Tawnaghbeg Bog (SAC 002298), Co. Mayo

Executive Summary

This survey, carried out in October 2012, aimed to assess the conservation status of habitats listed on Annex I of the European Habitats Directive (92/43EEC) on the high bog at Tawnaghbeg 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 9.87ha (13.77%) of the high bog area, and consists of both central ecotope and sub-central ecotope. High quality Active Raised Bog consists of 2.83ha of central ecotope, in which large, interconnecting pools with *Sphagnum* cover of over 75%, occupy 34-50% of the habitat. High hummocks, low hummocks, hollows and lawns also form part of the micro-topography here.

Degraded Raised Bog covers 61.79ha (86.23%) of the high bog area. It is drier than Active Raised Bog and supports a lower density of *Sphagnum* mosses – total *Sphagnum* cover did not exceed 25% in any part of the Degraded Raised Bog. It has a less developed micro-topography, with permanent pools and *Sphagnum* lawns generally absent. Degraded Raised Bog at the site consists of marginal, sub-marginal and facebank ecotope, and inactive flush.

Depressions on peat substrates of the Rhynchosporion are found in both Active and Degraded Raised Bog, but tend to be best developed and most stable in the wettest areas of Active Raised Bog. At Tawnaghbeg Bog, this habitat was most common in the sub-central community complex 4/35.

The current conservation objective for Tawnaghbeg Bog is to restore the area of Active Raised Bog to the area present when the Habitats Directive came into force in 1994. In the case of Active Raised Bog, the objective also includes the restoration of all of the sub-marginal ecotope present at the time as this represents the area of Degraded Raised Bog most technically feasible to restore. The Area objective for Active Raised Bog is 54.81ha. 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 no change in the area of Active Raised Bog at Tawnaghbeg Bog in the 2005 to 2012 period, although the boundaries of each of the individual Active Raised Bog areas have been refined as a result of more comprehensive field mapping. Central ecotope at the site was formerly all within a single area, **C1**, which has now been expanded and split into two distinct areas, **C1** and **C2**. Again, this is due to more comprehensive field mapping rather than a reflection of real changes to the habitat.

Drainage, particularly that associated with the management of conifer plantations, on and adjacent to the high bog, represents the most threatening current activity at the site. 3.577km of drains remain functional and 0.096km reduced functional. Other drains within the conifer plantations and in adjacent agricultural land are believed to be functional and also impacting negatively on the hydrological functioning of the bog.

Peat cutting no longer takes place at the site and no high bog habitat is believed to have been lost to this practice in the current reporting period.

No fire events have affected the bog in the reporting period.

Active Raised Bog has been given an overall **Unfavourable Bad–Stable** conservation status assessment. Habitat Area and quality has remained unchanged in the reporting period. However, the current values for both Area, and S&Fs are below favourable reference values. Future prospects are considered Unfavourable Bad-Stable as impacting activities (primarily drainage) continue to threaten the habitat.

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

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

A series of **recommendations** have been also given, these include: the continued cessation of peat cutting; restoration works (including drain blocking) on the high bog and cutover areas; further hydrological and topographical studies to ascertain the capacity of the high bog to support Active Raised Bog and thereby estimate more accurate FRVs; further botanical monitoring surveys; further botanical surveys on the high bog and an impact assessment of maintenance works on adjacent land drainage with a view to the potential of blocking these drains; further studies to assess the actual impact of adjacent conifer plantations on the high bog habitats and investigate the potential to restore any potential future clearfell areas to Active Raised Bog.

Site identification

SAC Site Code	002298 (River Moy)	**6" Sheet:**	MO 52/64
Grid Reference:	G 58 04	**1:50,000 Sheet:**	32
High Bog area (ha):	71.66ha		
Dates of Visit:	18/10/2012		
Townlands:	Tawnaghbeg, Gowlaun and Kilgarriff		

[1] The current extent of the high bog is 71.66ha, while that reported in 2005 was 71.71ha (Fernandez *et al.*, 2005). This discrepancy is the result of more accurate mapping of the high bog edge by using the higher resolution 2010 aerial images compared to those used in 2004. The actual high bog extent in 2004 was 71.61ha (see tables 8.1 and 8.3 2004 (amended) figures).

Site location

Tawnaghbeg Bog is approximately 11.5km northeast of Charlestown, Co. Mayo and 6km southeast of Tobercurry, Co. Sligo. Tawnaghbeg Bog is part of the River Moy SAC (002298) and is one of a number of raised bogs in the SAC, the others being Derrynabrock (which is less than 2km to the southwest of Tawnaghbeg), Cloongoonagh, Kilgariff and Gowlaun. Flughany Bog (SAC 000497) is approximately 2km northeast of Tawnaghbeg Bog.

Access to this site may be gained at the southern end, where a track extends westwards from the road to Cloontia.

Description of the survey

The survey was carried out in October 2012 and involved a vegetation survey of the high bog at Tawnaghbeg Bog and the recording of impacting activities affecting high bog vegetation. A similar survey was carried out in 2005 (by Fernandez *et al*. (2005). High bog vegetation was described and mapped, based on raised bog ecotope vegetation community complexes developed by Kelly and Schouten (2002). Detailed notes were taken on each community complex and any flushed areas that were present. These included: species lists; estimation of % cover of dominant species; percentage *Sphagnum* cover; evidence of damage (due to burning, peat cutting or drainage); micro-topography; ground firmness; and presence of *Cladonia* species. A list of photographical records is given in

Appendix II. The survey aimed to assess the conservation status of Habitats Directive (Council Directive 92/43/EEC) Annex I habitats on the high bog.

The entire high bog of Tawnaghbeg Bog was re-surveyed. Sections mapped as sub-marginal, sub-central and central ecotope in 2005 were surveyed in more detail. These are the areas where changes were likely to have occurred. Quadrats, which describe the micro-topographical features and indicator species, recorded in the 2005 project (Fernandez *et al*. 2005) were re-surveyed and additional quadrats were recorded where necessary, (see Appendix III). The size of quadrats was 4m x 4m 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

Tawnaghbeg Bog is classed as a Ridge Basin bog. It is an Intermediate Raised Bog and thus shares features with blanket bogs. These types of bogs are characterised by the absence of a definitive dome and by the undulating nature of the topography (Kelly *et al*., 1995).

Peat cutting has largely divided the high bog into two lobes, with a narrow central zone linking the two.

Ecological Information

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

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

- Active Raised Bog (EU code 7110),

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

Active Raised Bog (7110)

The current area of Active Raised Bog at Tawnaghbeg Bog is 9.87ha (13.77% of the high bog), which is a decrease of 2.96ha since 1994.

Active Raised Bog at the site includes central and sub-central ecotope.

Central ecotope was found at two locations (**C1** & **C2**) (see Appendix IV, Map 1). A single community complex was recorded in these two central areas. Complex **35** consisted of high and low hummocks, pools, hollows and lawns. Pools, which were mostly large and interconnecting, covered 34-50% of the complex area, and typically had a high cover of *Sphagnum* (c. 75%), most of which was accounted for by S. *cuspidatum*. *Sphagnum* cover did vary, however, between the two central ecotope areas, with the more northerly **C2** having pools with more open water and algae and a correspondingly lower *Sphagnum* cover. *S. denticulatum* was also present but infrequent in pools, while *Campylopus atrovirens* and *Pleurozia purpurea* were occasional at pool edges.

The interpool areas had low hummocks, mostly dominated by *S. capillifolium*. Other *Sphagnum* species included *S. papillosum*, *S. tenellum*. Small *S. fuscum* hummocks and *Racomitrium lanuginosum* hummocks were present, but rare, in the complex.

An occasional high hummock within the complex had tall *Calluna vulgaris*, *Pleurozium schreberi*, and a generally high cover of *Cladonia portentosa*.

Sub-central ecotope was found at three locations (**Sc1**, **Sc2** & **Sc3**). Only two sub-central community complexes – 6/35 and 4/35 - were recorded. These complexes resemble the central complex 35, but are generally of lesser quality, having a lower cover of pools and lower *Sphagnum* cover. Complex 6/35 consisted of pools, low hummocks and hollows. Pools covered 11-25% of the complex (somewhat lower than the 34-50% of central complex 35), while *Sphagnum* cover was 34-50%. Pools had a generally high cover of *S. cuspidatum* (up to 70%), while *S. denticulatum* was also present, though quite infrequent. Pool edges had hummocks of *S. capillifolium* and/or *S. papillosum*, while *S. magellanicum* was also present, but rare, at pool edges. The interpool habitat had low hummocks – mostly of *S. capillifolium* – while occasional small hummocks of *S. austinii* and *S. fuscum* were also present. *Narthecium ossifragum* was particularly common in interpool flats, with *Calluna vulgaris* and *Eriophorum vaginatum* the other dominant species there. Complex 4/35 was similar to 6/35, differing mainly in the relative abundance of *Rhynchospora alba*. *Sphagnum* cover in pools – mostly *S.*

cuspidatum – varied considerably in this complex, with some pools having a high cover and others very little.

Degraded Raised Bog (7120)

The current area of Degraded Raised Bog at Tawnaghbeg Bog is 61.79ha (86.23% of the high bog).

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

The sub-marginal ecotope features the most developed micro-topography within Degraded Raised Bog. All of the sub-marginal ecotope at Tawnaghbeg Bog was classified either in community complex 9/7, or in one of a number of variants of this complex. Pools were mostly absent from sub-marginal ecotope, although they were found, at a total cover of <10%, in 9/7/6+Pools and 9/7/6+Tear Pools, two of the wetter of the 9/7 community complex variants that were described. *Sphagnum* cover in pools here was lower than in those in Active Raised Bog, while *S. cuspidatum* and *S. papillosum* were the dominant pool species. The micro-topography in sub-marginal ecotope generally consisted of hummocks, hollows and flats, and the overall *Sphagnum* cover was in the range of 11-25%. *Calluna vulgaris*, *Eriophorum vaginatum*, *E. angustifolium*, *Narthecium ossifragum* and *Carex panicea* were the most common species in the sub-marginal ecotope, while *Sphagnum* hummocks were dominated by *S. capillifolium*, with *S. papillosum*, *S. tenellum* and *S. subnitens* also present.

Marginal ecotope is slightly drier than sub-marginal ecotope and mainly occurred as a narrow band near the margins of the high bog, although there were several areas of Tawnaghbeg Bog where sub-marginal ecotope was mapped to the edge of the high bog, with marginal ecotope not present. Low *Sphagnum* hummocks and *Calluna vulgaris* hummocks characterised the micro-topography. *Sphagnum* cover ranged from 5-10%, while the more common species included *Narthecium ossifragum*, *Eriophorum vaginatum*, *E. angustifolium*, *Erica tetralix*, *Carex panicea* and *Trichophorum germanicum*.

Face bank ecotope was characterised by firm ground, tall *Calluna vulgaris*, poor *Sphagnum* cover and a flat micro-topography. This ecotope occurred intermittently on the high bog margin.

The high bog also features several inactive flushes (**A, W, Y** and **Z**). Flush **Z** covered a wide area in the centre of the bog, where the high bog margin narrows to effectively divide the bog into two lobes, with this narrow central zone linking the two. The other flushes are small and found at the

margins of the high bog. The flushes were generally dominated by *Molinia caerulea*, although other flush species were common in places, such as *Phragmites australis* in the eastern half of flush Z.

Depressions on peat substrates of the Rhynchosporion (7150)

Rhynchosporion vegetation is widespread on Tawnaghbeg Bog. It is found in both Active and Degraded Raised Bog, but tends to be best developed and most stable in the wettest areas of Active Raised Bog, particularly those in the sub-central complex 4/35, where it was most frequent. In these areas, the Rhynchosporion vegetation occurs within *Sphagnum* hollows and along *Sphagnum* pool edges and on lawns. Typical plant species include *Rhynchospora alba*, *Sphagnum cuspidatum, S. papillosum* and *Eriophorum angustifolium*.

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

Detailed vegetation description of the high bog

A detailed description of high bog vegetation recorded during the 2012 survey of Tawnaghbeg 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 Tawnaghbeg 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
J02.07	Drainage	M	-1	3.673km [1]	Inside High Bog	**7110/7120/7150**
J02.07	Drainage	M	-1	n/av	Outside High Bog	**7110/7120/7150**
B01.02	Artificial planting on	M	-1	3.17ha	Inside High	**7110/7120/7150**

	open ground (non-native trees)				Bog	
B01.02	Artificial planting on open ground (non-native trees)	L	-1	32.8ha	Outside High Bog; N/NW and SE of High Bog	**7110/7120/7150**
G01.03	Motorised vehicles	L	-1	<0.5ha	Inside High Bog	**7120**

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.

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

Peat cutting

Peat cutting has not taken place at the site in the 2005-2010 period, and thus no high bog was lost to cutting in this period. The loss of high bog is calculated using GIS techniques on aerial photography from 2004/05 and 2010. As aerial photography is not available post-2010, it cannot be ruled out that cutting may have taken place in additional locations in the period 2011-2012. However, this is unlikely in the case of Tawnaghbeg Bog, as no evidence of recent cutting was noted during the 2012 visit.

Peat cutting was thought to be no longer taking place at the site in 2005 (Fernandez *et al*., 2005). Kelly *et al*. (1995) had estimated that 42% of the original bog had been cut over by that time, and that 19.2% of the remaining margin was actively cut in 1994, with the western part of the northwest lobe being the most extensively exploited area. Peat cutting continued for a few years after the 1994 survey, and 0.33ha of high bog were estimated as lost to this activity in 1995-2000, before the subsequent cessation of the practice (Fernandez *et al*., 2005).

Although peat cutting no longer takes place at Tawnaghbeg Bog and no high bog was believed to be lost to cutting during the reporting period, 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 no change on the status of high bog drains. All drains mapped in the high bog remain functional (3.577km), or reduced functional (0.096km). There were no non-functional drains mapped during the present survey.

Significant water losses through drains were noted in a number of areas during the field survey. In the northeast of the site, flowing water was observed in the interconnected drains bA1, bB and bW, while in the north and northwest, flowing water was noted in the interconnected bN, bO and bP. Flowing water was also observed in drains bK in the southwest, bT in the southeast, and in the interconnected bM and bX in the western side of the bog.

Drains bA1, bp, bX and bW were identified as firebreaks associated with the conifer plantations in the north of the site by Fernandez *et al*. (2005), but are included here as drains, as they essentially function as drains in discharging water from the high bog. These drains are 5-6m wide and approximately 0.6m deep and were recorded as carrying flowing water during the field survey.

Photograph numbers P1030141, P1030142 and P1030143 (Appendix II) illustrate drain maintenance work in drains bA1, bP, bX and bW.

No blockage of drains has occurred to date and high bog drainage is considered to have medium importance/impact on high bog habitats.

Table 6.2 High bog drainage summary

Status	2005 (km) [1]	2012 (km)	Change
NB: functional	3.577	3.577	0.000
NB: reduced functional	0.096	0.096	0.000
NB: non- functional	0.000	0.000	0.000
B: functional	0.000	0.000	0.000
B: reduced functional	0.000	0.000	0.000
B: non- functional	0.000	0.000	0.000

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

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

Table 6.3 below provides a more detailed description of the drainage present on the high bog at Tawnaghbeg Bog, including any change in their functionality in the 2005 – 2012 reporting period (see Map 3).

Table 6.3 High bog drainage detail

Drain Name	Length (km)	2005 status	2012 status	Change	Comment
bA	0.077	NB: functional	NB: functional	No	
bA1	0.255	NB: functional	NB: functional	No	This drain has been recently widened; water flowing recorded during visit
bB	0.150	NB: functional	NB: functional	No	Water flowing recorded

					during visit
bD	0.028	NB: functional	NB: functional	No	
bE	0.036	NB: functional	NB: functional	No	
bF	0.035	NB: functional	NB: functional	No	
bG1	0.053	NB: functional	NB: functional	No	
bG2	0.079	NB: functional	NB: functional	No	
bH	0.024	NB: functional	NB: functional	No	
bJ	0.049	NB: functional	NB: functional	No	
bK	0.282	NB: functional	NB: functional	No	Double drain; water flowing recorded during visit
bM	0. 209	NB: functional	NB: functional	No	Water flowing recorded during visit
bN	0.333	NB: functional	NB: functional	No	Double drain; water flowing recorded during visit
bO	0. 269	NB: functional	NB: functional	No	Substantial water flow within this drain
bP	0. 686	NB: functional	NB: functional	No	This drain has been recently widened; water flowing recorded during visit
bR	0. 096	NB: reduced functional	NB: reduced functional	No	
bS	0. 033	NB: functional	NB: functional	No	Drain already present in 2005 but not mapped
bT	0. 044	NB: functional	NB: functional	No	Drain already present in 2005 but not mapped; water flowing recorded during visit
bV	0. 013	NB: functional	NB: functional	No	Drain already present in 2005 but not mapped
bW	0. 291	NB: functional	NB: functional	No	Drain already present in 2005 but not mapped; this drain has been recently widened; water flowing recorded during visit
bX	0. 631	NB: functional	NB: functional	No	Drain already present in 2005 but not mapped; this drain has been recently widened; water flowing recorded during visit

Bog margin drainage

The cutover areas were not surveyed for drains during 2012.

Drains associated with the former peat cutting areas are present in the cutover, and are particularly evident in the southwest part of the bog. These drains continue to drain the high bog and impacting on high bog habitats.

Peripheral agriculture land drainage maintenance in the southwest (of approximately 1km) is evident on the 2010 aerial photographs, and may be occurring in other places adjacent to the high bog. Drains have also been inserted within the conifer plantations in the north of the high bog (Fernandez *et al*., 2005). As these drains are likely to be mostly functional and, therefore, represent a continuing threat to the hydrological functioning of the high bog, they are considered to have a negative impact (of medium intensity) on the high bog habitats.

Fire history

No fire events have been reported on the high bog in the 2005-2011 reporting period, while Fernandez *et al*. (2005) reported an absence of recent burn evidence on the high bog. Previous records of burn events include the observation by Douglas and Grogan (1986) that much of the site had been burnt approximately five years prior to their visit, while Kelly *et al*. (1995) noted evidence of burn history in a number of locations.

Invasive species

A single location for *Pinus contorta* seedlings on the high bog (near drain bX in the west of the site) was recorded during the field survey. There were no other records of invasive species at Tawnaghbeg Bog. Invasive species are therefore considered to have a negligible impact on the high bog habitats.

Afforestation and forestry management

There are conifer plantations on the northern section of the high bog, and also along the western and south-eastern edges of the bog, in all cases consisting of Sitka spruce (*Picea sitchensis*), with Lodgepole pine (*Pinus contorta*) or Birch (*Betula pubescens*) at the edges. Drains have been cut within these plantations (Fernandez *et al*., 2005), while firebreaks have been excavated along some of the edges. The firebreaks were mapped here as drains (and included in table 6.3) as they essentially function as drains in discharging water from the high bog. The plantations in the north and north-west, which includes those located on the high bog, are thought to have a negative impact of

medium intensity on the high bog habitats. The plantations that are entirely within cutover are thought to have a negative impact of low intensity on high bog habitats.

Other impacting activities

Vehicle tracks associated with the maintenance of the conifer plantation firebreaks/drains were noted. These were confined to the margins of the high bog and are likely to exert only a low intensity negative impact on the Degraded Raised Bog habitat.

No other significant impacting activities were noted or recorded in 2012

Conservation activities

Although no physical management actions such as the blocking of drains or the restoration of the former peat exploitation areas, which would also require the blocking of drains, have been carried out to improve the conservation status of the high bog habitats, the NPWS has engaged in negotiation with landowners in relation to the cessation of peat cutting at the site and the practice has now been discontinued for several years.

Conservation status assessment

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

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

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

FUTURE PROSPECTS - an assessment of the influence of current and future activities both negative and positive (e.g. restoration works) affecting these habitats. Future Prospects for Active and

Degraded Raised Bog are assessed at status and trend level based on the prospects for the habitat to reach favourable reference values in a two reporting period (12 years).

Active Raised Bog (7110)

Area

Table 8.1 indicates no change in the area of Active Raised Bog during the current reporting period. Nevertheless, there have been some substantial changes in the mapped distribution of habitats at the site. The central ecotope, which was all formerly mapped as a single area (**C1**) in the southern lobe of the bog, has now been divided into two separate areas – **C1** and **C2.** At least some of the new **C2** was within the old **C1** boundary, but the more intensive mapping effort employed in the present survey has indicated that a substantial body of sub-central ecotope divides the central ecotope into these two distinct entities.

The new **C1** area now has a more convoluted boundary than was previously the case, and its former quite circular outline has been re-mapped as a more elongated shape along an approximate north-west to south-east axis. These changes are all attributed to the more comprehensive surveying and accurate mapping associated with the present survey. The previous ecotope map (Fernandez *et al*., 2005) was distinctly lacking in boundary mapping points in the areas described above, and the re-drawing of the central ecotope boundaries does not, therefore, involve any re-classification or re-interpretation of habitats.

Sub-central ecotope formerly consisted of three separate areas; the small **Sc1** in the northern lobe of the high bog, the substantially larger **Sc2** surrounding central ecotope in the southern part of the bog, and **Sc3**, a small area to the southwest of **Sc1**. This remains the case after the re-mapping of boundaries in this survey, and the boundary refinements that have been made to these three areas are also attributed to the more comprehensive surveying and accurate mapping that were applied in the current survey. The former **Sc3** boundary was particularly unsatisfactory, being based on a single ecotope point. The new **Sc3** boundary is based on numerous mapping points and shows considerable changes from the previous one.

In summary, all changes to the boundaries of Active Raised Bog habitat at Tawnaghbeg Bog can be attributed to the more comprehensive surveying and accurate mapping that were employed in the present survey. The overall area of ARB is, therefore, deemed to be unchanged from the previous figure of 9.87ha, reported by Fernandez *et al*. (2005).

The favourable reference value (FRV) for Area is considered to be the sum of Active Raised Bog (central and sub-central ecotopes) plus sub-marginal ecotope when the Habitats Directive came into force in 1994 (see table 8.4). Therefore, Active Raised Bog Area FRV is 54.81ha (based on 1994/5 Kelly (1995) figures amended by Fernandez *et al.* (2005), see tables 8.1 and 8.3 below). This FRV is only approximate until further hydrological and topographical studies are carried out in order to assess the maximum potential capacity of the high bog to support Active Raised Bog. The current habitat Area value of 9.87ha is 81.99% below the FRV. A current Area value more than 15% below FRV falls into the **Unfavourable Bad** assessment category. Although a long term (1994/5-2012) trend indicates a decrease in the area of Active Raised Bog at the site (-2.96ha) (see table 8.1), a more recent and short term trend analysis (7 years; 2005-2012) gives a more optimistic result with no change (0%) in the area of Active Raised Bog. The short term trend in habitat area is therefore assessed as **Stable**.

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

Structure & Functions

The FRV for S&Fs is for at least half of the Active Raised Bog area to be made up of central and active flush, i.e. the higher quality wetter vegetation communities. This value is 4.94ha (half of 9.87ha, the current area of Active Raised Bog). The current value is 2.83ha which is 42.71% below the FRV. As this is more than 25% below FRV, S&Fs are given an **Unfavourable-Bad** assessment.

A long term (1994/5-2012) trend indicates a decrease in the area of central ecotope (-2.96ha), while a short term (7 years; 2005-2012) trend indicates no change in the area of central ecotope (see table 8.1). S&Fs are therefore given a **Stable** trend.

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

Qc1: This quadrat was classified as central complex 35 in both 2005 and 2012, although a number of differences between the two survey periods were apparent. Pool cover and the associated *Sphagnum* pool cover were both 34-50% in 2012, whereas both of these attributes were 11-25% in 2005. There were also corresponding differences in the cover of typical *Sphagnum* pool species; *S. cuspidatum* and *S. papillosum* had 34-50% and 26-33% cover, respectively, in 2012, whereas in 2005 the figures were 4-10% for *S. cuspidatum* and 11-25% for *S. papillosum*. Total *Sphagnum* was 51-75% in 2012 and 34-50% in 2005. Both hollows and *Sphagnum* hummocks were adjudged to cover 11-25% in 2005 and only 4-10% in 2012. It is likely, therefore, that these differences are mostly due to variation in

quadrat location, with the 2012 quadrat encompassing more pools than the 2005 quadrat, which in turn had more hollows and *Sphagnum* hummocks.

Qsc2: This quadrat was classified in sub-central complex 6/35 in 2012, and previously in sub-central 9/3/35. Among the significant differences between the two were the greater pool cover in 2012, 34-50%, compared to 11-25% in 2005; *Sphagnum* pool cover – also 34-50% in 2012 and 11-25% in 2005 – and the frequency of the dominant pool *Sphagnum* species – *S. cuspidatum* had 26-33% cover in 2012 and only 4-10% in 2005. Total *Sphagnum* cover, at 34-50%, was also considerably higher in 2012, compared to 11-25% in 2005. *Calluna vulgaris* was also more abundant in 2012, with 26-33% cover, compared to only 4-10% in 2005. The changes in the quadrat are substantial, but are likely to be largely due to a difference in the quadrat location, with the 2012 version encompassing a greater area of pools. There may also be some differences in the interpretation of micro-topographical features, as the total values given in 2005 for all such features such as hummocks, pools, lawns etc. seems to be too low to fully account for the entire quadrat area.

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

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

Future Prospects

Habitat area has remained unchanged and S&Fs are assessed as Stable in the current reporting period. However, there are still over 3.5km of functional drains on the high bog, and others in the bog margins, such as those associated with cutover plots or conifer plantations. Flowing water was observed in several high bog drains during the field survey, indicating a significant discharge of water from the high bog.

Habitat **Area** is currently 81.99% below FRV (see table 8.4). Peat-cutting has ceased at the site, which should remove the incentive to maintain the functionality of many of the drains. However, the absence of any restoration measures indicates no improvements are expected. As the recent trend has been for stability in habitat area, and there are no known impacting activities that are likely to lead to a short-term decline in habitat quality, the trend for future prospects is considered to be **Stable**.

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 42.71% 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).

Although turf-cutting no longer takes place, there have not been any remediation works involving the blocking of drains at the site. The blocking of the remaining functional drains, both on the high bog and cutover, and the continued cessation of peat cutting is necessary. Particularly important, due to their dimensions and the volumes of flowing water noted during the field survey, would be the blocking of drains associated with the conifer plantations - bA1, bP, bX and bW, and also drain bO (within flush Y) in which a substantial volume of flowing water was also observed.

The actual impact of the forestry plantations on and adjacent to the high bog should also be assessed, so that measures to counter negative impacts can be introduced.

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

Table 8.1 Changes in Active Raised Bog area

Active Ecotopes	1994[1]	2005	2005 (amended)	2012	Change (2005-2012)	
	Area (ha)	Area (ha)	Area (ha)	Area (ha)	Area (ha)	%
Central	9.96	2.42	2.83	2.83	0.00	0.00
Sub-central	2.87	7.90	7.04	7.04	0.00	0.00
Total	**12.83**	**10.32**	**9.87**	**9.87**	**0.00**	**0.00**

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

Note: Table 8.1 includes 2005 figures and 2005 amended figures. The latter shows the ecotope area believed to be present in 2005 after surveying improvements in 2012. The comparison between 2005 (amended) and 2012 illustrates the actual changes in ecotope area in the 2005-2012 period. Any change in ecotope area between the 2005 and the 2005 (amended) values is due to improvement in mapping accuracy and/or the result of a more comprehensive survey in 2012 (see table 8.2 for further detail).

Table 8.2 Assessment of changes in individual Active Raised Bog areas

Area	Quadrats	Trend	Comment	Quadrats analysis
C1	Qc1	Stable	Changes in boundary: former C1 now consists of two separate central ecotope areas (C1 & C2) as a result of more comprehensive surveying in 2012 which resulted in	Pool cover and *Sphagnum* pool cover greater in 2012 with correspondingly greater cover of typical *Sphagnum* pool species; cover of both hollows and

			more accurate mapping.	*Sphagnum* hummocks greater in 2005, indicating differences likely to be largely due to slight change in the quadrat location.
C2	None	Stable	Changes in boundary: former C1 now consists of two separate central ecotope areas (C1 & C2) as a result of more comprehensive surveying in 2012 which resulted in more accurate mapping.	
Sc1	None	Stable	Slight changes in boundary: now slightly smaller. This change is the result of more comprehensive surveying in 2012 which resulted in more accurate mapping.	
Sc2	Qsc2	Stable	Slight changes in boundary: now slightly smaller. This change is the result of more comprehensive surveying in 2012 which resulted in more accurate mapping.	Greater pool cover and *Sphagnum* pool cover in 2012, with associated higher cover of typical *Sphagnum* pool species. Likely to be due to slight difference in quadrat location.
Sc3	None	Stable	Changes in boundary (now smaller). This change is the result of more comprehensive surveying in 2012 which resulted in more accurate mapping.	

Degraded Raised Bog (7120)

Area

The Degraded Raised Bog FRV for Area is 16.85ha at Tawnaghbeg Bog. This value corresponds with the difference between the current high bog area (71.66ha) and the Active Raised Bog FRV (54.81ha) 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 266.71% bigger than FRV. Any value more than 15% above FRV falls into the Unfavourable Bad assessment category. Therefore the habitat Area is given an **Unfavourable Bad** assessment (see table 8.4).

Table 8.3 indicates no change in the area of Degraded Raised Bog (comprising sub-marginal, marginal, face bank, inactive flush and conifer plantation at Tawnaghbeg Bog). Some of the DRB areas have changed considerably, e.g. the already extensive flush Z now covers more than twice the area mapped in 2005. However, this, and other changes in DRB are all attributed to the more

comprehensive surveying and mapping in the 2012 project. As a result the habitat Area is given a **Stable** trend.

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

Structure & Functions

The FRV for S&Fs is for a maximum 25% of the Degraded Raised Bog area to be made up of marginal and face bank, i.e. the lower quality and drier vegetation communities. This value is 15.45ha (25% of 61.79ha, the current area of Degraded Raised Bog). The current marginal and face bank ecotopes area value (7.60ha) is 50.80% 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 no change in the area of either marginal ecotope or face bank ecotopes. Thus, the DRB's S&Fs at Tawnaghbeg Bog are given a **Stable** trend.

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

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

Future Prospects

Degraded Raised Bog has shown recent Stable trends in both Area and S&Fs. However, drainage on the high bog, particularly in the north and north-west, and drainage in cutover areas will continue to damage the habitat and hinder its recovery to FRV's, as well as minimise the chances of converting face bank or marginal ecotope into sub-marginal and/or Active Raised Bog. However, turf cutting is no longer taking place at the site, meaning there should be no imminent direct loss of habitat, and no deterioration in potentially damaging drainage management regimes. At the same time, the absence of restoration measures indicates that no improvements in habitat Area or S&Fs should be expected. Habitat **Area** is currently 266.71% 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 50.80% below FRV (see table 8.4). A Stable

trend is foreseen in the following two reporting periods and therefore **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).

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

Table 8.3 Changes in Degraded Raised Bog area

Inactive Ecotopes	1994[1]	2005	2005 (amended)	2012	Change (2005-2012)	
	Area (ha)	Area (ha)	Area (ha)	Area (ha)	Area (ha)	%
Sub-marginal	41.98	44.18	43.68	43.68	0.00	0.00
Marginal	12.02	10.54	6.58	6.58	0.00	0.00
Face bank	n/a	1.46	1.02	1.02	0.00	0.00
Inactive flush	2.04	2.04	7.34	7.34	0.00	0.00
Conifer plantation	3.17	3.17	3.17	3.17	0.00	0.00
Total	**59.21**	**61.39**	**61.79**	**61.79**	**0.00**	**0.00**

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

Note: Table 8.3 includes 2005 figures and 2005 amended figures. The latter shows the ecotope area believed to be present in 2005 after surveying improvements in 2012. The comparison between 2005 (amended) and 2012 illustrates the actual changes in ecotope area in the 2005-2012 period. Any change in ecotope area between the 2005 and the 2005 (amended) values is due to improvement in mapping accuracy and/or the result of a more comprehensive survey in 2012.

Depressions on peat substrates of the Rhynchosporion (7150)

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

The physical structure and distribution of the habitat across large sections of the high bog makes the process of calculating its area unfeasible and as a consequence makes the process of calculating realistic FRVs unfeasible. Thus, the assessment of the habitat's Area conservation status is indirectly

based on the assessment of Active Raised Bog habitat Area (a favourable assessment indicates that all sub-marginal ecotope has turned Active Raised Bog). The habitat Area is given an **Unfavourable Bad** assessment.

The Area trend assessment is based on the variation on Active Raised Bog and sub-marginal ecotope within Degraded Raised Bog in the reporting period. The area of Active Raised Bog has remained stable in the reporting period, as also has the area of sub-marginal ecotope. 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 drainage, and forestry on adjacent land, are threatening Active and Degraded Raised Bog and this has to have a negative effect on Rhynchosporion depressions. However, of the undesirable impacts at the site, high bog drainage is regarded as an impact of only medium importance and peat cutting has apparently ceased. Furthermore, habitat Area and quality in Active Raised Bog and sub-marginal ecotope have not changed in the reporting period. 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-Stable** assessment.

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

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

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

Table 8.4 Habitats favourable reference values

Habitat	Area Assessment			Structure & Functions Assessment		
	FRV Target (ha) [1]	2012 value (ha) [2]	% below target	FRV 2012 Target (ha) [3]	2012 value (ha) [4]	% below target
7110	54.81	9.87	81.99	4.94	2.83	42.71

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

[2] 2012 central, sub-central ecotope, active flush and bog woodland area.

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

[4] 2012 central ecotope and active flush area.

	FRV Target (ha) [5]	2012 value (ha) [6]	% above target	FRV 2012 Target (ha) [7]	2012 value (ha) [8]	% below target
7120	16.85	61.79	266.71	15.45	7.60	50.80

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

[6] 2012 Degraded Raised Bog area.

[7] 25% of the current Degraded Raised Bog habitat area. The target is that the extent of marginal and face bank ecotopes should not be larger than 25% of the current Degraded Raised Bog habitat area.

[8] Current marginal and face bank ecotopes area.

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

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

Table 8.5 Habitats conservation status assessments

Habitat	Area Assessment	Structure & Functions Assessment	Future Prospects Assessment	Overall Assessment
7110	Unfavourable Bad-Stable	Unfavourable Bad-Stable	Unfavourable Bad-Stable	Unfavourable Bad-Stable
7120	Unfavourable Bad-Stable	Favourable -Stable	Unfavourable Bad-Stable	Unfavourable Bad-Stable
7150	Unfavourable Bad-Stable	Unfavourable Bad-Stable	Unfavourable Bad-Stable	Unfavourable Bad-Stable

Conclusions

Summary of impacting activities

- Active peat cutting no longer takes place at the site and was thought to have ceased before the 2005 survey by Fernandez *et al*. (2005). Kelly *et al*. (1995) previously noted peat cutting in the west of the northern lobe, southeast of the northern lobe, and in the extreme

southwest of the site. This consisted of hand and Difco cutting and was most intensive in the west of the northern lobe.

- Over 3.6km of drains on the high bog remain functional and 0.096km reduced functional. Some of these are associated with conifer plantations, and indeed the primary function of a number of these drains in the north of the site is apparently to act as firebreaks. They are included in the catalogue of drains in this survey, as they essentially function as drains in discharging water from the bog.
- Cutover drainage (peripheral drainage) associated with former peat cutting areas continues to impact on the high bog habitats. Many drains are likely to be still functional and therefore impacting negatively on the high bog habitats.
- To the southwest of the high bog (E158121/N303920), peripheral agriculture land drainage maintenance (on approximately 1km of the drainage network), has recently taken place and is evident from 2010 aerial photographs. It may have also occurred in other places, and is quite likely to have done so within the conifer plantations.
- No fire events have damaged the high bog in the reporting period. The most recent significant burning event is thought to have pre-dated the 1994 survey of the bog (Fernandez *et al.*, 2005).

Changes in active peat forming areas

- Although figures indicate no change in area in all of the Active Raised Bog ecotopes, the distribution of the habitat has changed considerably. Central ecotope, which was formerly all within a single area (**C1**) is now divided into two separate areas, **C1** and **C2**. **C2** was at least partly within the former C1 area, and therefore does not represent a new peat-forming area, but rather is the result of more comprehensive surveying and greater mapping accuracy.
- Sub-central ecotope was formerly mapped in three distinct areas – **Sc1**, **Sc2** and **Sc3** and this remains the case after the current surveying and mapping exercise. However, the boundaries of each of these sub-central areas have been refined by the more comprehensive mapping approach of this survey.

Other changes

- A number of other changes to the mapped distribution of habitats have resulted from the more comprehensive surveying and mapping accuracy of the present survey. None of these are regarded as real changes. These include the substantial re-drawing of the flush **Z**

boundary, which now has a mapped area more than twice that mapped in 2005; refinements to the boundaries of other flushes – **A**, **W, X** and **Y (**and the labelling of flush **X** which was previously mapped but unnamed); several slight changes to the marginal/sub-marginal ecotopes boundary; and slight changes to the areas of face bank ecotope.

Quadrats analysis

- Quadrat **Qc1**: Greatly increased total cover of pools, *Sphagnum* pools, total *Sphagnum* and associated *Sphagnum* species in 2012. Cover of hollows and *Sphagnum* hummocks greater in 2005, indicating differences likely to be mostly due to slight change in the quadrat location.
- **Qsc2**: Greater pool cover and *Sphagnum* pool cover in 2012, with associated higher cover of typical *Sphagnum* pool species. Likely to be due to slight difference in quadrat location.

Restoration works

- No restoration works have been undertaken at the site.
- NPWS has engaged in negotiation with landowners in relation to peat cutting, which no longer takes place at the site, and is thought to have ceased prior to the 2005 survey by Fernandez *et al*. (2005).

Summary of conservation status

- **Active Raised Bog** has been given an **Unfavourable Bad–Stable** conservation status at Tawnaghbeg Bog. Habitat Area and quality have remained unchanged, but both of these elements of conservation status assessment have values below the FRVs. Future prospects are considered **Unfavourable Bad-Stable** as impacting activities (drainage, forestry plantations) continue to threaten the habitat, although no imminent loss of habitat is expected.
- **Degraded Raised Bog** has been given an **Unfavourable Bad-Stable** conservation status at Tawnaghbeg Bog. Habitat Area has remained unchanged, but is substantially above FRV, while S&Fs were assessed as stable, reflecting the lack of change in the area of marginal and face bank ecotopes. Future Prospects are considered **Unfavourable Bad-Stable** due to threatening impacting activities and the lack of restoration measures at the site.
- **Depressions on peat substrates of the Rhynchosporion** has been given an **Unfavourable Bad-Stable** conservation status at Tawnaghbeg Bog. Habitat Area and quality (S&Fs) are considered to have remained unchanged in the reporting period. Future prospects are

considered **Unfavourable Bad-Stable** due to the likelihood of peat cutting having ceased at the site, and the absence of major threatening impacts.

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

Recommendations

- **The continued cessation of peat cutting.**
- **Restoration works** including the blocking of high bog functional and reduced functional drains, as well as cutover drains. The blocking of a number of drains, distinguished by their large dimensions and the volumes of water observed flowing within them, should be particularly targeted. These include drains bA1, bP, bX and bW, associated with the conifer plantations, and drain bO, within flush Y. It may also be necessary to restore some cutaway areas if it is not possible to achieve FRV's in the current high bog area
- **Further studies** to assess the actual impact of adjacent conifer plantations on the high bog habitats and investigate the potential to restore any future clearfell areas to Active Raised Bog. There is potential to restore cutover following the removal of conifers along the east, southeast, north, and northwest of the bog. This could be particularly important, as reaching the ARB target exclusively on the high bog may prove unattainable.
- **Further hydrological and topographical studies** to ascertain the capacity of the high bog to support Active Raised Bog and thus estimate a more accurate favourable reference value.
- **Further botanical monitoring surveys** on the high bog in order to assess changes in the conservation status of habitats, and potential monitoring surveys of cutover areas if they become part of future restoration programmes at the site.

References

Douglas, C. & Grogan, H. 1986. Survey to locate raised bogs of scientific interest in Longford, Westmeath and East Mayo. Unpublished report, National Parks & Wildlife Service, Department of Environment, and Local Government, Dublin.

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

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

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

Appendix I Detailed vegetation description of the high bog

Active Raised Bog (7110)

Central Ecotope Complex

COMPLEX 35

- **Location**: southern section of the bog within **C1** and **C2**
- **Ground**: soft to very soft
- **Physical indicators**: absent
- ***Calluna* height**: 11-20cm
- ***Cladonia* cover**: 5-10%
- **Macro-topography**: gentle slope to south
- **Pools**: large, interconnecting, 34-50%
- ***Sphagnum* cover**: 34-50% (c. 50%)
- ***Narthecium* cover**: 5-10%
- **Micro-topography**: low hummocks, high hummocks, hollows, lawns and pools
- **Tussocks**: absent
- **Degradation or regeneration evidence**: absent
- **Species cover**: *Sphagnum capillifolium* (11-25%), *S. cuspidatum* (11-25%), *S. papillosum* (11-25%), *S. tenellum* (1-4%), *S. denticulatum* (1-4%), *S. fuscum* (<1%), *Calluna vulgaris* (11-25%), *Eriophorum vaginatum* (11-20%), *Eriophorum angustifolium* (5-10%), *Erica tetralix* (5-10%).
- **Additional comments**: Many of the pools within the complex were aligned in an approximately north-south orientation. Pools contained *S. cuspidatum*, which had an overall cover in pools of c. 75%. *S. denticulatum* was also present in pools, as was *Drosera anglica*. *Campylopus atrovirens* and *Pleurozia purpurea* were occasional at pool edges. The interpool areas had low hummocks, mostly dominated by *S. capillifolium*. Small hummocks of *Racomitrium lanuginosum* were present, but rare, in the complex. An occasional high hummock within the complex had tall *Calluna vulgaris*, *Pleurozium schreberi*, and a generally high cover of *Cladonia portentosa*. C2, to the north of C1, consisted of complex 35, but had pools with more open water and algae. C2 was surrounded by the Sub-central complex 6/35, which at this site, had lower *Sphagnum* cover than 4/35. In general, the northern C2/Sc1 zone was of poorer quality than the more southerly sections.

Sub-Central Ecotope Complexes

COMPLEX 4/35

- **Location**: found around the edges of **Sc1** and in the west of **Sc3**
- **Ground**: soft to very soft
- **Physical indicators**: absent
- ***Calluna* height**: 11-25cm
- ***Cladonia* cover**: 5-10% (c. 5%)
- **Macro-topography**: gentle slope to south
- **Pools**: long, linear, interconnecting, 11-25%
- ***Sphagnum* cover**: 34-50% (c. 50%)
- ***Narthecium* cover**: 5-10%
- **Micro-topography:** low hummocks/hollows/pools
- **Tussocks:** absent
- **Degradation or regeneration evidence**: absent
- **Species cover**: *Sphagnum capillifolium* (11-25%), *S. cuspidatum* (5-10%), *S. papillosum* (11-25%), *S. denticulatum* (<1%), *S. tenellum* (1-4%), *Calluna vulgaris* (11-25%), *Rhynchospora alba* (11-25%), *Narthecium ossifragum* (5-10%), *Eriophorum vaginatum* (11-25%), *Eriophorum angustifolium* (1-4%), *Racomitrium lanuginosum* (1-4%).
- **Additional comments**: Complex 4/35 is similar to 6/35 (below), and is mainly distinguished by the greater abundance of *Rhynchospora alba*. *Sphagnum* cover – mostly *S. cuspidatum* - varied considerably in pools - some had very little, while others had a high cover.

COMPLEX 6/35

- **Location**: this community complex characterizes **Sc2**,**Sc3** and the western section of **Sc1**
- **Ground**: soft to very soft
- **Physical indicators**: absent
- ***Calluna* height**: 11-25cm
- ***Cladonia* cover**: 5-10% (c. 5%)
- **Macro-topography**: gentle slope to south
- **Pools**: long, linear, interconnecting, 11-25%
- ***Sphagnum* cover**: 34-50% (c. 50%)
- ***Narthecium* cover**: 11-25%
- **Micro-topography:** low hummocks/hollows/pools

- **Tussocks:** absent
- **Degradation or regeneration evidence**: absent
- **Species cover**: *Sphagnum capillifolium* (11-25%), *S. cuspidatum* (5-10%), *S. papillosum* (11-25%), *S. denticulatum* (<1%), *S. tenellum* (1-4%), *S. magellanicum* (1-4%), *S. austinii* (<1%), *S. fuscum* (<1%), *Calluna vulgaris* (11-25%), *Rhynchospora alba* (11-25%), *Narthecium ossifragum* (11-25%), *Eriophorum vaginatum* (11-25%), *Eriophorum angustifolium* (1-4%), *Racomitrium lanuginosum* (1-4%), *Campylopus atrovirens* (1-4%).
- **Additional comments**: The overall cover of *Sphagnum* in pools – mostly *S. cuspidatum*, with *S. denticulatum* also present – was approximately 70%. Pools were generally long – up to 20m - and narrow, with a general East-West orientation. Pools edges had hummocks of *S. capillifolium* and/or *S. papillosum*, while *S. magellanicum* was also present, but rare, at pool edges. The interpool habitat of Sc2 was of poorer quality than Sc1, with lower *Sphagnum* cover and more *Narthecium ossifragum* (11-25%). The complex 6/35 was similar to 4/35, differing most obviously in the relative abundances of Narthecium ossifragum and Rhynchospora alba.

Degraded Raised Bog (7120)

Sub-Marginal Ecotope Complexes

COMPLEX 9/7

- **Location**: this is the most widespread SM community complex at the site
- **Ground**: soft
- **Physical indicators**: absent
- ***Calluna* height**: 21-40cm
- ***Cladonia* cover**: 34-50%
- **Macro-topography**: gentle slope to south
- **Pools**: absent
- ***Sphagnum* cover**: 11-25%
- ***Narthecium* cover**: 1-4%
- **Micro-topography**: low hummocks, hollows, flats
- **Tussocks**: absent
- **Degradation or regeneration evidence**: absent
- **Species cover**: *Calluna vulgaris* (34-50%), *Sphagnum capillifolium* (11-25%), *S. papillosum* (1-4%), *S. tenellum* (1-4%), *S. subnitens* (1-4%), *Eriophorum vaginatum* (11-25%), *E. angustifolium* (5-10%), *Hypnum jutlandicum* (1-4%), *Trichophorum germanicum* (1-4%).

- **Additional comments***:* Much of the sub-marginal ecotope at Tawnaghbeg Bog was of a broadly similar nature, generally characterised by the presence and abundance of *Calluna vulgaris* and *Eriophorum* species. Only a single complex (9/7) was fully described, with other similar types accommodated as variants of 9/7.
  - Variant 1: 9/7/6: Lower *Sphagnum* cover (<25%) and generally not as soft or wet underfoot. Also higher cover of *Narthecium ossifragum* (>10%).
  - Variant 2: 9/7/6+*Cladonia*: in the south east corner of the site; indicates very high cover of *Cladonia* (>50%), otherwise similar to 9/7/6.
  - Variant 3: 9/7/6+P: Pools covered 4-10% of the complex; *S. cuspidatum* and *S. papillosum* in pools; *Narthecium ossifragum* and *Rhynchospora alba* common. Found surrounding **Sc1** and **Sc2**.
  - Variant 4: 9/7/6+TP: Where pools are elongated, indicating tears; *Eriophorum* cover decreases to 4-10% and *Narthecium ossifragum* increased to 26-33%. Pools contained *S. papillosum* and *S. cuspidatum*. Hummocks were absent at edge of pools and interpool areas had low *Sphagnum* cover. Found surrounding **Sc2**.
  - Variant 5: 9/7/3: Used instead of 9/7/6 when *Carex panicea* cover increased to 4-10% and *Narthecium ossifragum* cover was lower.
  - Variant 6: 9a/7: Similar to 9/7, but characterised by the abundance of *Eriophorum angustifolium*, which in the case of this community complex variant, exceeds that of *E. vaginatum*. Recorded in the northern part of the site, to the south of the sub-central ecotope in that area, this complex variant had numerous *Racomitrium lanuginosum* hummocks, and was generally somewhat wetter than 9/7.

Marginal Ecotope Complexes

COMPLEX 3/6/2

- **Location**: this is the only marginal ecotope community complex recorded at the site
- **Ground**: firm
- **Physical indicators**: absent
- ***Calluna* height**: 11-20cm
- ***Cladonia* cover**: 11-25%
- **Macro-topography**: steep slope to margin of bog
- **Pools**: ***Sphagnum* cover**: 5-10%
- ***Narthecium* cover**: 11-25%

- **Micro-topography:** low hummocks/hollows
- **Tussocks:** *Trichophorum germanicum* 1-4%
- **Degradation or regeneration evidence**: absent
- **Species cover**: *Sphagnum capillifolium* (1-4%), *S. papillosum* (1-4%), *S. subnitens* (1-4%), *Calluna vulgaris* (11-25%), *Narthecium ossifragum* (11-25%), *Eriophorum vaginatum* (5-10%), *Eriophorum angustifolium* (5-10%), *Erica tetralix* 5-10%; *Carex panicea* 4-10%; *Trichophorum germanicum* (1-4%).
- **Additional comments**: none

Inactive flushes

FLUSH A

- **Location**: south west part of southern lobe
- **Ground**: soft
- **Physical indicators**: absent
- ***Calluna* height**: 20-30cm
- ***Cladonia* cover**: 1-4%
- **Macro-topography**: flat
- **Pools**: absent
- ***Sphagnum* cover**: 5-10%
- ***Narthecium* cover**: <1%
- **Micro-topography:** hummocks/hollows
- **Tussocks:** *Molinia caerulea* 5-10%
- **Degradation or regeneration evidence**: absent
- **Species cover**: *Molinia caerulea* (51-75%), *Calluna vulgaris* (5-10%), *Sphagnum capillifolium* (5-10%), *S. papillosum* (1-4%), *Erica tetralix* (4-10%), *Eriophorum vaginatum* (1-4%) *Potentilla erecta* (1-4%).
- **Additional comments**: none

FLUSH W

- **Location**: southwest part of southern lobe
- **Ground**: soft
- **Physical indicators**: absent
- ***Calluna* height**: 11-25cm
- ***Cladonia* cover**: 5-10%

- **Macro-topography**: flat
- **Pools**: absent
- ***Sphagnum* cover**: 11-25%
- ***Narthecium* cover**: <1%
- **Micro-topography:** hummocks/hollows
- **Tussocks:** *Molinia caerulea* 5-10%
- **Degradation or regeneration evidence**: absent
- **Species cover**: *Molinia caerulea* (51-75%), *Sphagnum capillifolium* (11-25%), *Calluna vulgaris* (4-10%), *Erica tetralix* (5-10%), *Potentilla erecta* (1-4%), *Eriophorum vaginatum* (1-4%), *Carex panicea* (1-4 %), *Racomitrium lanuginosum* (1-4%).
- **Additional comments**: none

FLUSH Z

- **Location**: between the two lobes of the site, where the bog is narrowest
- **Ground**: firm
- **Physical indicators**: absent
- ***Calluna* height**: 34-50cm
- ***Cladonia* cover**: 11-25%
- **Macro-topography**: flat
- **Pools**: absent
- ***Sphagnum* cover**: 11-25%
- ***Narthecium* cover**: absent
- **Micro-topography:** hummocks/hollows
- **Tussocks:** absent
- **Degradation or regeneration evidence**: absent
- **Species cover**: *Calluna vulgaris* (26-33%), *Molinia caerulea* (34-50%), *Phragmites australis* (11-25%), *S. capillifolium* (11-25%), *Myrica gale* (5-10%), *Eriophorum vaginatum* (5-10%), *E. angustifolium* (5-10%), *Potentilla erecta* (1-4%).
- **Additional comments**: Flush Z extends further south than was indicated in recent comparable data (Fernandez *et al*., 2005). However, there was a clear deficit in ecotope boundary mapping at Tawnaghbeg Bog in that survey, and differences in the recorded extent of the flush can be attributed to the greater mapping accuracy of the present survey, rather than any real change. The flush is dominated by *Molinia caerulea* and the vegetation is largely similar throughout, although *Phragmites australis* is particularly common in the eastern half.

Flush **X** is a very small, *Molinia caerulea*-dominated flush in the northwest of the bog that is mostly surrounded by marginal ecotope, and is similar to the adjacent flush Z.

Flush **Y** refers to a narrow band of vegetation along the sides of a drain/underground stream feature in the northwest of the site. *Molinia caerulea*, tall *Calluna vulgaris* and *Myrica gale* characterise the flush vegetation. A number of swallow holes are present at the surface, some of which reveal a strong subterranean flow of water from a south-easterly direction.

Face bank Complexes

COMPLEX 1

- **Location**: distributed throughout the margin of the high bog
- **Ground**: firm
- **Physical indicators**: absent
- ***Calluna* height**: >60cm
- ***Cladonia* cover**: 34-50%
- **Macro-topography**: flat, cutover facebanks
- **Pools**: absent
- ***Sphagnum* cover**: 1-4%
- ***Narthecium* cover**: none
- **Micro-topography:** Tall *Calluna vulgaris*-dominated hummocks
- **Tussocks:** *Trichophorum germanicum* 5-10%
- **Degradation or regeneration evidence**: absent
- **Species cover**: *Calluna vulgaris* (51-75%), *Cladonia portentosa* (34-50%), *Trichophorum germanicum* (5-10%), *Hypnum jutlandicum* (5-10%), *Eriophorum angustifolium* (1-4%), *S. subnitens* (1-4%).
- **Additional comments**: none.

Depressions on peat substrates of the Rhynchosporion (7150)

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

R. alba is found in all ecotopes in Tawnaghbeg Bog, such as: central ecotope 35; sub-central ecotope (4/35; 6/35); sub-marginal ecotope (9/7 and associated 9/7 variants; 9/7/6; 9/7/6+P; 9/7/6+TP; 9/7/6+Cl; 9a/7; 9/7/3), marginal ecotope (3/6/2) and face bank ecotope (1).

The species becomes very frequent within complexes 35 (central), 4/35 (sub-central) and 9/7/6+P (sub-marginal).

The species is always found associated with wet features such as *Sphagnum* pools, *Sphagnum* lawns and hollows, along with species such as *Sphagnum magellanicum*, *S. papillosum* and *S. cuspidatum*.

It was also recorded in the more degraded areas of the bog, particularly where tear pools or erosion channels were found.

Appendix II Photographical records

Photograph Number	Aspect	Type	Feature	Date
DSCF3594	NE	Overview	Qsc2	18/10/2012
DSCF3593	NE	Overview	Qc1	18/10/2012
P1030141	NW	Overview	Maintenance work within drain bA1 and bW	18/10/2012
P1030142	NW	Overview	Maintenance work within drain bP	18/10/2012
P1030143	SE	Overview	Maintenance work within drain bX (top layer removed)	18/10/2012

Appendix III Quadrats

Ecotope type	Central	Central	Sub-central	Sub-central
Complex Name	35	35	9/4/35	9/3/35
Quadrat Name	Qc1	Qc1	Qsc1	Qsc2
Easting	158566	158561.81	158649	158610
Northing	303941	303940.47	304047	304529
Date	05/04/2005	18/10/2012	05/04/2005	05/04/2005
Firmness	very soft	very soft	soft	firm-soft
Burnt	No	No	No	No
Algae in hollows %	Absent	Absent	1-3 (many indiv)	Absent
Algae in pools %	Absent	Absent	1-3 (many indiv)	1-3 (many indiv)
Bare peat %	Absent	Absent	1-3 (many indiv)	1-3 (many indiv)
High hummocks %	na	Absent	na	na
Low hummocks %	11-25	11-25	11-25	11-25
Hollows %	11-25	4-10	11-25	11-25
Lawns %	11-25	11-25	Absent	Absent
Pools %	11-25	34-50	11-25	11-25
Pool type	na	Interconnecting	Tear	Tear
S.austinii hum type	na	Absent	na	na
S.austinii hum %	Absent	Absent	Absent	Absent
S.austinii height(cm)	na	Absent	na	na
S.fuscum hum type	na	Absent	na	na
S.fuscum hum %	Absent	Absent	Absent	Absent
S.fuscum height(cm)	na	Absent	na	na
Leucobryum glaucum	Absent	Absent	Absent	Absent

Ecotope type	Central	Central	Sub-central	Sub-central
Complex Name	35	35	9/4/35	9/3/35
Trichophorum type	Absent	Absent	Tussocks	Tussocks
Trichophorum %	Absent	Absent	1-3 (many indiv)	1-3 (many indiv)
S.magellanicum %	Absent	Absent	Absent	Absent
S.cuspidatum %	4-10	34-50	na	4-10
S.papillosum %	11-25	26-33	4-10	1-3 (many indiv)
S.denticulatum %	4-10	Absent	1-3 (many indiv)	1-3 (many indiv)
S.capillifolium%	4-10	4-10	11-25	11-25
S.tenellum %	na	1-3 (several indiv)	na	na
S.subnitens %	Absent	Absent	Absent	Absent
R.fusca %	Absent	Absent	Absent	Absent
R.alba %	4-10	1-3 (many indiv)	11-25	4-10
N.ossifragum %	Absent	4-10	1-3 (many indiv)	4-10
Sphag pools %	11-25	34-50	4-10	11-25
Dominant pool Sphag	S. cuspidatum	S. cuspidatum	S.cuspidatum	S.cuspidatum
Sphag lawns %	11-25	11-25	Absent	Absent
Sphag humm %	11-25	4-10	11-25	11-25
Sphag holl %	4-10	Absent	4-10	4-10
Total Sphag %	34-50	51-75	26-33	11-25
Hummocks indicators	Absent	Absent	Absent	Absent
Cladonia portent %	11-25	4-10	na	4-10
Other Cladonia sp	na	C. uncialis	na	na
C. panicea %	na	Absent	na	na
Calluna cover %	4-10	4-10	4-10	4-10
Calluna height(cm)	11-20	11-20	11-20	21-40
Other Notable Species		Drosera anglica; Pleurozia purpurea;		Racomotrium lanuginosum; Campylopus

Ecotope type	Central	Central	Sub-central	Sub-central
Complex Name	35	35	9/4/35	9/3/35
		Racomitrium lanuginosum		atrovirens
Other comment		Pool cover greater – attributed to location discrepancy		

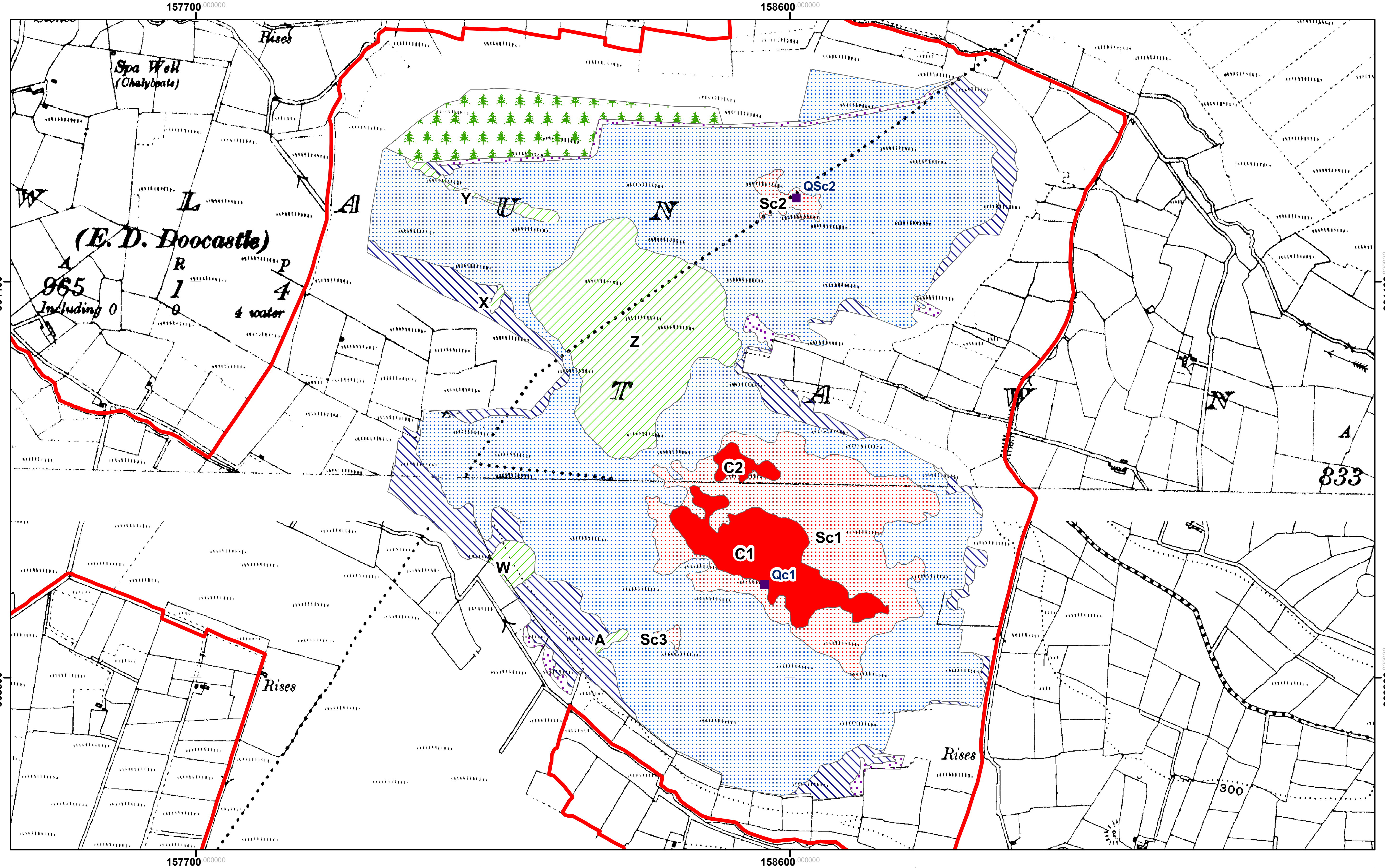
Ecotope type	Sub-central	Sub-central
Complex Name	6/35	9/4/35
Quadrat Name	QSc2	Qsc3
Easting	158609.534	158682
Northing	304526.594	304086
Date	18/10/2012	05/04/2005
Firmness	Soft	very soft
Burnt	No	No
Algae in hollows %	Absent	Absent
Algae in pools %	Absent	Absent
Bare peat %	Absent	1-3 (many indiv)
High hummocks %	Absent	na
Low hummocks %	34-50	11-25
Hollows %	Absent	4-10
Lawns %	1-3 (many indiv)	Absent
Pools %	34-50	26-33
Pool type	Tear	Interconnecting
S.austinii hum type	Absent	na
S.austinii hum %	Absent	Absent
S.austinii height(cm)	Absent	na
S.fuscum hum type	Absent	na

Ecotope type	Sub-central	Sub-central
Complex Name	6/35	9/4/35
S.fuscum hum %	Absent	Absent
S.fuscum height(cm)	Absent	na
Leucobryum glaucum	Absent	Absent
Trichophorum type	Absent	Absent
Trichophorum %	Absent	Absent
S.magellanicum %	4-10	Absent
S.cuspidatum %	26-33	4-10
S.papillosum %	4-10	11-25
S.denticulatum %	1-3 (many indiv)	1-3 (many indiv)
S.capillifolium%	4-10	4-10
S.tenellum %	1-3 (many indiv)	na
S.subnitens %	Absent	Absent
R.fusca %	Absent	Absent
R.alba %	1-3 (several indiv)	11-25
N.ossifragum %	4-10	4-10
Sphag pools %	34-50	11-25
Dominant pool Sphag	S.cuspidatum	S.cuspidatum
Sphag lawns %	1-3 (many indiv)	Absent
Sphag humm %	26-33	11-25
Sphag holl %	4-10	4-10
Total Sphag %	34-50	34-50
Hummocks indicators	Absent	Absent
Cladonia portent %	4-10	1-3 (many indiv)
Other Cladonia sp	C. uncialis	na
C. panicea %	Absent	na
Calluna cover %	26-33	1-3 (many indiv)

Ecotope type	Sub-central	Sub-central
Complex Name	6/35	9/4/35
Calluna height(cm)	21-40	11-20
Other Notable Species	Hyp jut	C. atrovirens, Pleurozia purpurea,
Other comment	pool cover - location	

Note: Data for those 2005 quadrats re-surveyed in 2012 is given to the right of the original 2005 quadrat data in table above. Not all quadrats reported in 2005 were re-surveyed in 2012. Nonetheless, all 2005 quadrat data is given above. Additional quadrats were recorded where necessary. Some 2005 quadrats may have been classified under a different ecotope category in 2012; further detail is given within the report.

Appendix IV Survey maps



Raised Bog Monitoring & Assessment Survey 2013

Map 1: Ecotopes Map and Quadrats

Ecology and Environmental Consultants Ireland Ltd.

Tawnaghbeg SAC (002298)
Co. Mayo

1:5,500

0 65 130 260 390 520 Meters

N

Legend

Quadrat

Ecotope type

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

157700 000000 158600 000000 159500 000000

304400 000000 303800 000000

Raised Bog Monitoring & Assessment Survey 2013

Map 2: Vegetation community complexes

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Ecology and Environmental Consultants Ireland Ltd.

Tawnaghbeg SAC (002298)
Co. Mayo

1:5,500

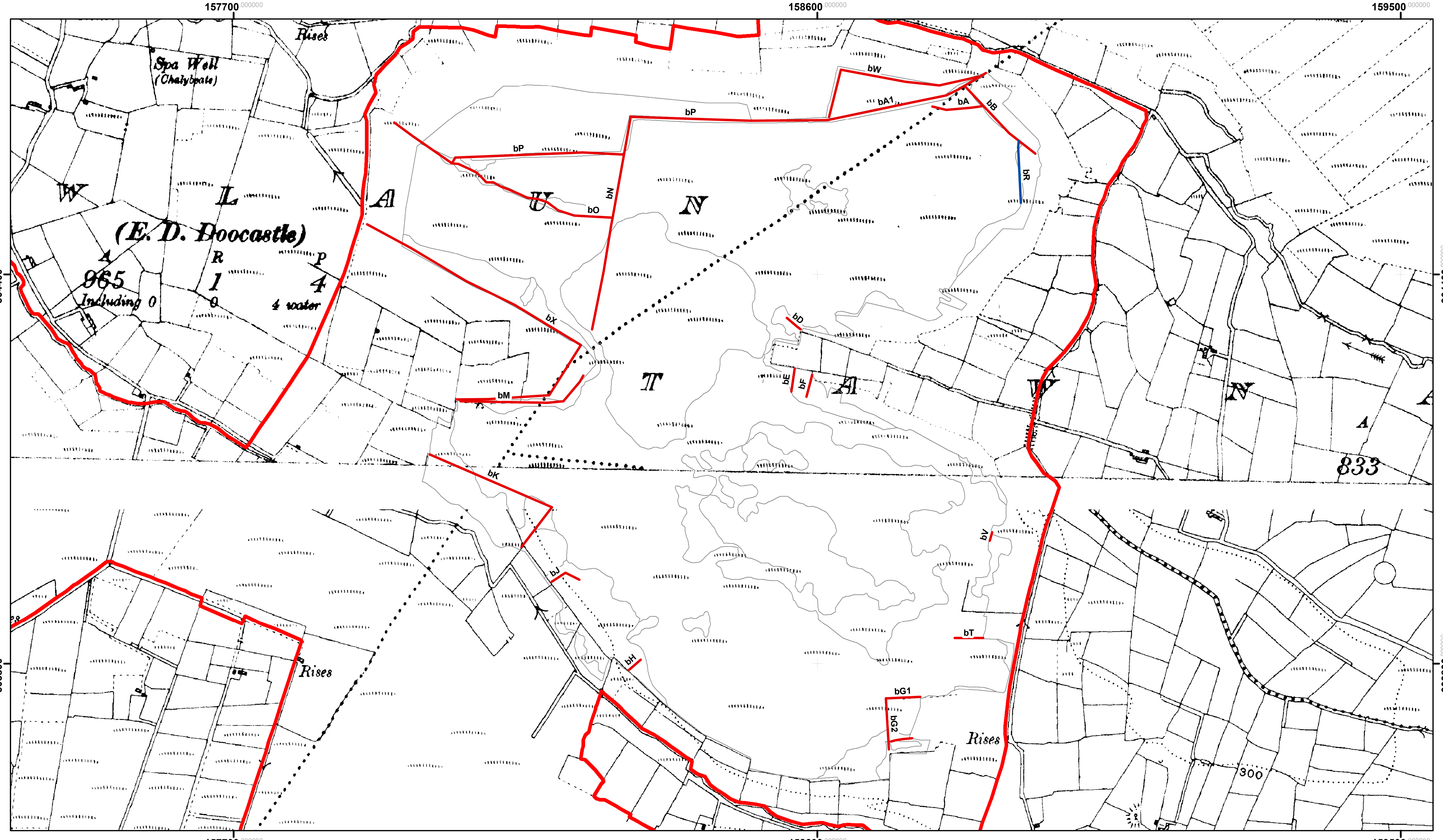
N

0 75 150 300 450 600 Meters

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)

Ecology and Environmental Consultants Ireland Ltd.

Tawnaghbeg SAC (002298)
Co. Mayo

1:5,500

N

0 70 140 280 420 560 Meters

Legend

High Bog drainage

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