

Carn Park Bog (SAC 002336), Co.

Westmeath

Executive Summary

This survey, carried out in February 2013, aimed to assess the conservation status of habitats listed on Annex I of the European Habitats Directive (92/43EEC) on the high bog at Carn Park 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 3.15 ha (1.97%) of the high bog area. Central ecotope and active flush are not present on site, and sub-central ecotope was found at six locations. Sub-central vegetation mainly consisted of lawns and hummocks of *Sphagnum*, including abundant *S. pulchrum*, with only scattered pools.

Degraded Raised Bog covers 157.14 ha (98.03%) of the high bog area. It is drier than Active Raised Bog and supports a lower density of *Sphagnum* mosses. *Sphagnum* lawns are generally absent, but high hummocks of *Sphagnum austinii* and *S. fuscum* in good condition are still relatively frequent in sub-marginal ecotope across the site. Clearfelled conifer plantations also support Degraded Raised Bog vegetation, and one section is developing inactive flush vegetation

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. In the latter, *Rhynchospora alba* occurs in association with *Sphagnum* lawns, hollows and small pools.

Restoration works were carried out from 2005-2006 by Coillte as part of their LIFE funded raised bog restoration project. Works included clearfelling and/or felling to waste four conifer blocks on the high bog, felling lodgepole pine regeneration on the high bog, and blocking drains. Carn Park Bog is a project demonstration site, and Coillte has provided access in the form of a car park, a walking route adjacent to the bog and a short boardwalk on the high bog. Hydrological and vegetation monitoring took place from 2005-2008.

The current conservation objective for Carn Park Bog is to restore the area of Active Raised Bog to the area present when the Habitats Directive came into force in 1994. 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. As data from 1994 are not available, the area estimated in 2000, the year of the first mapping survey, was used. The Area objective for Active Raised Bog is 69.91 ha. 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 considerable decrease in the area of Active Raised Bog (21.24 ha) at Carn Park Bog in the 2000 to 2013 period. This loss has been associated with large changes on the high bog topography and hydrology associated with the large bog burst, which took place in the 2000-2005 period, caused by peat cutting along the southern section of high bog. High bog and peripheral drainage, cut face banks and the recently removed conifer plantations on the high bog would have also contributed to the ongoing drying out of the high bog. These losses have been slightly balanced by the regeneration of new Active Raised Bog as a direct result of recent restoration works.

Marginal drainage on cutover bog around all edges of the high bog is the most threatening current activity at the site. Until recently, peat cutting was a highly threatening activity. 1.19 ha of high bog have been lost in the 2004/05-2010 period due to peat cutting, but peat cutting was reported to have ceased in 2012. Cut faces continue to drain the high bog, and as some are 4 m or greater in height, they appear susceptible to future subsidence events. An estimated 1.9 km of drains remain unblocked and are either functional or reduced functional, while a further 3.4 km of blocked drains remain reduced functional. Regeneration of lodgepole pine is frequent in Degraded Raised Bog across the site and is abundant on high bog clearfells, where it threatens restoration of bog habitats.

Active Raised Bog has been given an overall **Unfavourable Bad–Declining** conservation status assessment. Habitat Area has decreased considerably and is significantly below favourable

reference values. S&Fs are also below their reference value. Future Prospects are only considered Unfavourable Bad-Stable.

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 **Carn Park SAC** has been given an **Unfavourable Bad–Declining** assessment.

A series of **recommendations** have been also given, these include: maintain the cessation of peat cutting; ongoing monitoring and management of restoration works; blocking marginal and cutover drains and other hydrological restoration works; further hydrological and topographical studies to ascertain more accurate FRVs; detailed hydrological studies to determine optimal restoration strategies; and further botanical monitoring surveys.

Site identification

SAC Site Code	002336	6" Sheet:	WH: 029B, 029D, 030A
Grid Reference:	E 211500 / N 242000	1:50,000 Sheet:	47
High Bog area (ha):	160.29 ha ¹		
Dates of Visit:	19 to 21/02/13		
Townlands:	Carn Park, Tullywood, Cappaghbrack, Warren High, Moydrum		

¹The current extent of the high bog is 160.29ha, while that reported in 2000 was 156.4ha (Derwin and MacGowan, 2000). This discrepancy is mostly the result of more accurate mapping of the high bog edge by using the higher resolution 2010 aerial images compared to those used in 2000, rather than any actual increase in high bog extent. In addition, areas previously considered conifer plantations adjacent to the high bog clearly correspond with clear felled areas on the high bog as shown on the 2010 aerial images and thus now mapped and reported as part of the site's high bog. On the other hand high bog area has in fact decreased in the 2004/05-2010 period due to peat cutting by 1.19ha. The actual high bog extent in 2000 was 161.48ha (see tables 8.1 and 8.3 2000 (amended) figures).

Site location

Carn Park Bog is located 4 km east-northeast of Athlone between the villages of Baylin and Mount Temple. Crosswood Bog (SAC 002337) is located just over 1.5 km to the southwest of the site.

The site may be accessed from the local road that runs south from the Baylin – Mount Temple Road. There is a small car park constructed as part of the Coillte LIFE project along this road; although it is usually locked, there is space for parking outside it. From the car park, a walking path runs along the edge of the high bog, which can be easily accessed from a boardwalk (Irish Grid E 212365 / N 241695) or a footbridge further to the west (Irish Grid E 211998 / N 241748).

Description of the survey

The survey was carried out in February 2013 and involved a vegetation survey of the high bog at Carn Park Bog and the recording of impacting activities affecting high bog vegetation. A similar survey was carried out in 2000 by Derwin and MacGowan (2000). 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 photographic 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 Carn Park Bog was re-surveyed. Sections mapped as sub-marginal and sub-central ecotope in 2000 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, were recorded. 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

Carn Park Bog is a medium size raised bog; it has vegetation typical of Midland Raised Bog and is an example of Basin Bog. The bog is bisected, into unequal parts, by a mineral ridge stretching into the bog from the northeast. The site has a complex shape, with a narrow strip to the north of the ridge and a larger roughly rectangular shaped section to the south of the mineral ridge. Large areas of the high bog were formerly afforested with lodgepole pine (*Pinus contorta*). These were felled in 2005/6 as part of Coillte's LIFE project on restoring raised bogs. The remaining high bog is surrounded by cutover bog; turf cutting has been more extensive to the west and northwest of the site. The bog appears to be deep, as cut faces on the west and south were approximately 4-5 m high from high bog top to the bottom of drains on the adjacent cutover. This bog is notable for the abundance of *Sphagnum pulchrum* at one of its easternmost stations.

Ecological Information

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

The following Raised Bog EU Annex I habitats, are found in Carn Park 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 Carn Park Bog is 3.15 ha (1.97% of the high bog), which is estimated to be a decrease of 21.24 ha (87.08%) since 2000.

Active Raised Bog includes sub-central ecotope; no central ecotope, active flushes or Bog Woodland were present at Carn Park Bog.

Sub-central ecotope was found at six locations (**Sc1** to **Sc6**) (see Appendix IV, Map 1). Community complex 6/9+P was the best quality complex type (nearly central ecotope quality), but also the least abundant and was restricted to **Sc4**. This complex was dominated by lawns of *Sphagnum papillosum* and *S. magellanicum* interspersed with shallow *S. cuspidatum* pools. Low and high *Sphagnum* hummocks were present, and *S. austinii* was relatively abundant. Total *Sphagnum* cover was 34-50%, increasing to 75% in places. *Eriophorum vaginatum* was the most prominent vascular plant, accompanied by some *Narthecium ossifragum*.

Complex 10/4 was more widespread, and was characterised by lawns and hollows of *Sphagnum papillosum* and *S. pulchrum* interspersed with high and low hummocks dominated by *S. fuscum* and *S. austinii*. *S. capillifolium* was only scattered in hummocks. *Rhynchospora alba* was notably abundant in this complex, being rather rare across most of the rest of the site. Pools were absent.

Complex 10/6 was found in **Sc2**, which was a recently formed sliver of sub-central ecotope to the north of clearfell **CF1**. It formed as a result of Coillte's restoration works. *Sphagnum* cover was high (51-75%), mainly comprising *S. papillosum* and *S. capillifolium* hummocks and lawns. *S. pulchrum* and *S. cuspidatum* hollows and small pools were also present.

Complex 9/7/10 was found in the southern part of **Sc6**. It was very wet with some standing water and was dominated by high hummocks of *Sphagnum capillifolium* and lawns of *S. magellanicum*. The area showed signs of flushing with frequent *Polytrichum strictum* and occasional *Vaccinium*

oxyccocos. There were occasional pools with *S. cuspidatum* and standing water in areas around pools.

Complex 9+P was dominated by *Eriophorum vaginatum* with relatively little *Calluna vulgaris*. The ground was very soft with numerous small, shallow pools and lawns mainly occupied by vigorous *Sphagnum papillosum* interspersed with low *S. capillifolium* hummocks. The overall impression of this complex was of one large shallow, soupy pool with small hummock islands. *S. cuspidatum* was frequent but of low cover (<4%) in **Sc4**, but was abundant (26-33% cover) in **Sc6**. Where it occurred, this complex appeared to be of recent origin as the result of drain blocking in the vicinity.

Degraded Raised Bog (7120)

The current area of Degraded Raised Bog at Carn Park Bog is 157.14 ha (98.03% of the high bog).

Degraded Raised Bog includes the sub-marginal, marginal and face bank ecotopes, as well as inactive flushes and clearfelled conifer plantation. 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. Scattered pine (*Pinus* spp.) seedlings were present throughout most of the site; larger saplings have mostly been felled to waste as part of Coillte's LIFE restoration project.

The sub-marginal ecotope features the most developed micro-topography within Degraded Raised Bog. High hummocks of *Sphagnum austinii* and *S. fuscum* in good condition are still relatively frequent in sub-marginal ecotope across the site. The highest quality sub-marginal community complex was 9/7, and some examples approached sub-central quality. It was characterised by abundant *Eriophorum vaginatum* (11-25% cover) with *Calluna vulgaris* (26-33%) and *Cladonia portentosa* (26-33%). The scarcity of *Narthecium ossifragum* and *Carex panicea* was distinctive, and *Sphagnum pulchrum* was more frequent in this complex than in other sub-marginal complex types. Complex 9/7/6 was the most abundant across the site and was characterised by uneven hummocks of *Calluna* and *Sphagnum capillifolium* with *Eriophorum vaginatum*. *Cladonia portentosa* was very prominent in the vegetation. A higher quality variant of this complex was mapped as 9/7/3. It was distinguished by higher cover of *Carex panicea* (11-25%) and *Sphagnum* (11-25%).

Marginal ecotope is slightly drier than sub-marginal ecotope and mainly occurs as a narrow band near the margins of the high bog. The sliver of high bog north of the mineral ridge mainly comprised marginal ecotope. Complex 7/9+Cl was transitional to sub-marginal ecotope. It was characterised by firm surface with uneven hummocks of *Calluna vulgaris* (34-50%) with some *Eriophorum vaginatum* (4-10%) and very little *Sphagnum* (<4%). Complex 3/7/6 occupied the western

and northern bog margins. This complex was dominated by *Calluna vulgaris* (26-33%) and *Carex panicea* (26-33%) with some *Narthecium ossifragum* (4-10%). On a steep, subsiding slope on the western margin, a variant 3/7/6+TP was recorded, characterised by higher cover of *Calluna vulgaris*, lower cover of *Carex panicea*, bare peat cover of 4-10% and abundant, deep tear pools covering 11-25%. Complex 6/7 was dominated mainly by *Calluna vulgaris* (76-90%) with *Rhynchospora alba* (11-25%), *Narthecium ossifragum* (4-10%) and bare peat (4-10%). A variant of this complex occurred near clearfell CF2 where cracking and slumping of the bog surface had formed tear pools; this was mapped as 6/7+TP.

Face bank ecotope was characterised by firm ground, tall *Calluna vulgaris* (76-90% cover), poor *Sphagnum* cover and frequent cracking and slumping of the bog surface. This ecotope was found along some of the extreme fringes of the high bog and along some drainage channels.

The high bog also featured an inactive flush (Z) which had developed on clearfelled conifer plantation (CF3). *Molinia caerulea* was the dominant species (51-75%). Former forestry drains were blocked and were forming pools that sometimes supported good *Sphagnum cuspidatum* cover. *S. palustre* (4-10%) and *S. fallax* (<4%) occurred at pool edges. Planting ridges were dominated by *Calluna vulgaris* (26-33%) and other species typical of drier conditions. This area will likely become an actively peat-forming flush in the future.

Four clearfelled conifer plantations were on the high bog (CF1-4). These were former lodgepole pine (*Pinus contorta*) plantations felled in 2005/2006 as part of Coillte's LIFE project on restoring raised bogs. The microtopography of each clearfell was characterised by the old planting ridges, pine stumps, old forestry drains and felling brash. In most cases, the forestry drains were dry; some of the wet drains were blocked as part of restoration works. CF1 supported abundant pine (*Pinus contorta*) regeneration 2-2.5 m tall on average (11-25% cover). Overall, *Sphagnum* cover was <4% and patchy. The most abundant species (apart from pine regeneration) were *Eriophorum vaginatum* (34-50%), *Calluna vulgaris* (34-50%) and *Hypnum jutlandicum* (4-10%). CF2 was similar, but *Eriophorum vaginatum* (51-75%) was more abundant than *Calluna vulgaris* (34-50%). CF3 differed from CF1 and CF2 in that the plantation was younger at felling and the canopy apparently never closed. Pine (*Pinus contorta*) regeneration was scattered (<4% cover) and varied widely in height, ranging from 1-4 m tall. Birch (*Betula pubescens*) regeneration was more abundant (4-10% cover), forming an open stand with trees 3-4 m tall on average. Overall, *Sphagnum* cover was <4% and patchy. The dominant species was *Calluna vulgaris* (76-90%). CF4 was situated on the northern side of the high bog between a narrow strip of open, unplanted bog and open woodland of *Betula pubescens*, *Sorbus aucuparia*, and *Ilex aquifolium* on the lower slopes of the mineral ridge. Drains were wetter here than

in most of the other three clearfells; they had not been blocked, but most had naturally infilled. The vegetation was sub-marginal in character and was quite wet in places. These areas will likely become actively peat-forming in the future. The most abundant species present were *Eriophorum vaginatum* (51-75%), *Calluna vulgaris* (11-25% (-50% locally)), *Cladonia portentosa* (4-10%) and *Betula pubescens* saplings (4-10%).

Depressions on peat substrates of the Rhynchosporion (7150)

Rhynchosporion vegetation is not particularly common on Carn Park 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 (complex 10/4). In these areas, the Rhynchosporion vegetation occurred within *Sphagnum* hollows and along *Sphagnum* pool edges and on lawns. However, neither pools nor lawns are very common at this site. Typical plant species included *Rhynchospora alba*, *Sphagnum cuspidatum*, *S. pulchrum*, *S. papillosum* and *S. magellanicum*, with *Eriophorum angustifolium* and *Narthecium ossifragum* occurring much less frequently.

R. alba was also found within Degraded Raised Bog (especially marginal complex 6/7), but always associated with wet features such as hollows, tear pools and erosion channels.

Bog Woodland

Bog Woodland was not present at this site. *Betula pubescens* was regenerating well in several of the clearfell areas, and these may develop true Bog Woodland habitat if they become sufficiently wet.

Detailed vegetation description of the high bog

A detailed description of high bog vegetation recorded during the 2013 survey of Carn Park 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 Carn Park 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	1.19 ha of the high bog cut away	Inside High Bog: 31 different locations along northern, western & southern edges	7110/7120/7150
J02.07	Drainage	M	-1	5.384 km ¹	Inside High Bog	7110/7120/7150
J02.07	Drainage	M	-1	n/av	Outside High Bog	7110/7120/7150
I01	Invasive alien species	L	-1	<0.1 ha ³	Inside High Bog	7110/7150
I01	Invasive alien species	H	-1	54.86 ha ⁴	Inside High Bog	7120
B01.02	Artificial planting on open ground (non-native trees)	L	-1	16 ha	Outside High Bog	7110/7120/7150
B02.02	Forestry clearance	H	+1	54.86 ha	Inside High Bog	7110/7120/7150
4.2	Restoring/Improving the hydrological regime	H	+1	3.784 km ²	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.

³ This figure is estimated and represents the extent of trees across entire high bog, excluding clearfelled conifer plantations.

⁴ This figure is the total area of clearfelled conifer plantations. *Pinus contorta* regeneration is frequent in clearfells.

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

Peat cutting

This activity has taken place at 31 locations (plots) along the northern section (9 plots), western (16 plots) and southern (6 plots) of high bog in the 2004/5-2010 period and has reduced the area of high bog by 1.19ha. The loss of high bog from peat cutting is calculated using GIS techniques on aerial photography from 2004/05 and 2010. Information from the NPWS indicates that 30 plots were cut on Carn Park Bog in 2010/2011 but that no (0) plots were cut in 2012. The latter information is supported by observations during the 2013 survey that active peat cutting had ceased. Thus the area of high bog lost on Carn Park Bog during the 2004/5-2010 period is in excess of 1.19 ha, but since there is no aerial photography available post 2010, the area lost from 2010 to 2013 cannot be estimated.

Peat cutting has had a severe impact on remnant high bog habitats in some locations. Fernandez *et al.* (2006) noted major subsidence in the western part of the site, where cracking and slumping extended up to 130 m into the high bog. Examining Ordnance Survey aerial photography shows that this event occurred between 1995 and 2000. An even greater subsidence episode has since occurred on the southern margin of the bog adjacent to **CF2**. Here, a large section of bog has subsided, with cracking and tear pool formation extending up to 400 m into the high bog and affecting more than 7.5 ha. During the 2013 survey, it was noted that some cut faces at the high bog edge were 4 m or more high, and it is likely that such a high face has contributed to the risk of subsidence.

It is difficult to estimate accurately the area of Active Raised Bog prior to the 2013 survey, as the 2000 survey was carried out without the aid of GPS technology. Furthermore, review of the site report (Derwin and MacGowan, 2000) suggests that the interpretation of Active Raised Bog during that survey was more generous than that used in the 2013 survey. For example, Derwin and MacGowan (2000) report that inter-pool *Sphagnum* cover in Active Raised Bog was only 30%. Nevertheless, it is certain that recent peat-cutting activities and associated subsidence in the southern part of the bog has resulted in the loss of Active Raised Bog, especially in or near **Sc3**.

This activity is considered to have a high importance/impact on high bog habitats. In addition, old face banks and high bog and cutover drainage associated with cutting continue to cause negative impacts on the high bog habitats.

Drainage

High bog drainage

Table 6.2 shows a decrease on functional drainage as a result of blocking of drains. The majority of drains in the high bog have been blocked and are reduced functional (3.4 km). Some blocked

drains, particularly on the northern side of the main lobe, have not been blocked along their entire length. As it was not possible to map these sections separately, the length of blocked, reduced functional drains has been slightly overestimated. An estimated 1.9 km of drains remain unblocked and are either functional or reduced functional. Reduced functional drains are 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. Prior to blocking in 2005/2006, drainage would have had a much more significant impact on high bog habitats. Over time, the impact of drainage would be expected to decline as blocked drains become non-functional.

Table 6.2 High bog drainage summary

Status	2000 (km) ¹	2013 (km)	Change
NB: functional	2.585	0.876	(-)-1.709
NB: reduced functional	2.799	1.064	(-)-1.735
NB: non- functional	1.354	1.014	(-)-0.340
B: functional	0.000	0.000	0.000
B: reduced functional	0.000	3.444	(+)3.444
B: non- functional	0.000	0.340	(+)0.340

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 from those mapped by Derwin and MacGowan (2000) and digitised by Fernandez *et al.* (2006).

Table 6.3 below provides a more detailed description of the drainage present on the high bog at Carn Park Bog including any change in their functionality in the 2000 – 2013 period (see Map 3).

Table 6.3 High bog drainage detail

Drain Name	Length (km)	2000 status	2013 status	Change	Comment
D1	0.372	NB: functional	NB: reduced functional	Yes	
D2	0.249	NB: functional	B: reduced functional	Yes	
D3	0.104	NB: non-functional	NB: non- functional	No	Drain complex
D4	0.547	NB: non-functional	NB: non- functional	No	
D5	0.396	NB: functional	B: reduced functional	Yes	
D6	0.692	NB: functional	NB: reduced functional	Yes	
D7	0.261	NB: non-functional	NB: non- functional	No	Drain complex
D8	0.340	NB: non-functional	B: non- functional	Yes	Drain complex
D8	1.541	NB: reduced functional	B: reduced functional	Yes	Drain complex
D9	0.101	NB: functional	NB: functional	No	Drain complex
D9	1.258	NB: reduced functional	B: reduced functional	Yes	Drain complex
D10	0.775	NB: functional	NB: functional	No	Drain already present in 2000 but not mapped; some sections reduced functional
D11	0.102	NB: functional	NB: functional	No	Drain already present in 2000 but not mapped

Bog margin drainage

The cutover areas were not surveyed for drains during 2013.

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. Cutover drainage in combination with past peat cutting activities has contributed to subsidence in the southern and western sections of the bog, as discussed above.

There has been no obvious recent agricultural land drainage maintenance visible on the 2010 aerial photographs that would have the potential to significantly impact on high bog habitats.

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

Fire history

There were no signs of recent fires on Carn Park Bog. Derwin and MacGowan (2000) also noted no signs of recent fire, and Fernandez *et al.* (2006) did not find any evidence of fire since the 1970s in their review of previous surveys. The lack of fire at this site may contribute to the notable abundance of *Cladonia portentosa* across large parts of the bog.

Invasive species

Regeneration of pines, mainly *Pinus contorta* but also some *Pinus sylvestris*, was widespread across Degraded Raised Bog but generally absent from Active Raised Bog and Rhynchosporion habitats. Most larger pine saplings on the open bog had been felled to waste in 2005/6 as part of Coillte's raised bog restoration project. Seedlings regenerating since that date remain frequent in sub-marginal and marginal ecotopes. In clearfelled conifer plantations on the bog, *Pinus contorta* saplings are now abundant, averaging 2-2.5 m in height. There appears to have been some follow-up control of regenerating pines in clearfells as pine regeneration in **CF1** and **CF2** is absent from the edges of the clearfells adjoining unplanted open bog.

Invasive species are considered to have low importance/impact on Active Raised Bog and Rhynchosporion vegetation where they are rare. Invasive species are considered to have a high importance/impact on Degraded Raised Bog where pine regeneration is abundant.

Afforestation and forestry management

Four conifer plantation (*Pinus contorta*) blocks situated on the high bog have been clearfelled or felled to waste in 2005/6 as part of Coillte's EU LIFE project on raised bog restoration (Derwin, 2008). These areas are now mapped as **CF1-CF4** (Appendix IV, Map 1) and their vegetation is described in detail in Appendix I. Most of the significant drains associated with the plantations have been blocked. Further details are given under *Conservation Activities* below.

Forestry clearance is considered to have a high positive importance/impact on high bog communities.

Forestry plantations are still present on cutover bog to the northeast and southwest of the high bog. Some of the plantations are immediately adjacent to high bog (including clearfells) whereas others are separated by roads and are thus likely to be more hydrologically isolated. Overall, existing plantation forests adjacent to the high bog are considered to have a low importance/impact on high bog habitats.

Other impacting activities

Carn Park Bog is a demonstration site for Coillte's LIFE project on raised bog restoration. As part of this, access is maintained along a looped track that runs along the base of the mineral ridge including along the northern edge of the main raised bog lobe. This walking route was seen to be used by several people for recreational purposes during the 2013 field survey. This loop connects to a boardwalk that runs along the western margin of **CF3** to a viewing platform at the edge of the unplanted open bog. The boardwalk has been used to access the bog for educational purposes, according to the project website (<http://www.raisedbogrestoration.ie/life04/raised-bog-demonstration-sites-ireland.html>). The walking route and boardwalk and their usage are considered as having a neutral impact on high bog habitats.

Conservation activities

As noted above, the four lodgepole pine (*Pinus contorta*) plantations on the high bog were felled as part of Coillte's LIFE-funded raised bog restoration project. Restoration activities took place on Carn Park Bog in 2005-2006 (Derwin, 2008). Mature plantations were clearfelled and timber removed from site. Poorly developed plantations (including **CF3** and part of **CF2**) were felled to waste with the felled material windrowed. Most pine saplings regenerating on the open bog were felled to waste as part of the restoration project, although some Scots pine (*Pinus sylvestris*) saplings were not felled. Drainage networks at the margins of clearfells and on the adjacent high bog have mostly been blocked. The latter include drains installed in preparation for afforestation that was never carried out. Some naturally reduced functional drains and shallow, dry forest drains within the clearfells have not been blocked. In addition, some sections of blocked drains appear to require additional dams installed for optimum effectiveness. A few other unblocked drains appear to have been omitted in error. Vegetation and hydrological monitoring by Derwin (2008) has detailed early benefits of the restoration works for water levels and bog vegetation regeneration.

During the 2013 survey, it was found that the vegetation within clearfells was generally similar to sub-marginal ecotope communities. One section was developing flush vegetation and was mapped separately (flush **Z**). On the unplanted parts of the bog, **Sc2** has developed adjacent to **CF1** as a direct result of restoration works. Furthermore, parts of **Sc4** and **Sc6** appear to have expanded as a result of restoration work. Part of the high bog north of **Sc4** adjoining *Typha latifolia* dominated swamp on cutover bog was found to be entirely flooded at the time of survey. Derwin (2008)

suggests that this part of the high bog – cutover interface may in time develop lagg zone vegetation and observations during the 2013 survey support this prediction.

Drainage blocking is reported as a high positive importance/impacting activity under restoring/improving the hydrological regime in table 6.1 above.

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 suggests that there has been a net loss of 21.24 ha (87.08%) of the area of Active Raised Bog at Carn Park Bog. Derwin and MacGowan (2000) reported a total of 32.53 ha of Active Raised Bog habitat within the site in 2000. The 2000 survey was done without the aid of GPS and thus ecotopes were mapped by hand. Their hand-drawn map was subsequently digitised by Fernandez *et al.* (2006). In addition, Derwin and MacGowan (2000) completed their survey in a single day, and this in combination with the survey's technological constraints means that there would have been some amount of error in their Active Raised Bog map. Derwin and MacGowan (2000) only recorded sub-

central ecotope at the site and two different community complexes were reported. These were complex 10/9/7 + Cladonia and complex 10/9/7 + Cladonia + Pools. Each community complex covered approximately 50% of the habitat extent. Both complexes already contained degradation features: thus complex 10/9/7+Cl+P was described as containing former pools described as hollows infilled with *Narthecium ossifragum* (15%) and *Eriophorum vaginatum*. Some pools remained, but also featured some degradation features “few pools remaining - these are algal and contain *S. cuspidatum* and *Rhynchospora alba*”. The area between pools was described as with only containing 30% *Sphagnum* cover. Furthermore the acrotelm layer within the complex was thin (i.e. only 0-5cm), which would be considered rather thin for an active peat forming community complex. Complex 10/9/7+Cl, was also described as containing a thin acrotelm layer (around 5cm) and also “bare peat patches with hummocks of dead and drying mosses” were described. The *Sphagnum* cover of this complex was with 50% and comprised *S. capillifolium*, *S. magellanicum* and *S. papillosum*. The abundance of these *Sphagnum* species and dominance of *Eriophorum vaginatum* (40%), indicates that complex 10/9/7+Cl would have corresponded with complex 9/7/10 +Cl, sub-central ecotope community complex frequently recorded in the 2012/2013 surveys. The latter would correspond with a borderline sub-central / sub-marginal vegetation type. Thus indicating that some sections within former 9/7/10 +Cl could have in fact correspond with sub-marginal ecotope. Derwin and MacGowan (2000) also described an area within 9/7/10 +Cl containing in-filled pools, which were “filled with *S. cuspidatum*, *S. magellanicum*, *S. capillifolium*, *Eriophorum vaginatum* and *E. angustifolium*.” and thus this area within 9/7/10 +Cl is likely to have correspond with actual sub-central ecotope. Nevertheless degradation features were also reported within this wetter area “Even in this wet region there are plenty of *Trichophorum germanicum* and *Carex panicea*. Desiccation, however, is evidenced by patches of dead leaf bases with *Cladonia floerkeana* and *Campylopus introflexus*”. Thus overall, although a large area of sub-central ecotope (32.53 ha) was reported by Derwin and MacGowan (2000), the vegetation described had borderline sub-central / sub-marginal characteristics, particularly within complex 9/7/10 +Cl. Therefore, discrepancies as a result of re-interpretation of vegetation and a more comprehensive surveying in 2013 should be taken into account to review the original 2000 habitat extent figure and carry out a more accurate assessment. Thus, complex 10/9/7+Cl+P, which covered approximately 50% (16.26ha) of the habitat’s extent is considered to correspond with the wettest vegetation type, as indicated by the frequency of pools, and thus to consist entirely of sub-central ecotope. Whereas only half of the extent of 9/7/10 +Cl (8.13ha), which consists of the area containing in-filled pools, is considered to correspond with sub-central ecotope. Indeed, according to MacGowan (pers. comm., 2013), the area of sub-central ecotope would have been overestimated during the 2000 survey and particularly along the southern

section where complex 9/7/10 +Cl was reported. Thus, only 24.39ha of the original habitats extent are considered to actually correspond with sub-central ecotope.

Despite the difficulties in accurately estimating the true scale of decline in Active Raised Bog area, it was clear during the 2013 survey that there had been some recent losses. Indications of Active Raised Bog degradation included: frequent damp *Nartheceum* hollows that appeared to be former pools; frequent relict hummocks of *Sphagnum fuscum* and *S. austinii*; isolated tiny patches of sub-central vegetation; and the presence of high quality sub-marginal vegetation (complex 9/7) near Active Raised Bog, suggesting recent declines in quality. Most sub-central ecotope areas showed these signs and are likely to have experienced real loss in Active Raised Bog area in the 2000-2013 period. The 2000 sub-central ecotope descriptions already illustrated degradation processes within the habitat. This degradation would have been rapidly exacerbated by the large bog burst, which took place in the 2000-2005 period, along the southern section of the high bog. This bog burst has extended up to 400 m into the high bog right into the middle section of the high bog where sub-central ecotope were described in 2000.

On the other hand, drain blocking and forest clearance as part of Coillte's raised bog restoration project has resulted in expansion of Active Raised Bog in some places. **Sc2** is an area (0.08 ha) of sub-central ecotope that appears to have developed recently as the direct result of restoration works at **CF1**. The nearby southwestern section of **Sc6** also appears to have developed recently. Northern and eastern parts of **Sc4** also appear to have expanded as a result of blocking the drain complex to the northwest, counterbalancing to some extent losses to the southern part of the area.

The favourable reference value (FRV) for Area is considered to be the sum of Active Raised Bog (sub-central ecotope) plus sub-marginal ecotope when the Habitats Directive came into force in 1994 (see table 8.4). As these data are not available for Carn Park Bog, the total area of sub-marginal and sub-central ecotope estimated by Derwin and MacGowan (2000) were used. Therefore, Active Raised Bog Area FRV is 69.91 ha (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 (3.15 ha) is 95.49% below the FRV. A current Area value more than 15% below FRV falls into the **Unfavourable Bad** assessment category.

As the trend over the period 2000-2013 is a net reduction in the area of Active Raised Bog at the site (21.24 ha) (see table 8.1), the habitat Area is given a **Decreasing** trend assessment.

The Area of Active Raised Bog at Carn Park Bog is assessed as Unfavourable Bad-Decreasing (see table 8.5).

Structure & Functions

The FRV for S&F 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 1.58 ha (half of 3.15 ha, the current area of Active Raised Bog). The current value is 0 ha (i.e. central ecotope and active flush are absent) which is 100% above the FRV. Therefore S&F are given an **Unfavourable Bad** assessment.

Due to the absence of central ecotope and active flush in 2000, there has been no variation in their extent in the reporting period. Therefore the habitat's S&Fs could be given a Stable trend assessment. However, an 87.08% decrease in Active Raised Bog habitat in the reporting period would have been coupled by a reasonably expected decline in habitat quality (S&Fs). Thus S&Fs are given a **Declining** trend.

Quadrats were not recorded in the 2000 survey. Two quadrats were recorded for the first time in 2013 (**Qsc1** and **Qsc2**).

Qsc1: this quadrat was recorded in **Sc1** in community complex 10/4. This quadrat was recorded at the same location as Derwin's (2008) Quadrat 7, surveyed annually from 2005-2008 to monitor changes following Coillte's raised bog restoration project. Qsc1 was dominated by quaking lawns of *Sphagnum*, mainly *S. papillosum* and *S. pulchrum*, with low hummocks of *S. capillifolium*, *Calluna vulgaris* and *Cladonia portentosa*. Pools were absent, but *S. fuscum* and *S. austinii* hummocks were present at low cover. Total *Sphagnum* cover was 51-75%. These data agree with Derwin's monitoring data from 2008, and any differences are attributable to methodology and plot size (100 m² in Derwin (2008)).

Qsc2: this quadrat was recorded in **Sc6** in an example of complex 10/4 that approached central ecotope in quality. Qsc2 was dominated by quaking lawns of *Sphagnum* (>90% cover), mainly *S. papillosum*, *S. pulchrum* and *S. magellanicum*. Small hollows and pools occupied by *S. cuspidatum* were also present, but *S. fuscum* and *S. austinii* were not found within the quadrat, though both species were present in the vicinity.

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

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

Future Prospects

Over the 2000-2013 period, there have been losses in the area of Active Raised Bog resulting from peat cutting and high bog and marginal drainage. In the initial years of this period, forestry plantations on the high bog would have contributed to decreases. These factors have also resulted in a major subsidence event (bog burst) in the southern part of the site in the 2000-2005 period, similar to but larger than that experienced earlier (1995-2000) in the western part. In more recent years, restoration works have resulted in some increases in the area of Active Raised Bog, and it appeared during the field survey that additional future increases were likely. Furthermore, peat cutting at the site has ceased. Functional drains on adjacent cutover bog and the presence of old, high peat cutting faces around most of the high bog margin, however, will continue to have a negative impact on bog hydrology and may result in further subsidence. Lodgepole pine regeneration remains a significant problem in most of the clearfelled areas. On the other hand the bog burst (west of CF2), which is almost certainly due to peat cutting, will cause localised re-wetting within the subsided area, but more extensive drying out of the areas to the north and west of the bog burst due to increased surface slopes and potential further ARB habitat losses. This combination of positive and negative influences on the conservation status of Carn Park Bog make predicting Future Prospects difficult.

Habitat **Area** is currently 95.49% below FRV (see table 8.4). Future increases to Active Raised Bog area as a result of restoration works and further losses due to current impacts are likely balance each other and thus no net changed in habitats extent or S&Fs are expected, unless further restoration works are undertaken. The habitat Area is expected to be more than 15% below FRV in the following two reporting periods (12 years). Thus, habitat's **Area Future Prospects** are assessed as **Unfavourable Bad-Stable**. Habitat's **S&Fs** are currently 1000% below FRV (see table 8.4) and a stable trend is also foreseen. Therefore S&Fs are expected to more than 25% below FRV in the following two reporting periods. Thus, **S&Fs Future Prospects** are assessed as **Unfavourable Bad-Stable**. **The overall habitat's Future Prospects are Unfavourable Bad-Stable** (see table 8.5).

There is a risk of losses arising from long term damage to bog hydrology. A hydrological investigation of the high bog and adjoining cutover is required to provide critical information on the long term Future Prospects and the most appropriate restoration strategy for the bog. Reprofiling the high bog edges may be an option and the edge to the north of the narrow lobe to the north side of the mineral ridge may provide a suitable location for trials, as it is largely isolated from the majority of the bog. Blocking remaining reduced-functional and functional drains both on the high bog and cutover is necessary. Ongoing management of regenerating conifers and other

measures to consolidate the benefits from forestry clearance are also required (and are currently part of the Coillte LIFE project).

Cutover areas, particularly on the northern, western and north-western margins of the bog, have the potential to play a major role in the restoration of the habitat as the current characteristics of the high bog (i.e. small size and high cut faces slopes) may make it difficult to regenerate Active Raised Bog on the high bog over the long term.

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

Table 8.1 Changes in Active Raised Bog area

Active Ecotopes	1994 ¹	2000	2000 (amended)	2013	Change (2000-2013)	
	Area (ha)	Area (ha)	Area (ha)	Area (ha)	Area (ha)	%
Sub-central	n/av	32.53	24.39	3.15	(-)21.24	(-)87.08
Total	n/av	32.53	24.39	3.15	(-)21.24	(-)87.08

¹ This site was not surveyed by Kelly *et al.* (1995). The earliest available figures are derived from the vegetation map drawn by Derwin and MacGowan (2000) that was geo-referenced, digitised and in some cases adjusted by Fernandez *et al.* (2006).

Note: Table 8.1 includes 2000 figures and 2000 amended figures. The latter shows the ecotope area believed to be present in 2000 after surveying improvements in 2013. The comparison between 2000 (amended) and 2013 illustrates the actual changes in ecotope area in the 2000-2013 period. Any change in ecotope area between the 2000 and the 2000 (amended) values is due to improvement in mapping accuracy and/or the result of a more comprehensive survey in 2013 (see discussion above and table 8.2 for further detail).

Table 8.2 Assessment of changes in individual Active Raised Bog areas

Area	Quadrats	Trend	Comment	Quadrats analysis
Sc1	Qsc1	Decreasing	Large losses associated with drying out processes caused by impacting activities, but particularly large bog burst along the southern section caused by peat cutting.	New quadrat situated within Derwin's (2008) monitoring Quadrat 7. 2013 results similar to 2008 data.
Sc2	None	Newly developed	This sub-central area result of re-wetting associated with the blocking of drains.	
Sc3	None	Decreasing	Large losses associated with drying out processes caused by impacting activities, but particularly large bog burst along the southern section caused by peat cutting.	
Sc4	None	Decreasing	Large losses associated with drying out processes caused by impacting activities, but particularly large bog burst along the southern section caused by peat cutting. On the other hand partly newly developed as a result of rewetting associated with the blocking of drains.	
Sc5	None	Decreasing	Large losses associated with drying out processes caused by impacting activities, but particularly large bog burst along the southern section caused by peat cutting.	
Sc6	Qsc2	Decreasing	Large losses associated with drying out processes caused by impacting activities, but particularly large bog burst along the southern section caused by peat cutting. On the other hand partly newly developed as a result of rewetting associated with the blocking of drains.	New quadrat.

Degraded Raised Bog (7120)

Area

The Degraded Raised Bog FRV for Area is 90.38 ha at Carn Park Bog. This value corresponds with the difference between the current high bog area (160.29 ha) and the Active Raised Bog FRV (69.91 ha) 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 73.87% bigger than FRV and therefore the habitat Area is given an **Unfavourable Bad** assessment (see table 8.4).

The total area in 2013 of Degraded Raised Bog in table 8.3 is 157.14 ha, a net increase of 20.05 ha from the amended area estimate of 137.09ha in 2000. The 2000 estimated areas in different Degraded Raised Bog ecotopes would be affected by lack of precision in mapping and also by differences in interpreting the vegetation. The differences in 2000 and 2000 (amended) areas in sub-marginal and marginal ecotopes are partly the result of changes in interpretation. Fernandez *et al.* (2006) also suggested the small area of sub-marginal ecotope mapped by Derwin and MacGowan (2000) was an underestimate.

Table 8.3 shows a considerable increase of 21.24 ha in sub-marginal ecotope. This is the net result of the degradation of an estimated 20.96 ha of former sub-central ecotope to sub-marginal combined with the regeneration of 0.28 ha of sub-marginal ecotope to Active Raised Bog. An estimated 1.19 ha of Degraded Raised Bog have been lost to peat cutting over the 2004/05-2010 period, 0.95 ha from marginal ecotope and 0.24 ha from areas mapped as clearfell on the western side of CF1. In addition, 0.57 ha of former conifer plantation are now considered to be inactive flush. There may have been additional changes among Degraded Raised Bog ecotope categories, sub-marginal, marginal and face bank, but they are not possible to quantify due to the lack of precise baseline mapping for the site.

In summary, table 8.3 indicates that there has been a net increase (20.05 ha) in the area of Degraded Raised Bog. The increase is the result of degradation and expansion of Active Raised Bog and high bog losses caused by peat cutting. As a result the habitat is given an **Increasing** trend.

The Area of Degraded Raised Bog at Carn Park Bog is assessed as Unfavourable Bad-Increasing (see table 8.5).

Structure & Functions

The FRV for S&Fs is for a maximum 25% of the Degraded Raised Bog area to be made up of marginal and face bank, i.e. the lower quality and drier vegetation communities. This value is 39.29ha (25% of 157.14ha, the current area of Degraded Raised Bog). The current marginal and face bank ecotopes area value (34.95ha) is 11.03% below 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 below FRV falls into the **Favourable** 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 loss of 0.95 ha of marginal ecotope due to peat cutting, but no change in the area of face bank ecotope. Additional changes among Degraded Raised Bog ecotope categories, sub-marginal, marginal and face bank would have taken place in the reporting period, associated by drying out processes on the high bog, as the severe Active Raised Bog losses indicate. But these changes within Degraded Raised Bog cannot be quantified due to the lack of precise baseline mapping for the site. Thus, a **Declining** trend in the DRB's S&Fs at Carn Park is assumed.

Typical good quality indicators and typical plant species are still found throughout the entire bog on sub-marginal ecotope. Healthy relict hummocks of *Sphagnum fuscum* and *S. austinii* were notably frequent in sub-marginal ecotope on this site, suggesting there may be good potential for restoration.

The Structure & functions of Degraded Raised Bog at Carn Park Bog are assessed as Favourable - Declining (see table 8.5).

Future Prospects

Degraded Raised Bog has decreased as result of peat cutting, and this activity has also damaged the habitat's S&Fs. Peat cutting has recently ceased on Carn Park Bog, however the effects of former peat cutting, including marginal drainage, are likely to continue to delay recovery of Degraded Raised Bog to Active Raised Bog. In addition the bog burst (west of CF2), which is almost certainly due to peat cutting, will cause localised re-wetting within the subsided area, but more extensive drying out of the areas to the north and west of the bog burst due to increased surface slopes. More positively, forestry clearance and drain blocking on the high bog have resulted in the restoration of Degraded Raised Bog to Active Raised Bog. The effects of these recent restoration works can be expected to persist, provided that there is sufficient follow-up, such as additional drain blocking and control of conifer regeneration. However, it is only expected that negative and positive

activities (i.e. restoration works) balance each other and thus no net changed in habitats extent or S&Fs will occur, unless further restoration works are undertaken.

Habitat **Area** is currently 157.14% above FRV (see table 8.4) and a Stable trend is expected in the following two reporting periods (12 years). As a result habitat Area is expected to remain more than 15% above FRV. Thus, habitat’s **Area Future Prospects** are assessed as **Unfavourable Bad-Stable**. Habitat’s **S&Fs** are currently 11.03% below FRV (see table 8.4). A Stable trend is foreseen in the following two reporting periods and thus **S&Fs** are expected to remain below FRV. As a result, habitat’s **S&Fs Future Prospects** are assessed as **Favourable-Stable**.

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

Table 8.3 Changes in Degraded Raised Bog area

Inactive Ecotopes	1994 ¹	2000	2000 (amended)	2013	Change (2000-2013)	
	Area (ha)	Area (ha)	Area (ha)	Area (ha)	Area (ha)	%
Sub-marginal	n/av	5.27	45.52	66.76	(+)21.24	(+)46.66
Marginal ²	n/av	68.78	31.91	30.96	(-)0.95	(-)2.98
Face bank ²	n/av	n/a	3.99	3.99	0.00	0.00
Inactive flush	n/av	n/a	0.00	0.57	(+)0.57	(+)100.00
Conifer plantation/Clear felled area	n/av	46.04	55.67	54.86	(-)0.81	(-)1.46
Total	n/av	120.09	137.09	157.14	(+)20.05	(+)14.63

¹ This site was not surveyed by Kelly *et al.* (1995). The earliest available figures are derived from the vegetation map drawn by Derwin and McGowan (2000) that was geo-referenced, digitised and in some cases adjusted by Fernandez *et al.* (2006).

² Any 2013 marginal and face bank ecotope value given within the report should be taken as a maximum value. Their extent is based on the 2013 habitat survey and 2010 aerial photographs. Additional peat cutting took place in 2010/2011, and since there is no aerial photography available post 2010, the area lost from 2010 to 2013 cannot be estimated.

Note: Table 8.3 includes 2000 figures and 2000 amended figures. The latter shows the ecotope area believed to be present in 2000 after surveying improvements in 2013. The comparison between 2000 (amended) and 2013 illustrates the estimated changes in ecotope area in the 2000-2013 period. Any change in ecotope area between the 2000 and the 2000 (amended) values is due to improvement in mapping accuracy and/or the result of a more comprehensive survey in 2013.

The overall conservation status of Degraded Raised Bog at Carn Park 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, but were uncommon relative to other raised bog sites. 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 considerably decreased over the 2000-2013 period, but this is as a result of change to sub-marginal ecotope. Therefore, the Area and S&Fs of depressions on peat substrates of the *Rhynchosporion* is likely to be stable or to have decreased slightly. 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 threatened Active and Degraded Raised Bog in the past. The effects of past peat cutting and marginal drainage are still operating. On the other hand, recent restoration works have slightly increased the area of Active Raised Bog. The effects of these recent restoration works can be expected to persist, provided that there is sufficient follow-up, such as additional drain blocking and control of conifer regeneration. However, it is only expected that negative and positive activities (i.e. restoration works) balance each other and thus no net changed in habitats extent or S&F will occur, unless further restoration works are undertaken. Therefore, the habitat's Area Future Prospects are given an **Unfavourable Bad-Stable** assessment.

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

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

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

The conservation status of depressions on peat substrates of the Rhynchosporion at Carn 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	2013 value (ha) ²	% below target	FRV 2013 Target (ha) ³	2013 value (ha) ⁴	% below target
7110	69.91	3.15	95.49	1.58	0.00	100.00

¹ 1994 central, sub-central, active flush, bog woodland and sub-marginal ecotope area. As these data are not available for Carn Park Bog, 2000 (unamended) values have been used.

² 2013 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 2013 central ecotope and active flush area.

Habitat	Area Assessment			Structure & Functions Assessment		
	FRV Target (ha) ⁵	2013 value (ha) ⁶	% above target	FRV 2013 Target (ha) ⁷	2013 value (ha) ⁸	% below target
7120	90.38	157.14	73.87	39.29	34.95	11.03

⁵ Current high bog area minus 7110 area FRV.

⁶ 2013 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	Future Prospects Assessment	Overall Assessment
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Assessment				
7110	Unfavourable Bad-Decreasing	Unfavourable Bad-Declining	Unfavourable Bad-Stable	Unfavourable Bad-Declining
7120	Unfavourable Bad-Increasing	Favourable-Declining	Unfavourable Bad-Stable	Unfavourable Bad-Declining
7150	Unfavourable Bad-Stable	Unfavourable Bad-Declining	Unfavourable Bad-Stable	Unfavourable Bad-Declining

Conclusions

Summary of impacting activities

- Peat cutting over the 2004/05-2010 period has resulted in the direct loss of 1.19 ha of high bog and is considered to have contributed to the estimated decrease in the area of Active Raised Bog. Peat cutting is reported to have recently ceased, with no plots cut in 2012. Former peat cutting has resulted in significant subsidence affecting two large parts of the high bog, and further slumping events are likely.
- The majority (3.4 km) of drains on the high bog have been blocked and are reduced functional. A further 1.9 km of drains on the high bog remain unblocked and are either functional or reduced functional.
- Cutover drainage (peripheral drainage) associated with former peat cutting continues to impact on the high bog habitats.
- There has been no evidence of fire on the bog since the 1970s.
- Lodgepole pine regeneration is widespread across Degraded Raised Bog and is abundant in former clearfells. Some control of regeneration took place as part of restoration activities, but more work is required.

Changes in active peat forming areas

- There has been an estimated net loss of 21.24 ha of Active Raised Bog, representing 87.08% of the total Active Raised Bog area. This loss is based on the comparison of the 2000 (amended) figures against the 2013 habitat extent. The 2000 (amended) figure has been calculated taking into account changes in survey methodology and interpretation of the vegetation between the 2000 and 2013 surveys. This loss has been associated with large changes on the high bog topography and hydrology associated with the large bog burst, which took place in the 2000-2005 period, caused by peat cutting along the southern section of high bog.

- The habitat losses have occurred also as a result of high bog drains (now mostly blocked), existing marginal drainage, cut faces and the recently removed conifer plantations on the high bog, which have contributed to the ongoing drying out of the high bog.
- More recently, drain-blocking and other restoration works have led to the rewetting of the bog and regeneration of Active Raised Bog in **Sc2** and parts of **Sc4** and **Sc6**.

Other changes

- Inactive flush vegetation (**Z**) has developed on clearfelled conifer plantation (**CF3**). *Sphagnum* regeneration there suggests that the flush may become actively peat-forming in the future.
- The vegetation on other clearfelled conifer plantations is generally sub-marginal in character. Wetter pockets may become peat forming in the future, particularly in **CF4** where abundant *Betula pubescens* regeneration may lead to development of Bog Woodland.

Quadrats analysis

- Quadrat **Qsc1** was recorded within a quadrat (Quadrat 7) surveyed by Derwin (2008) as part of Coillte's restoration monitoring. The quadrat was dominated by quaking lawns of *Sphagnum* (cover 51-75%), and present survey data show no changes from 2008 that are distinguishable from differences in recording methods.
- Quadrat **Qsc2** was newly recorded in **Sc6** in an example of complex 10/4 that approached central ecotope in quality.

Restoration works

- Four conifer plantation blocks have been recently clearfelled under Coillte's EU LIFE project on raised bog restoration. Additional restoration works carried out as part of this project include drain blocking and clearance of some conifer regeneration on the high bog and within clearfelled areas (positive impacts) and provision of recreational access (neutral impact). Monitoring studies (Derwin, 2008) have detailed early benefits for raised bog hydrology and vegetation regeneration.

Summary of conservation status

- **Active Raised Bog** has been given an **Unfavourable Bad–Declining** conservation status at Carn Park Bog. Habitat area has decreased considerably and both area and quality are significantly below the FRVs. There have been some local increases in Active Raised Bog

area due to restoration works. These works are likely to yield additional increases in Active Raised Bog in the short to medium term, but currently negatively impacting activities and major changes on the hydrology of the bog (i.e. bog burst) are likely to counteract some of this future potential gains and thus, Future Prospects are only considered Unfavourable Bad–Stable, unless further restoration works are undertaken.

- **Degraded Raised Bog** has been given an **Unfavourable Bad–Declining** conservation status at Carn Park Bog. Habitat Area has overall increased as a result of the degradation of Active Raised Bog and losses associated with peat cutting. The habitat’s S&Fs have also declined due to peat cutting. Habitat Area is above the FRV. Future Prospects are only considered Unfavourable Bad-Stable.
- **Depressions on peat substrates of the Rhynchosporion** has been given an **Unfavourable Bad–Declining** conservation status at Carn Park Bog. Habitat Area is considered to have not changed significantly and quality (S&Fs) declined in the reporting period. Future Prospects are considered Unfavourable Bad-Stable.

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

Recommendations

- **Maintain cessation of peat cutting.**
- **Ongoing monitoring and management of restoration works** that are being carried out as part of Coillte’s LIFE-funded raised bog restoration project should be continued. This includes monitoring walrags and removing regenerating conifers. Blocked drains should be inspected and additional blocks installed in sections where required.
- **Blocking marginal and cutover drains** and other hydrological restoration works, such as reprofiling or sealing cut faces, should be carried out subject to detailed hydrological studies as below.
- **Further hydrological and topographical studies** should be carried out to ascertain the capacity of the high bog to support Active Raised Bog and thus estimate a more accurate favourable reference value.
- **Detailed hydrological studies** are also required to identify the drain blocking and other hydrological works that would have the greatest likelihood of enhancing the conservation status of the bog and to evaluate potential impacts on surrounding land.

- **Further botanical monitoring surveys** on the high bog should be carried out in order to assess changes in habitat conservation status.

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Appendix I Detailed vegetation description of the high bog

Active Raised Bog (7110)

Sub-Central Ecotope Complexes

COMPLEX 6/9+P

- **Location:** centre of Sc4
- **Ground:** very soft to quaking
- **Physical indicators:** absent
- **Calluna height:** 11-20cm
- **Cladonia cover:** 4-10%
- **Macro-topography:** local depression
- **Pools:** 11-25% regular
- **Sphagnum cover:** 34-50% (to 75% in places)
- **Narthecium cover:** 4-10%
- **Micro-topography:** Low and high hummocks, pools, lawns and hollows
- **Tussocks:** *Eriophorum vaginatum* (<4%)
- **Degradation or regeneration evidence:** absent
- **Species cover:** *Calluna vulgaris* (11-25%), *Eriophorum vaginatum* (11-25%), *E. angustifolium* (4-10%), *Rhynchospora alba* (<4% frequent), *Narthecium ossifragum* (4-10%), *Sphagnum capillifolium* (4-10%), *S. papillosum* (11-25%), *S. magellanicum* (11-25%), *S. pulchrum* (<4% occasional), *S. cuspidatum* (11-25%), *S. fuscum* (<4% occasional), *S. austinii* (4-10%).
- **Additional comments:** This complex was dominated by lawns of *Sphagnum papillosum* and *S. magellanicum* interspersed with shallow *S. cuspidatum* pools. *Eriophorum vaginatum* was the most prominent vascular plant, accompanied by some *Narthecium ossifragum*. The relatively low cover of *S. pulchrum* and high cover of *S. cuspidatum* were notable, compared with other sub-central complexes. This complex was very wet and of high, nearly central, quality.

COMPLEX 10/4

- **Location:** in Sc1, Sc3 and Sc5 and southwestern section of Sc4 and northern section of Sc6
- **Ground:** very soft - quaking

- **Physical indicators:** absent
- **Calluna height:** 11-20cm
- **Cladonia cover:** 11-25%
- **Macro-topography:** flats and depressions
- **Pools:** absent
- **Sphagnum cover:** 51-75%
- **Narthecium cover:** <4%
- **Micro-topography:** Low and high hummocks, lawns and hollows
- **Tussocks:** *Eriophorum vaginatum* (<4%)
- **Degradation or regeneration evidence:** absent
- **Species cover:** *Calluna vulgaris* (26-33%), *Eriophorum vaginatum* (4-10%), *E. angustifolium* (<4% occasional), *Rhynchospora alba* (11-25%), *Carex panicea* (<4% occasional), *Narthecium ossifragum* (<4% occasional), *Trichophorum germanicum* (<4% rare), *Sphagnum capillifolium* (4-10%), *S. papillosum* (11-25%), *S. magellanicum* (<4-4-10%), *S. pulchrum* (11-25%), *S. fuscum* (4-10%), *S. austinii* (<4% occasional), *Leucobryum glaucum* (<4% occasional).
- **Additional comments:** This complex was characterised by lawns and hollows of *Sphagnum papillosum* and *S. pulchrum* interspersed with high and low hummocks dominated by *S. fuscum* and *S. austinii*. *S. capillifolium* was only scattered in hummocks. *Rhynchospora alba* was notably abundant in this complex, being rather rare across most of the rest of the site. Pools were absent.

In **Sc1**, this complex occurred in mosaic with sub-marginal complex 9/7/3. Only the best areas within this area conformed to the above description.

In **Sc3**, the complex occurred in a mosaic with sub-marginal ecotype in some areas and therefore includes some sub-marginal patches that were too small to map out. This area differed from **Sc1** in higher overall frequency and cover of *Rhynchospora alba* (11-25%) and *Eriophorum vaginatum* (26-33%), lower cover of *Calluna vulgaris* (4-10%) and *Cladonia portentosa* (4-10%) and less developed micro-topography. Lawns of *Rhynchospora alba* and *Sphagnum* dominated. Occasional hollows with *Sphagnum cuspidatum* (<4%) were present. *Sphagnum pulchrum* was frequent throughout but of low overall cover (<4%).

In **Sc5**, this complex was found in a small depression. Micro-topography was less well-developed (no high hummocks), and algal pools were occasional (<4%). Covers of *Eriophorum angustifolium* (4-10%) and *E. vaginatum* (11-25%) were higher than detailed above. *Rhynchospora alba* (11-25%) was dominant in lawns. Overall *Sphagnum* cover was similar (51-75%) and *Sphagnum* lawns were dominant with *S. pulchrum* (11-25%), *S. papillosum* (11-25%),

Sphagnum capillifolium (11-25%) and *S. magellanicum* (4-10%). *S. cuspidatum* (<4%) was present in small hollows. The sub-central ecotope graded into good quality sub-marginal vegetation on the NW boundary, with frequent *Sphagnum fuscum* hummocks. Elsewhere the sub-central vegetation graded into poorer quality sub-marginal complex 9/7/6 with abundant *Narthecium ossifragum* in hollows. There was a small flushed area to the north of Sc5 and a sub-central point was mapped to the north of this suggesting that there may be some local flushing and higher water levels in this area.

In Sc6, this complex was also located in a small depression, which was very wet and quaking in some areas. *Sphagnum* cover was similar overall (51-75%) but locally increased to 76-90%. There were occasional low and high hummocks of *Sphagnum fuscum* and *S. capillifolium*. Algal pools (<4%) had a low cover of *S. cuspidatum*. *Sphagnum* lawns were abundant with *S. pulchrum* (11-25%), *S. papillosum* (26-33%), *Sphagnum capillifolium* (4-10%) and *S. magellanicum* (4-10%). The non-native moss *Campylopus introflexus* was recorded in one location (<4%). There was a small group of *Pinus contorta* saplings in the north-east with good *Sphagnum* cover underneath the trees and frequent *Sphagnum pulchrum* but low *Calluna vulgaris* cover. Small areas with high *Sphagnum* cover (76-90%) were almost central ecotope quality (similar to central complex 10/15), but were localised and too small to map. *Sphagnum fuscum* cover was high here (4-10%) with *S. magellanicum* (34-50%), *S. papillosum* (34-50%) and *S. pulchrum* (4-10%). *Rhynchospora alba* (11-25%) was the dominant vascular plant. The ground was very wet and quaking.

Qsc1 was recorded in this complex in Sc1 and Qsc2 was recorded in this complex in the north-eastern part of Sc6.

COMPLEX 10/6

- **Location:** Sc2
- **Ground:** very soft
- **Physical indicators:** absent
- **Calluna height:** 11-20cm
- **Cladonia cover:** 11-25%
- **Macro-topography:** gentle slope
- **Pools:** <4% regular
- **Sphagnum cover:** 51-75%
- **Narthecium cover:** 4-10%
- **Micro-topography:** Low hummocks, lawns, pools and hollows

- **Tussocks:** *Eriophorum vaginatum* (<4%), *Trichophorum germanicum* (<4%)
- **Degradation or regeneration evidence:** blocked drains in vicinity
- **Species cover:** *Calluna vulgaris* (26-33%), *Eriophorum vaginatum* (4-10%), *E. angustifolium* (<4% occasional), *Carex panicea* (<4% occasional), *Narthecium ossifragum* (4-10%), *Trichophorum germanicum* (4-10%), *Sphagnum capillifolium* (11-25%), *S. papillosum* (26-33%), *S. magellanicum* (<4% occasional), *S. pulchrum* (4-10%), *S. cuspidatum* (4-10%).

Additional comments: This complex was found in **Sc2**, which was a recently formed sliver of sub-central ecotope to the north of **Clearfell 1**. It formed as a result of Coillte's restoration works. The western and northern boundaries are the result of slightly steeper slopes there. Part of the sub-central area occupies a former forestry fire-break.

COMPLEX 9/7/10

- **Location:** southern area of **Sc6**
- **Ground:** soft to very soft
- **Physical indicators:** absent
- **Calluna height:** 21-40cm
- **Cladonia cover:** 11-25%
- **Macro-topography:** flat
- **Pools:** regular pools <4% (rare)
- **Sphagnum cover:** 51-75%
- **Narthecium cover:** <4%
- **Micro-topography:** high hummocks, low hummocks and lawns
- **Tussocks:** *Eriophorum vaginatum* (<4%).
- **Degradation or regeneration evidence:** absent
- **Species cover:** *Calluna vulgaris* (34-50%), *Carex panicea* (<4% - mainly at boundary with sub-marginal ecotope), *E. vaginatum* (26-33%), *Sphagnum capillifolium* (34-50%), *S. cuspidatum* (<4% - rare, in pools), *S. magellanicum* (34-50%), *S. papillosum* (<4%), *S. pulchrum* (<4% - occasional), *S. austinii* (<4% - occasional high hummocks), *Hypnum jutlandicum* (<4%), *Polytrichum strictum* (<4%).
- **Additional comments:** Very wet with some standing water. Dominated by high hummocks of *Sphagnum capillifolium* and lawns of *S. magellanicum*. The area showed signs of flushing with frequent *Polytrichum strictum* and occasional *Vaccinium oxycoccos*. There were occasional pools in the SE area with *S. cuspidatum* and standing water in areas around pools. The 9/7/10 vegetation occurred in a mosaic with 9/7 and 9/7/3 (particularly in the east), and small areas of

sub-marginal ecotope have been included in the area mapped as sub-central ecotope. In the south of the area (north of **Clearfell 1**), *Sphagnum papillosum* lawns were present.

COMPLEX 9+P

- **Location:** Sc4 and southwestern section of Sc6
- **Ground:** very soft
- **Physical indicators:** absent
- **Calluna height:** 11-20cm
- **Cladonia cover:** 11-25%
- **Macro-topography:** gentle slope & localized depressions
- **Pools:** 11-25% regular
- **Sphagnum cover:** 34-50%
- **Narthecium cover:** <4% (-10% at edges)
- **Micro- topography:** Low hummocks, lawns, pools and hollows
- **Tussocks:** *Eriophorum vaginatum* (4-10%), *Trichophorum germanicum* (<4%)
- **Degradation or regeneration evidence:** see comments
- **Species cover:** *Calluna vulgaris* (11-25%), *Eriophorum vaginatum* (34-50%), *E. angustifolium* (4-10%), *Carex panicea* (<4% occasional), *Narthecium ossifragum* (<4% (-10% at edges)), *Trichophorum germanicum* (<4%), *Sphagnum capillifolium* (4-10%), *S. papillosum* (26-33%), *S. magellanicum* (4-10%), *S. pulchrum* (<4% occasional), *S. cuspidatum* (<4% frequent).
- **Additional comments:** The overall impression of this complex was of one large shallow, soupy pool with small hummock islands. The high cover of *Eriophorum vaginatum* and relatively low cover of *Calluna vulgaris* was distinctive. The ground was very soft with numerous small, shallow pools and lawns mainly occupied by vigorous *Sphagnum papillosum* interspersed with low *S. capillifolium* hummocks. In Sc4, this complex appeared to be of recent origin as the result of drain blocking to the north. (The edge of the high bog to the north backed on to *Typha latifolia* swamp on cutover bog, with the adjacent high bog entirely flooded at the time of survey and supporting pure *Eriophorum angustifolium* swards.) Where this complex graded into sub-marginal ecotope (sometimes forming mosaics), pools became smaller and in transition to *Narthecium* dominated hollows.

In Sc6, *E. vaginatum* was somewhat less abundant (26-33%), but still the dominant vascular plant, and *E. angustifolium* was frequent in pools. Large *Sphagnum* pools and lawns were abundant. Pools were dominated by *Sphagnum cuspidatum* (26-33%) and standing water was present throughout much of the area. *S. papillosum* and *S. magellanicum* were the dominant

lawn *Sphagna* as above. This vegetation graded into 9/7/10 sub-central ecotope in the east and 9/7 sub-marginal ecotope in the west.

Degraded Raised Bog (7120)

Sub-Marginal Ecotope Complexes

COMPLEX 9/7

- **Location:** scattered throughout the high bog, but mostly middle section surrounding sub-central ecotope area
- **Ground:** soft – very soft
- **Physical indicators:** absent
- **Calluna height:** 11-20cm
- **Cladonia cover:** 26-33%
- **Macro-topography:** flat to gentle slope
- **Pools:** absent
- **Sphagnum cover:** 11-25% (to 50% in small localised patches)
- **Narthecium cover:** <4%
- **Micro-topography:** Low hummocks, hollows
- **Tussocks:** *Eriophorum vaginatum* (<4%)
- **Degradation or regeneration evidence:** absent
- **Species cover:** *Calluna vulgaris* (26-33%), *Eriophorum vaginatum* (11-25%), *E. angustifolium* (<4% frequent), *Carex panicea* (<4% occasional), *Narthecium ossifragum* (<4% rare), *Erica tetralix* (<4% frequent), *Sphagnum capillifolium* (11-25%), *S. papillosum* (4-10%), *S. tenellum* (<4% frequent), *S. magellanicum* (<4% occasional), *S. pulchrum* (<4% occasional – locally abundant), *S. fuscum* (<4% rare), *S. austinii* (<4% rare).
- **Additional comments:** Some examples of this complex approached sub-central ecotope quality. The surface was low and undulating. The scarcity of *Narthecium* and *Carex panicea* was distinctive. *Sphagnum pulchrum* was more frequent in this sub-marginal complex than in 9/7/6 or 9/7/3.

COMPLEX 9/7/6

- **Location:** this complex is found throughout the high bog
- **Ground:** soft

- **Physical indicators:** absent
- **Calluna height:** 21-30cm
- **Cladonia cover:** 26-33%
- **Macro-topography:** gentle slope
- **Pools:** absent
- **Sphagnum cover:** 11-25%
- **Narthecium cover:** 4-10% patchy
- **Micro- topography:** Low hummocks, hollows
- **Tussocks:** *Eriophorum vaginatum* (4-10%), *Trichophorum germanicum* (<4%)
- **Degradation or regeneration evidence:** absent
- **Species cover:** *Calluna vulgaris* (26-33%), *Eriophorum vaginatum* (11-25%), *E. angustifolium* (<4% occasional), *Carex panicea* (<4% frequent, occasionally 4-10%), *Narthecium ossifragum* (4-10%), *Trichophorum germanicum* (<4% occasional), *Pinus* spp seedlings (<4% occasional), *Sphagnum capillifolium* (4-10%), *S. papillosum* (4-10%), *S. tenellum* (<4% frequent), *S. magellanicum* (<4% occasional), *Leucobryum glaucum* (<4% occasional).
- **Additional comments:** Characterised by uneven hummocks of *Calluna* and *Sphagnum capillifolium* with *Eriophorum vaginatum*. *Cladonia portentosa* was very prominent in the vegetation. *Sphagnum* cover was reasonably good and healthy throughout most of the bog, and rarely included relict hummocks of *S. austinii* and *S. fuscum*. Scattered pine seedlings were present throughout most of the site; larger saplings have mostly been felled to waste as part of Coillte's LIFE restoration project.

A variant of this complex was mapped as 9/7/3. It was distinguished by higher cover of *Carex panicea* (11-25%) and *Sphagnum* (11-25%) and lower cover of *Narthecium ossifragum* (<4%), *Eriophorum vaginatum* (4-10%) and *Cladonia portentosa* (11-25%). Hummocks were not as tall or uneven and showed less signs of degradation. This complex was often transitional to or found in mosaic with sub-marginal complex 9/7 or sub-central ecotope. Due to its higher *Sphagnum* cover, it was a higher quality variant.

Where *E. angustifolium* replaced *E. vaginatum* in the eastern lobe of the high bog, the above variant was mapped as 9a/7/3. Vegetation composition was similar to 9/7/3 with *Carex panicea* prominent in the vegetation. However, *Eriophorum vaginatum* had low cover (<4%) and *E. angustifolium* was dominant (25-33%). Lichen cover was high (*Cladonia portentosa* 25-33%). The ground was wetter than in areas of 9/7/3 and there may have been some flushing. *Trichophorum germanicum* and *Rhynchospora alba* were present at low overall cover (<4%) but locally frequent. *Sphagnum* cover was 11-25% with locally abundant *Sphagnum pulchrum* (<4%),

also indicating that this is a slightly wetter sub-marginal community. This area was previously mapped as 7+Cl+ER+Pines (2000), the difference in 2013 is likely to be due to re-interpretation of the vegetation.

A tiny area of inactive flush recorded as a point and too small to map as a polygon was found in the eastern part of the site. It was a drier, flushed 15 m diameter circle of *Myrica gale* and *Calluna*.

COMPLEX 9/2+TP

- **Location:** southeastern part of the bog near **Clearfell 2**
- **Ground:** soft to very soft
- **Physical indicators:** cracking and tear pools
- **Calluna height:** 11-20cm
- **Cladonia cover:** 26-33%
- **Macro-topography:** steep (moderately) slope
- **Pools:** <4% (-10% locally) tear pools
- **Sphagnum cover:** 11-25%
- **Narthecium cover:** <4%
- **Micro- topography:** Low hummocks, hollows, pools
- **Tussocks:** *Eriophorum vaginatum* (<4%), *Trichophorum germanicum* (<4% (-10%))
- **Degradation or regeneration evidence:** cracking and slumping
- **Species cover:** *Calluna vulgaris* (11-25%), *Eriophorum vaginatum* (11-25%), *E. angustifolium* (4-10% (-50% locally)), *Carex panicea* (<4% occasionally 4-10%), *Narthecium ossifragum* (<4% occasional), *Trichophorum germanicum* (<4% (-10%)), *Sphagnum capillifolium* (4-10%), *S. papillosum* (4-10%), *S. pulchrum* (<4% occasional), *S. fuscum* (<4% rare), *S. cuspidatum* (<4% frequent).
- **Additional comments:** This complex was very heterogeneous in terms of structure and community composition. Tear pools were a key feature. These were very deep, flooded cracks caused by slumping of the bog (or bog burst) in this area. There was some *Sphagnum cuspidatum* in shallow parts of pools. Some parts of the complex were much wetter with ponding water and higher cover of *Eriophorum angustifolium* and/or *E. vaginatum*. *Trichophorum germanicum* was locally abundant but sometimes absent. In examples of the latter, the vegetation was then similar to complex 9/7.

Marginal Ecotope Complexes

COMPLEX 7/9+CL

- **Location:** northeastern bog margin
- **Ground:** firm
- **Physical indicators:** bare peat (<4%)
- **Calluna height:** 21-30cm
- **Cladonia cover:** 34-50%
- **Macro-topography:** steep slope
- **Pools:** absent
- **Sphagnum cover:** <4%
- **Narthecium cover:** <4% (locally frequent)
- **Micro-topography:** low hummocks, hollows
- **Tussocks:** *Eriophorum vaginatum* (4-10%), *Trichophorum germanicum* (<4%)
- **Degradation or regeneration evidence:** absent
- **Species cover:** *Calluna vulgaris* (34-50%), *Eriophorum vaginatum* (4-10%), *E. angustifolium* (4-10%), *Erica tetralix* (4-10%), *Carex panicea* (<4% rare), *Pinus* spp. seedlings (<4% occasional), *Narthecium ossifragum* (<4% locally frequent), *Trichophorum germanicum* (<4% frequent), *Sphagnum capillifolium* (<4% occasional), *S. magellanicum* (<4% occasional), *S. papillosum* (<4% occasional).
- **Additional comments:** Microtopography was characterised by firm surface with uneven hummocks. Some conifer brush was present arising from felling of pine regeneration on the high bog. Patches of *Myrica gale* were present where this complex grades into sub-marginal ecotope.

COMPLEX 3/7/6

- **Location:** western and northern bog margins
- **Ground:** firm
- **Physical indicators:** bare peat (<4%)
- **Calluna height:** 21-30cm
- **Cladonia cover:** 11-25%
- **Macro-topography:** gentle to steep slopes
- **Pools:** absent
- **Sphagnum cover:** <4%

- **Narthecium cover:** 4%-10% (-25% locally)
- **Micro-topography:** low hummocks, hollows
- **Tussocks:** *Trichophorum germanicum* (<4%)
- **Degradation or regeneration evidence:** absent
- **Species cover:** *Calluna vulgaris* (26-33% (-50%)), *Eriophorum vaginatum* (<4% occasional), *E. angustifolium* (<4% occasional), *Carex panicea* (26-33% (-50%)), *Pinus* spp. seedlings (<4% frequent), *Narthecium ossifragum* (4-10% (-25%)), *Trichophorum germanicum* (<4% frequent), *Sphagnum capillifolium* (<4% occasional), *S. papillosum* (<4% occasional).
- **Additional comments:** This marginal complex graded into sub-marginal complex 9/7/6 where the bog was softer and wetter. It was distinguished from 9/7/6 by firm ground and lower cover of *Sphagnum* and *Eriophorum vaginatum* (the latter usually absent). On a steep, subsiding slope on the western margin, a variant 3/7/6+TP was recorded, characterised by higher cover of *Calluna vulgaris*, lower cover of *Carex panicea*, bare peat cover of 4-10% and abundant, deep tear pools covering 11-25%.

COMPLEX 6/7

- **Location:** southern and northeastern bog margin
- **Ground:** firm
- **Physical indicators:** bare peat (4-10%)
- **Calluna height:** 21-30cm
- **Cladonia cover:** <4%
- **Macro-topography:** steep slope
- **Pools:** absent
- **Sphagnum cover:** 4-10%
- **Narthecium cover:** 4-10% patchy
- **Micro-topography:** low hummocks, hollows
- **Tussocks:** *Trichophorum germanicum* (<4%)
- **Degradation or regeneration evidence:** cracking and slumping, increasing to east
- **Species cover:** *Calluna vulgaris* (76-90%), *Rhynchospora alba* (11-25%), *Pinus* spp. seedlings (<4% occasional), *Narthecium ossifragum* (4-10% patchy), *Trichophorum germanicum* (<4% frequent), *Sphagnum capillifolium* (<4% occasional), *S. tenellum* (<4% occasional), *S. subnitens* (<4% occasional), *S. papillosum* (<4% rare), *Campylopus introflexus* (<4% frequent).
- **Additional comments:** A variant of this complex occurred near **Clearfell 2** where cracking and slumping of the bog surface had formed tear pools; this was mapped as 6/7+TP. A significant

erosion channel had formed, draining a number of tear pools, and flowed towards the southern high bog edge.

Inactive flushes

FLUSH Z

- **Location:** north-eastern corner, adjacent/on Clearfell 3
- **Ground:** soft
- **Physical indicators:** conifer stumps and brash
- **Calluna height:** 31-40cm
- **Cladonia cover:** absent
- **Macro-topography:** flat
- **Pools:** <4% regular (blocked drains)
- **Sphagnum cover:** 4-10% in patches
- **Narthecium cover:** absent
- **Micro-topography:** forestry mounding and drains
- **Tussocks:** *Molinia caerulea* (51-75%)
- **Degradation or regeneration evidence:** *Sphagnum* regeneration locally
- **Species cover:** *Molinia caerulea* (51-75%), *Calluna vulgaris* (26-33%), *Ulex europaeus* (<4% occasional), *Eriophorum vaginatum* (<4% occasional), *Betula pubescens* (<4% occasional), *Juncus effusus* (<4% rare), *Rubus fruticosus* (<4% rare), *Sphagnum palustre* (4-10%), *S. fallax* (<4% occasional), *S. cuspidatum* (<4% occasional), *Hylocomium splendens* (<4% occasional), *Hypnum cupressiforme* (<4% frequent), *Pseudoscleropodium purum* (<4% frequent).
- **Additional comments:** This was a currently inactive flush on a clearfelled conifer plantation at the edge of the high bog beside the Coillte boardwalk. Former forestry drains were blocked and were forming pools that sometimes supported good *Sphagnum cuspidatum* cover. *S. palustre* and *S. fallax* occurred at pool edges. Planting ridges were dominated by *Calluna vulgaris* and other species typical of drier conditions. This area will likely become an actively peat-forming flush in the future.

Face bank Complexes

COMPLEX 1

- **Location:** along the bog margin

- **Ground:** firm
- **Physical indicators:** bare peat (<4%)
- **Calluna height:** 31-40 cm (locally 40 cm+)
- **Cladonia cover:** 34-50%
- **Macro-topography:** steep slope
- **Pools:** absent
- **Sphagnum cover:** <4%
- **Narthecium cover:** 4-10%
- **Micro- topography:** low hummocks, hollows
- **Tussocks:** *Trichophorum germanicum* (<4%)
- **Degradation or regeneration evidence:** frequently slumping and cracking bog surface
- **Species cover:** *Calluna vulgaris* (76-90%), *Carex panicea* (<4% occasional), *Pinus* spp. seedlings (<4% frequent), *Betula pubescens* (<4% occasional), *Trichophorum germanicum* (<4% occasional), *Narthecium ossifragum* (4-10%), *Sphagnum tenellum* (<4%), *S. subnitens* (<4%), *Hypnum jutlandicum* (<4% occasional)
- **Additional comments:** none

Clearfells

Four clearfelled conifer plantations were on the high bog. These were former lodgepole pine (*Pinus contorta*) plantations felled in 2005/2006 as part of Coillte's LIFE project on restoring raised bogs. The microtopography of each clearfell was characterised by the old planting ridges, pine stumps, old forestry drains and felling brash. In most cases, the forestry drains were dry; some of the wet drains were blocked as part of restoration works.

CLEARFELL 1

Clearfell 1 (CF1) was situated in the south-western corner of the high bog. Felling brash had been windrowed. The central area of the clearfell supported abundant pine (*Pinus contorta*) regeneration 2-2.5 m tall on average (11-25% cover). Regenerating pine saplings had apparently been cleared at the edges of the clearfelled area, and seedlings were very rare. Overall, *Sphagnum* cover was <4% and patchy. The most abundant species (apart from pine regeneration) were *Eriophorum vaginatum* (34-50%), *Calluna vulgaris* (34-50%) and *Hypnum jutlandicum* (4-10%). Other frequently occurring species that occupied less than 4% of the vegetation cover were *Betula pubescens* and *Eriophorum angustifolium*. Found occasionally were: *Rubus fruticosus*, *Polytrichum strictum*, *Lophozia incisa*, *Sphagnum cuspidatum*, *S. subnitens* and *Campylopus introflexus*.

CLEARFELL 2

Clearfell 2 (CF2) was situated in the south-eastern corner of the high bog. Some trees had been felled to waste and were windrowed. The central area of the clearfell supported abundant pine (*Pinus contorta*) regeneration 2-2.5 m tall on average (11-25% cover). Regenerating pine saplings had apparently been cleared at the edges of the clearfelled area, and seedlings were occasional. Overall, *Sphagnum* cover was <4% and patchy. The most abundant species (apart from pine regeneration) were *Eriophorum vaginatum* (51-75%) and *Calluna vulgaris* (34-50%). Frequently occurring (but covering <4%) were *Campylopus introflexus*, *Chamerion angustifolium*, *Hypnum jutlandicum* and *Sphagnum cuspidatum*. Occasionally occurring species included: *Polytrichum strictum*, *S. magellanicum*, *S. capillifolium*, *Andromeda polifolia*, *Juncus effusus* and *Vaccinium myrtillus*.

CLEARFELL 3

Clearfell 3 (CF3) was situated on the eastern side of the high bog. It differed from CF1 and CF2 in that the plantation was younger at felling and the canopy apparently never closed. Part of this clearfell supported inactive flush (Flush Z), with pockets of active *Sphagnum* growth, and this is described separately above. In the rest of the clearfell, pine (*Pinus contorta*) regeneration was scattered (<4% cover) and varied widely in height, ranging from 1-4 m tall. Birch (*Betula pubescens*) regeneration was more abundant (4-10% cover), forming an open stand with trees 3-4 m tall on average. Overall, *Sphagnum* cover was <4% and patchy. The dominant species was *Calluna vulgaris* (76-90%). Frequently occurring (but covering <4%) were *Cladonia portentosa* and *Pleurozium schreberi*. Occasionally occurring were: *Cladonia floerkeana*, *C. fimbriatum*, *Diplophyllum albicans*, *Hypnum cupressiforme*, *S. fallax* and *S. palustre*. Patches of bare peat supporting scattered cover of small mosses and *Cladonias* were frequent.

CLEARFELL 4

Clearfell 4 (CF4) was situated on the northern side of the high bog between a narrow strip of open, unplanted bog and open woodland of *Betula pubescens*, *Sorbus aucuparia*, and *Ilex aquifolium* on the lower slopes of the hill intruding into the bog from the northeast. This plantation had been felled to waste. Drains were wetter here than in most of the other three clearfells; they had not been blocked, but most had naturally infilled. Overall, the ground was damp with frequent waterlogged hollows (former drains) and pools. The vegetation was sub-marginal in character and was quite wet in places. These areas will likely become actively peat-forming in the future.

The most abundant species present were *Eriophorum vaginatum* (51-75%), *Calluna vulgaris* (11-25% (-50% locally)), *Cladonia portentosa* (4-10%) and *Betula pubescens* saplings (4-10%). Frequently occurring species occupying less than 4% cover were *Pinus contorta* saplings, *Sphagnum subnitens*, *S. cuspidatum* and *Hylocomium splendens*. Occurring occasionally were: *Polytrichum strictum*, *Rubus fruticosus*, *S. palustre*, *S. fallax*, *S. capillifolium*, *Vaccinium myrtillus*, *Aulacomnium palustre*, *Blechnum spicant* and *Pleurozium schreberi*.

In the eastern part of CF4, the vegetation was flushed with standing water in wet channels and high *Molinia caerulea* cover (76-90%). *Calluna vulgaris* was frequent throughout (4-10%). Overall *Sphagnum* cover was 4-10% (*S. fallax*, *S. capillifolium* and *S. papillosum*) and frequent throughout indicating that this area may transition to active flush if high water levels persist. *Pinus contorta* saplings (<4%) and small *Betula pubescens* saplings (4-10%) were frequent.

Depressions on peat substrates of the Rhynchosporion (7150)

The habitat occurs at Carn Park Bog in both Active and Degraded Raised Bog, but it is not particularly common. It is only occasionally found on Degraded Raised Bog. Only *Rhynchospora alba* was recorded during the 2013 survey at this site.

R. alba is found in most ecotopes in Carn Park Bog, such as: sub-central ecotope (6/9+P; 10/4); sub-marginal ecotope (9/7/6) and marginal ecotope (6/7). The species becomes very frequent within complex 10/4 (sub-central) and complex 6/7 (marginal).

The species is always found associated with wet features such as *Sphagnum* pools, *Sphagnum* lawns and hollows, along with *Sphagnum papillosum*, *S. pulchrum* and *S. magellanicum*. In more degraded areas of the bog, it was recorded at the edges of erosion channels, tear pools, and bare, peaty hollows.

Appendix II Photographical records

Photograph Number	Aspect	Type	Feature	Date
P1070020	NE	Overview	Qsc2	20/02/2013
P1070010	NE	Overview	Qsc1	19/02/2013

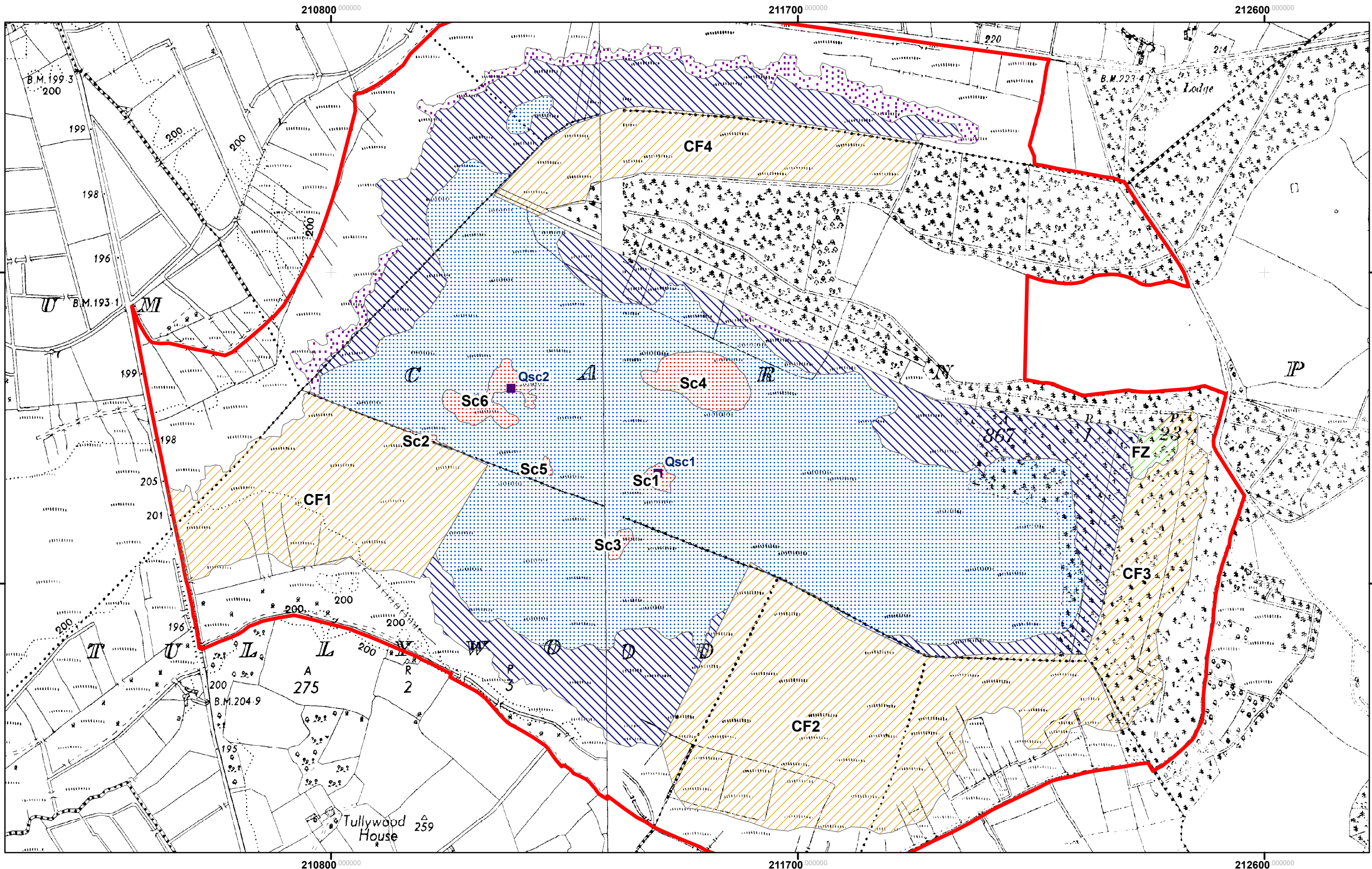
Appendix III Quadrats

Ecotope type	Sub-central	Sub-central
Complex Name	10/4	10/4
Quadrat Name	Qsc1	Qsc2
Easting	211430.18	211147.24
Northing	241612.65	241776.52
Date	19/02/2013	20/02/2013
Firmness	Quaking	Quaking
Burnt	No	No
Algae in hollows %	Absent	Absent
Algae in pools %	Absent	1-3 (few indiv)
Bare peat %	Absent	Absent
High hummocks %	Absent	Absent
Low hummocks %	26-33	1-3 (many indiv)
Hollows %	Absent	1-3 (several indiv)
Lawns %	51-75	91-100
Pools %	Absent	1-3 (many indiv)
Pool type	Absent	Regular
S.austinii hum type	Active	Absent
S.austinii hum %	1-3 (few indiv)	Absent
S.austinii height(cm)	21-30	Absent
S.fuscum hum type	Active	Absent
S.fuscum hum %	1-3 (few indiv)	Absent
S.fuscum height(cm)	0-10	Absent
Leucobryum glaucum	Absent	Absent

Ecotope type	Sub-central	Sub-central
Complex Name	10/4	10/4
Trichophorum type	Absent	Tussocks
Trichophorum %	Absent	1-3 (few indiv)
S.magellanicum %	Absent	4-10
S.cuspidatum %	1-3 (several indiv)	4-10
S.papillosum %	26-33	26-33
S.denticulatum %	Absent	Absent
S.capillifolium%	11-25	1-3 (many indiv)
S.tenellum %	Absent	Absent
S.subnitens %	Absent	Absent
R.fusca %	Absent	Absent
R.alba %	11-25	11-25
N.ossifragum %	1-3 (many indiv)	1-3 (many indiv)
Sphag pools %	Absent	1-3 (several indiv)
Dominant pool Sphag		S.cuspidatum
Sphag lawns %	51-75	91-100
Sphag humm %	11-25	1-3 (many indiv)
Sphag holl %	Absent	Absent
Total Sphag %	51-75	91-100
Hummocks indicators	S.austini&S.fuscum	Absent
Cladonia portent %	11-25	1-3 (few indiv)
Other Cladonia sp	none	
C. panicea %	Absent	Absent
Calluna cover %	11-25	4-10
Calluna height(cm)	11-20	0-10
Other NotableSpecies	sphapulc 11-25	sphapulc 26-33
Other comment	similar to Derwin 08 data; diffs due to methodology	new quadrat

Note: No quadrats were surveyed in the baseline 2000 survey. **Qsc1** was placed within Quadrat 7 surveyed annually from 2005-2008 by Derwin (2008) to monitor changes following Coillte's raised bog restoration project (<http://www.raisedbogrestoration.ie/downloads/monitoring-report-carn-park-bog-athlone-westmeath-ireland.pdf>).

Appendix IV Survey maps



Raised Bog Monitoring & Assessment Survey 2013

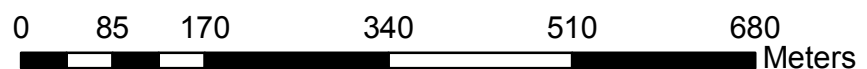
Map 1: Ecotopes Map and Quadrats

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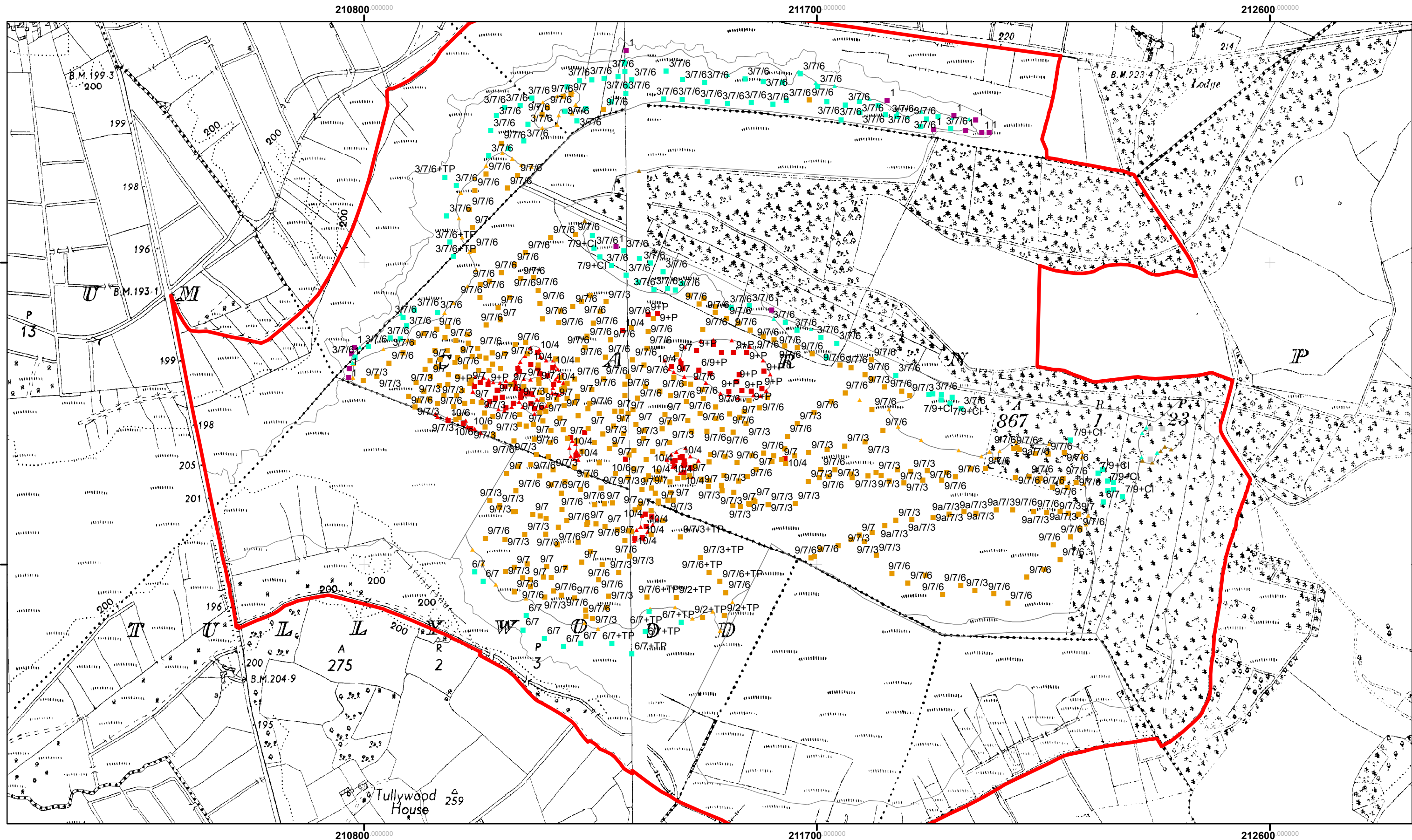
Carn Park SAC (002336) Co. Westmeath

1:7,000



Legend

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



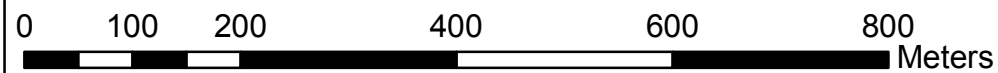
Raised Bog Monitoring & Assessment Survey 2013
Map 2: Vegetation community complexes

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Carn Park SAC (002336)
Co. Westmeath

1:7,000



Legend

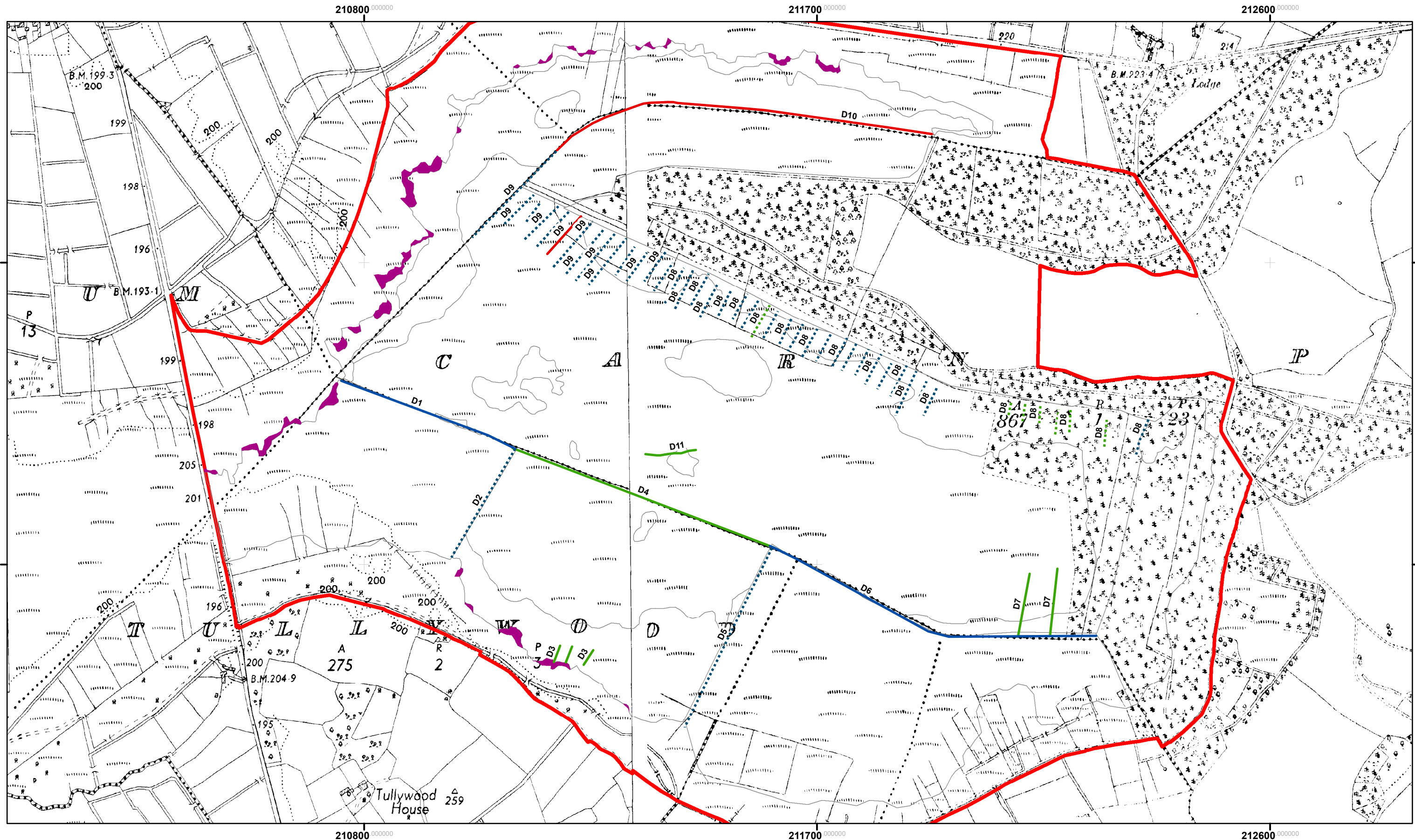
Ecotope type

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

Boundary type

- Flush
- ▲ 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



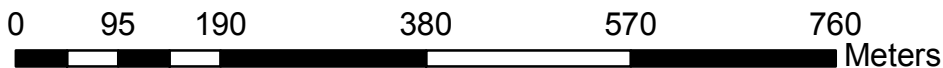
Raised Bog Monitoring & Assessment Survey 2013
Map 3: Impacts (High bog drainage; Turf cutting; Fire events)

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Carn Park SAC (002336)
Co. Westmeath

1:7,000



Legend

- | | | |
|-----------------------------------|-----------------------------------|-------|
| High Bog drainage | — Not blocked: functional | □ SAC |
| Blocked: non-functional | — Not blocked: non-functional | |
| Blocked: reduced functional | — Not blocked: reduced functional | |
| | ▨ Burnt high bog (2004/05-12/13) | |
| | ■ High bog cutaway (2004/05-10) | |