DSC00343	NE	Overview	Qsc1	03/10/2012
DSC00344	NE	Overview	Qsc3	03/10/2012
DSC00345	NE	Overview	Qsc4	04/10/2012
DSC00346	S	Overview	Last block on drain - contrast with final drain	04/10/2012

Appendix III Quadrats

Ecotope type	**Central**	**Central**	**Central**	**Central**
Complex Name	**9/14**	**15**	**6/14**	**6/14**
Quadrat Name	Qc1	Qc1	Qc2	Qc3
Easting	166797	166800.795	166664	166469
Northing	249900	249896.572	249922	250182
Date	11/08/2004	02/10/2012	11/08/2004	11/08/2004
Firmness	quaking	Quaking	quaking	quaking
Burnt	No	Light	No	No
Algae in hollows %	1-3 (many indiv)	Absent	Absent	Absent
Algae in pools %	Absent	4-10	Absent	Absent
Bare peat %	Absent	4-10	Absent	Absent
High hummocks %	na	Absent	na	na
Low hummocks %	11-25	26-33	11-25	11-25
Hollows %	4-10	4-10	11-25	11-25
Lawns %	Absent	11-25	Absent	Absent
Pools %	11-25	26-33	26-33	11-25
Pool type	Interconnecting	Interconnecting	Interconnecting	Interconnecting
S.austinii hum type	na	Absent	na	na
S.austinii hum %	Absent	Absent	Absent	Absent
S.austinii height(cm)	na	Absent	na	na
S.fuscum hum type	na	Absent	na	na
S.fuscum hum %	Absent	Absent	Absent	Absent
S.fuscum height(cm)	na	Absent	na	na
Leucobryum glaucum	Absent	Absent	Absent	Absent

Ecotope type	**Central**	**Central**	**Central**	**Central**
Complex Name	**9/14**	**15**	**6/14**	**6/14**
Trichophorum type	Absent	Absent	Absent	Absent
Trichophorum %	Absent	Absent	Absent	Absent
S.magellanicum %	4-10	1-3 (several indiv)	1-3 (many indiv)	4-10
S.cuspidatum %	1-3 (many indiv)	4-10	4-10	4-10
S.papillosum %	11-25	34-50	4-10	4-10
S.denticulatum %	4-10	1-3 (few indiv)	4-10	Absent
S.capillifolium%	4-10	11-25	11-25	4-10
S.tenellum %	na	1-3 (few indiv)	na	na
S.subnitens %	na	1-3 (several indiv)	na	na
R.fusca %	Absent	Absent	Absent	Absent
R.alba %	4-10	4-10	4-10	4-10
N.ossifragum %	1-3 (many indiv)	1-3 (few indiv)	11-25	11-25
Sphag pools %	11-25	11-25	26-33	11-25
Dominant pool Sphag	S.cuspidatum;S. denticulatum	S.cuspidatum	S.cuspidatum;S. denticulatum	S.cuspidatum
Sphag lawns %	Absent	4-10	Absent	Absent
Sphag humm %	11-25	26-33	11-25	11-25
Sphag holl %	4-10	1-3 (many indiv)	4-10	4-10
Total Sphag %	34-50	51-75	34-50	26-33
Hummocks indicators	Absent	Absent	Absent	Absent
Cladonia portent %	1-3 (many indiv)	1-3 (many indiv)	1-3 (many indiv)	1-3 (many indiv)
Other Cladonia sp	na	cladunci	na	na
C. panicea %	na	1-3 (several indiv)	na	na
Calluna cover %	11-25	4-10	11-25	11-25
Calluna height(cm)	21-30	0-10	21-30	31-40
Other NotableSpecies		none		

Ecotope type	**Central**	**Central**	**Central**	**Central**
Complex Name	**9/14**	**15**	**6/14**	**6/14**
Other comment		Calluna decrease due to fire; Sphagnum denticulatum likely Overestimated in past b/co confusion with Sphagnum papillosum in pools		

Ecotope type	**Sub-central**	**Sub-central**	**Sub-central**	**Sub-central**
Complex Name	**4/6**	**10/4**	**6/15**	**6/3 + P**
Quadrat Name	Qsc1	Qsc1	Qsc2	Qsc3
Easting	169409	166412.381	166286	167611
Northing	249799	249801.352	250303	250556
Date	11/08/2004	03/10/2012	11/08/2004	11/08/2004
Firmness	quaking	Quaking	very soft	firm-soft
Burnt	No	Light	No	No
Algae in hollows %	1-3 (many indiv)	1-3 (many indiv)	1-3 (many indiv)	Absent
Algae in pools %	Absent	11-25	4-10	4-10
Bare peat %	Absent	1-3 (several indiv)	Absent	Absent
High hummocks %	na	Absent	na	na
Low hummocks %	11-25	26-33	11-25	11-25
Hollows %	11-25	4-10	4-10	4-10
Lawns %	11-25	34-50	Absent	Absent
Pools %	Absent	26-33	4-10	11-25
Pool type	Absent	Regular	Tear	Tear
S.austinii hum type	na	Absent	na	na
S.austinii hum %	4-10	Absent	1-3 (many indiv)	na

Ecotope type	**Sub-central**	**Sub-central**	**Sub-central**	**Sub-central**
Complex Name	**4/6**	**10/4**	**6/15**	**6/3 + P**
S.austinii height(cm)	na	Absent	na	na
S.fuscum hum type	na	Absent	na	na
S.fuscum hum %	Absent	Absent	Absent	na
S.fuscum height(cm)	na	Absent	na	na
Leucobryum glaucum	Absent	Absent	Absent	Absent
Trichophorum type	Absent	Flats	Tussocks	Tussocks
Trichophorum %	Absent	1-3 (few indiv)	1-3 (many indiv)	1-3 (many indiv)
S.magellanicum %	4-10	11-25	1-3 (many indiv)	Absent
S.cuspidatum %	Absent	4-10	1-3 (many indiv)	11-25
S.papillosum %	11-25	11-25	4-10	4-10
S.denticulatum %	na	Absent	na	na
S.capillifolium%	Absent	4-10	11-25	4-10
S.tenellum %	na	4-10	na	na
S.subnitens %	na	4-10	11-25	na
R.fusca %	Absent	Absent	Absent	Absent
R.alba %	26-33	4-10	4-10	1-3 (many indiv)
N.ossifragum %	11-25	4-10	4-10	4-10
Sphag pools %	Absent	4-10	4-10	11-25
Dominant pool Sphag	na	S.cuspidatum	S.cuspidatum	S.cuspidatum
Sphag lawns %	11-25	34-50	Absent	Absent
Sphag humm %	11-25	26-33	11-25	11-25
Sphag holl %	11-25	4-10	4-10	4-10
Total Sphag %	51-75	51-75	26-33	26-33
Hummocks indicators	S.austinii	Absent	S.austinii	S.austinii&S.fuscum
Cladonia portent %	1-3 (many indiv)	4-10	4-10	4-10
Other Cladonia sp	na	C. uncialis	na	na

Ecotope type	**Sub-central**	**Sub-central**	**Sub-central**	**Sub-central**
Complex Name	**4/6**	**10/4**	**6/15**	**6/3 + P**
C. panicea %	na	1-3 (few indiv)	na	na
Calluna cover %	4-10	11-25	11-25	4-10
Calluna height(cm)	21-30	0-10	21-30	21-30
Other NotableSpecies		Aulacomnium palustre, Eriophorum angustifolium	Dicranum scoparium	
Other comment		just at burn line; spha auri near; no diffs from 04/5, any b/co fire & location		

Ecotope type	**Sub-central**	**Sub-central**	**Sub-central**	**Sub-marginal**
Complex Name	**9/7+P**	**6/3 + P**	**9/7+P**	**4/6**
Quadrat Name	Qsc3	Qsc4	Qsc4	Qsm1
Easting	167618.018	166773	166773.815	166483
Northing	250558.178	250735	250733.216	249618
Date	03/10/2012	11/08/2004	04/10/2012	11/08/2004
Firmness	Very soft	firm-soft	Quaking	quaking
Burnt	No	No	Light	No
Algae in hollows %	4-10	Absent	1-3 (many indiv)	1-3 (many indiv)
Algae in pools %	1-3 (many indiv)	4-10	11-25	Absent
Bare peat %	Absent	Absent	4-10	1-3 (many indiv)
High hummocks %	Absent	na	Absent	na
Low hummocks %	51-75	4-10	26-33	26-33
Hollows %	4-10	26-33	4-10	4-10
Lawns %	4-10	Absent	4-10	Absent
Pools %	11-25	11-25	34-50	4-10
Pool type	Tear	Tear	Interconnecting	Regular

Ecotope type	**Sub-central**	**Sub-central**	**Sub-central**	**Sub-marginal**
Complex Name	**9/7+P**	**6/3 + P**	**9/7+P**	**4/6**
S.austinii hum type	Absent	na	Absent	na
S.austinii hum %	Absent	Absent	Absent	11-25
S.austinii height(cm)	Absent	na	Absent	na
S.fuscum hum type	Absent	na	Absent	na
S.fuscum hum %	Absent	Absent	Absent	Absent
S.fuscum height(cm)	Absent	na	Absent	na
Leucobryum glaucum	Absent	Absent	Absent	Absent
Trichophorum type	Flats	Tussocks	Tussocks	Absent
Trichophorum %	4-10	1-3 (many indiv)	4-10	Absent
S.magellanicum %	1-3 (few indiv)	Absent	Absent	1-3 (many indiv)
S.cuspidatum %	4-10	11-25	11-25	Absent
S.papillosum %	4-10	4-10	4-10	1-3 (many indiv)
S.denticulatum %	Absent	na	Absent	na
S.capillifolium%	4-10	4-10	11-25	11-25
S.tenellum %	1-3 (many indiv)	na	1-3 (many indiv)	na
S.subnitens %	1-3 (many indiv)	na	4-10	na
R.fusca %	Absent	Absent	Absent	Absent
R.alba %	1-3 (several indiv)	1-3 (many indiv)	1-3 (many indiv)	11-25
N.ossifragum %	4-10	26-33	1-3 (many indiv)	4-10
Sphag pools %	76-90	11-25	11-25	4-10
Dominant pool Sphag	S.cuspidatum	S.cuspidatum	S.cuspidatum	na
Sphag lawns %	1-3 (many indiv)	Absent	4-10	Absent
Sphag humm %	34-50	4-10	26-33	26-33
Sphag holl %	4-10	4-10	4-10	4-10
Total Sphag %	26-33	26-33	51-75	26-33
Hummocks indicators	Absent	Absent	Absent	S.austinii

Ecotope type	**Sub-central**	**Sub-central**	**Sub-central**	**Sub-marginal**
Complex Name	**9/7+P**	**6/3 + P**	**9/7+P**	**4/6**
Cladonia portent %	4-10	4-10	1-3 (many indiv)	4-10
Other Cladonia sp	C.uncialis	na	C. uncialis	na
C. panicea %	4-10	na	1-3 (many indiv)	11-25
Calluna cover %	26-33	11-25	26-33	11-25
Calluna height(cm)	11-20	21-30	11-20	11-20
Other NotableSpecies	Pleurozia purpurea,		Pleurozia purpurea, Andromeda polifolia, Racomitrium lanuginosum	
Other comment	diffs probably b/co location; sphan fusc adjacent to plot		Quadrat moved slightly away from SC edge; likely cause of any diffs	

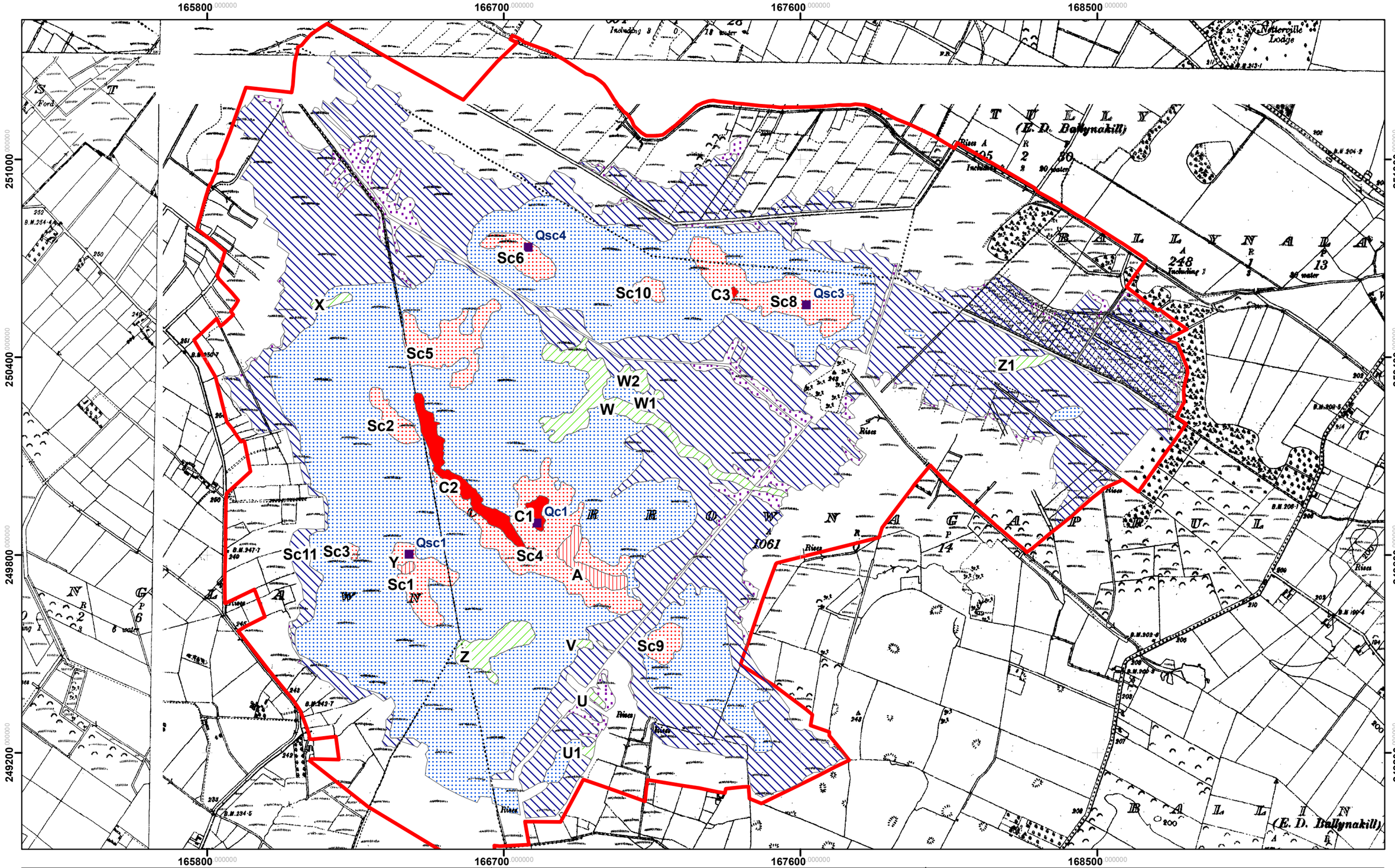
Ecotope type	**Sub-marginal**
Complex Name	**6/3 + P**
Quadrat Name	Qsm2
Easting	166691
Northing	250727
Date	11/08/2004
Firmness	firm-soft
Burnt	No
Algae in hollows %	Absent
Algae in pools %	11-25
Bare peat %	Absent
High hummocks %	Absent
Low hummocks %	na
Hollows %	11-25

Ecotope type	**Sub-marginal**
Complex Name	**6/3 + P**
Lawns %	Absent
Pools %	11-25
Pool type	Tear
S.austinii hum type	na
S.austinii hum %	na
S.austinii height(cm)	na
S.fuscum hum type	na
S.fuscum hum %	Absent
S.fuscum height(cm)	na
Leucobryum glaucum	Absent
Trichophorum type	Tussocks
Trichophorum %	1-3 (many indiv)
S.magellanicum %	Absent
S.cuspidatum %	4-10
S.papillosum %	Absent
S.denticulatum %	na
S.capillifolium%	4-10
S.tenellum %	na
S.subnitens %	na
R.fusca %	Absent
R.alba %	1-3 (many indiv)
N.ossifragum %	11-25
Sphag pools %	11-25
Dominant pool Sphag	S.cuspidatum
Sphag lawns %	Absent
Sphag humm %	na

Ecotope type	**Sub-marginal**
Complex Name	**6/3 + P**
Sphag holl %	4-10
Total Sphag %	11-25
Hummocks indicators	S.austinii
Cladonia portent %	4-10
Other Cladonia sp	na
C. panicea %	na
Calluna cover %	11-25
Calluna height(cm)	21-30
Other NotableSpecies	
Other comment	

Note: Data for those 2004 quadrats re-surveyed in 2012 is given to the right of the original 2004 quadrat data in table above. Not all quadrats reported in 2004 were re-surveyed in 2012. Nonetheless, all 2004 quadrat data is given above. Additional quadrats were recorded where necessary. Some 2004 quadrats may have been classified under a different ecotope category in 2012; further detail is given within the report.

Appendix IV Survey maps



Raised Bog Monitoring & Assessment Survey 2013

Map 1: Ecotopes Map and Quadrats

Ecology and Environmental Consultants Ireland Ltd.

Carrownagappul SAC (001242)
Co. Galway

1:11,000

N

0 135 270 540 810 1,080 Meters

Legend

- Quadrat

Ecotope type

- Central
- Sub-central
- Bog Woodland
- Active Flush
- Sub-marginal
- Marginal
- Inactive Flush
- Woodland
- Face bank
- Open water
- Conifer plantation
- Clear felled area
- SAC

Raised Bog Monitoring & Assessment Survey 2013

Map 2: Vegetation community complexes

Ecology and Environmental Consultants Ireland Ltd.

Carrownagappul SAC (001242)
Co. Galway

1:11,000

N

0 160 320 640 960 1,280 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 & Assessment Survey 2013

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

Ecology and Environmental Consultants Ireland Ltd.

Carrownagappul SAC (001242)
Co. Galway

1:11,000

N

0 145 290 580 870 1,160 Meters

Legend

High Bog drainage

- Blocked:non-functional
- Blocked:reduced functional
- Not blocked:functional
- Not blocked:non-functional
- Not blocked:reduced functional
- Burnt high bog (2004/05-12/13)
- High bog cutaway (2004/05-10)
- SAC