Raheenmore Bog (SAC 00582), Co. Offaly

Executive Summary

This survey, carried out in August 2011, aimed to assess the conservation status of habitats listed on Annex I of the European Habitats Directive (92/43EEC) on the high bog at Raheenmore 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 52.31ha (40.07%) of the high bog area. The highest quality example of Active Raised Bog consists of *Sphagnum* lawns, pools, hummocks and hollows. *Sphagnum* cover reaches 90% in certain locations. Active Raised Bog also includes some active peat forming flushes.

Degraded Raised Bog covers 78.23ha (59.93%) of the high bog area. It is drier than Active Raised Bog and supports lower density of *Sphagnum* mosses. It has a less developed micro-topography while permanent pools and *Sphagnum* lawns are generally absent.

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

Restoration works took place at the site including blocking of high bog drainage and construction of three dams at the edge of high bog in the 1990's.

The current conservation objective for Raheenmore 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 119.12ha. The objective in relation to Structure and Functions (S&Fs) is that at least half of the Active Raised Bog area should be made up of the central ecotope and active flush (i.e. the wetter vegetation communities). These values have been set as Favourable Reference Values or FRVs until more site specific values can be set based on hydrological and topographical studies. The objective for Degraded Raised Bog is for the sub-marginal area to be restored to active peat forming communities as stated above and that no loss or degradation of any kind occurs. Although FRVs could not be established for the Rhynchosporion depressions, the objectives are to increase its extent and improve its quality to values associated with a favourable conservation status of Active Raised Bog. Therefore, the habitat's objectives are indirectly associated with Active Raised Bog objectives.

There has been a slight increase in the area of Active Raised Bog (0.81ha) at Raheenmore in the 2004 to 2011 period. Some changes have been noted near dams at the edge of the high bog built as part of the restoration works carried out between 1994 and 1999. These include the expansion of active peat forming vegetation towards dam 1 and 3 as a result of a considerable amount of water running off towards these failed dams. In addition, a small new active peat forming flush has developed surrounding the large open water pond at dam 2. Three new peat forming areas have been described at the site, these are likely to be the result of more comprehensive field mapping rather than actual changes.

Cutover drainage continues to be the highest negatively impacting activity on Active Raised Bog at the site. Only a few drains on the high bog remain functional, and high bog drains have continued to infill in the 2004-2011 period. No fire events have affected the Bog in the reporting period. Peat cutting no longer takes place at the site. A few scattered *Pinus sylvestris* trees remain on the high bog; these do not pose a major threat to high bog habitats.

Active Raised Bog has been given an overall **Unfavourable Bad-Improving** conservation status assessment. Habitat Area has slightly increased and quality

improved in the reporting period, however both are below favourable reference values. Future Prospects are considered **Unfavourable Bad-Stable** as cutover drainage continues to hinder the restoration of peat forming communities and thus the habitat is not expected to reach favourable reference values in the following two reporting periods.

Degraded Raised Bog has been given an overall **Unfavourable Bad-Improving** conservation status assessment as there has been some restoration to Active Raised Bog. **Rhynchosporion depressions** has been given an overall **Unfavourable Bad-Stable** conservation status assessment.

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

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

Site identification

SAC Site Code	000582	**6" Sheet:**	OY: 10
Grid Reference:	E 243800 / N 232000	**1:50,000 Sheet:**	48
High Bog area (ha)[1]:	131.64ha		
Dates of Visit:	03 to 04/08/11		
Townlands:	Clonagh, Cloneen, Mullagharush, Cruit, Kilclonfert, Raheenmore, Puttaghan, Barnan and Kilduff.		

Site location

Raheenmore Bog developed in a small basin in the catchment of two major river systems, the Brosna and the Boyne. It is situated about 5km north-west of Daingean and 12km north-east of Tullamore, Co. Offaly on the central plain of the Irish midlands. Kelly *et al*. (1995) grouped Raheenmore Bog along with Blackcastle Bog as the Raised Bogs of W Offaly.

The road from Daingean to Tyrellspass runs about 3km east of the site. The Bog can be accessed by turning west off this road, just north of Kilduff House. This roadway forms the northern boundary of the site.

Description of the survey

The survey was carried out in August 2011 and involved a vegetation survey of the high bog at Raheenmore Bog and the recording of impacting activities affecting high bog vegetation. A similar survey was carried out in 2004 by Fernandez *et al*. (2005). High bog vegetation was described and mapped, based on raised bog ecotope vegetation community complexes developed by Kelly and Schouten (2002). Detailed notes were taken on each community complex and any flushed areas that were present. These included: species lists; estimation of % cover of dominant species; percentage *Sphagnum* cover; evidence of damage (due to

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

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 Raheenmore Bog was re-surveyed. Sections mapped as sub-marginal, sub-central and central ecotope in 2004 were surveyed in more detail. These are the areas where changes were likely to have occurred. Quadrats, which describe the micro-topographical features and indicator species, recorded in the 2004 project (Fernandez *et al*. 2005) were re-surveyed and additional quadrats were recorded where necessary (see Appendix III). The size of quadrats was 4m x 4m.

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

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

Description of the high bog

The majority of the site (89%) is a statutory Nature Reserve. This was established on 28th September 1987. The site was designated as SAC in 1997. Raheenmore Bog is a classic example of Midland Raised Bog and the deepest remaining in Ireland (Cross, 1990). The high bog at Raheenmore has an ellipsoid shape, which is elongated in a west-east direction.

Ecological information

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

The following Raised Bog EU Annex I habitats, are found in Raheenmore 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 Raheenmore Bog is 52.31 ha (40.07% of the high bog), which is a decrease of 8.18ha since 1994.

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

Central ecotope was found in Raheenmore at one location (**C1**) and sub-central ecotope at four locations (**Sc1** to **Sc4**) (see Appendix IV, Map 1). The highest quality Active Raised Bog sections consist of central ecotope (vegetation community complex 10/15) in a depressed area featuring hummocks, lawns, hollows, and occasional pools (<5%). *Sphagnum* cover ranges from 50 to 70%, but reaches 90% in places, and consists of *Sphagnum capillifolium, S. austinii* and *S. fuscum* hummocks, *S. magellanicum* and occasionally *S. papillosum* in lawns and low hummocks and *S. cuspidatum* in pools along with *Drosera anglica*.

Complex 9/7/10 is the most widespread complex within sub-central ecotope and consists of low *S. capillifolium* hummocks and hollows with *S. cuspidatum* in places. Overall *Sphagnum* cover is greater than 50%, and reaches 80% in places. Other *Sphagnum* species include *S. papillosum*, *S. magellanicum*, *S. tenellum*, and *S. subnitens*. Sub-central ecotope becomes wetter near central ecotope where *Rhynchospora alba* becomes frequent (complex 10/4). The wettest and finest quality sub-central ecotope areas feature higher content of *Eriophorum vaginatum* and *E. angustifolium* (complexes 10/ and 9/10); *Sphagnum* cover varies from 50 to 60% in these complexes, where pools are very occasionally found.

Three active peat forming flushed areas are also present at Raheenmore Bog (**F1** to **F3**).

Degraded Raised Bog (7120)

The current area of Degraded Raised Bog at Raheenmore Bog is 78.23ha (59.93% of the high bog).

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

The sub-marginal ecotope features the most developed micro-topography within Degraded Raised Bog, with higher presence of hummocks and hollows (frequently dominated by *Narthecium ossifragum* and only occasionally *Sphagnum cuspidatum* and *S. tenellum*). *Sphagnum* covers up to 40% of the ground and mostly consists of *S. capillifolium*. *S. papillosum*, *S. magellanicum*, *S. tenellum*, *S. subnitens* and *S. cuspidatum* are also present. Very occasionally *S. austinii* and *S. fuscum* hummocks are found. *Calluna vulgaris*, *Erica tetralix*, *Eriophorum vaginatum*, *E. angustifolium*, *Rhynchospora alba*, *N. ossifragum* and *Trichophorum germanicum* are also common at various degrees of coverage across the high bog.

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

Face bank ecotope is characterised by firm ground, tall *C. vulgaris*, poor *Sphagnum* cover and flat micro-topography. Several mounds raised from the surrounding high bog expanse are also found in Raheenmore. These mounds are generally dominated by marginal ecotope consisting of dry *C. vulgaris* and have little or no *Sphagnum* cover.

High bog also features scattered *Betula pubescens* and *Pinus sylvestris* trees.

Depressions on peat substrates of the Rhynchosporion (7150)

Rhynchosporion vegetation is widespread on Raheenmore. It is found in both Active and Degraded Raised Bog, but tends to be best developed and most stable in the wettest areas of Active Raised Bog. In these areas, the Rhynchosporion vegetation occurs along pool edges and on lawns underlain by deep, wet and quaking peat. Typical plant species include

Rhynchospora alba, *Sphagnum cuspidatum*, *S. magellanicum*, *S. papillosum*, *Drosera anglica* and *Eriophorum angustifolium*.

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

Detailed vegetation description of the high bog

A detailed description of high bog vegetation recorded during the 2011 survey of Raheenmore 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 Raheenmore 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; see section 7):

Table 6.1 Impacting activities

Code	Activity	Ranking	Influence	Area (ha) /Length(km) affected	Location	Habitat affected
J02.07	Drainage	M	-1	9.40km [1]	On HB	**7110/7120/7150**
J02.07	Drainage	H	-1	n/av	Adjacent to HB	**7110/7120/7150**
I02	Problematic native species	L	-1	<1ha [3]	On HB	**7110/7120/7150**
4.2	Restoring/Improving the hydrological regime	H	+1	9.486km^2	On HB	**7110/7120/7150**
4.2	Restoring/Improving	H	+1	3 peat dams	Adjacent to	**7110/7120/7150**

the hydrological regime	HB

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 (some of them blocked).

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

[3] This figure is estimated and represents the extent of trees across entire high bog

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

Peat cutting

Peat cutting no longer takes place at Raheenmore Bog. However, old face banks and cutover drainage are likely to continue to cause negative impacts on the high bog habitats.

Drainage

High bog drainage

The majority of drains in the high bog have been blocked (see Map 3); only a few short drains remain functional. In addition, the length of functional drains has decreased and the length of reduced functional and non-functional drains has increased in the 2004/5 – 2011 reporting period, as table 6.2 indicates.

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

Table 6.2 High bog drainage summary

Status	**2004/5 (km)** [1]	**2011(km)**	**Change**
NB: functional	0.550	0.268	(-) 0.282
NB: reduced functional	n/a	0.168	(+) 0.168
NB: non- functional	0.084	0.084	(+) 0.084
B: functional	n/a	n/a	n/a
B: reduced functional	9.372	9.393	(+) 0.021
B: non- functional	n/a	0.093	(+) 0.093

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

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

Table 6.3 below provides a more detail description of the drainage present on the high bog at Raheenmore including any change in their functionality in the 2004/5 – 2011 reporting period (see Map 3).

Table 6.3 High bog drainage detail

Drain Name	Length (km)	2004/5 status	2011 status	Change	Comment
dA	0.382	NB: functional	NB: functional	No	Water likely to flow as bare peat present
dB	0.168	NB: functional	NB: reduced functional	Yes	Infilling taking place
dC	0.084	NB: non-functional	NB: non- functional	No	
dD	8.139	B: reduced functional	B: reduced functional	No	Infilling taking place, some of them may not be functional
dE	1.140	B: reduced functional	B: reduced functional	No	Infilling taking place
dE	0.093	B: reduced functional	B: non- functional	Yes	Completely in-filled

Bog margin drainage

The cutover areas were not surveyed for drains during 2011.

According to Kelly (1993) Raheenmore Bog is surrounded almost completely by a very deep drain (up to 4m in places). Most of the drainage discharges through three large drains, two of which flow to the north, and one to the south-west. This was mostly part of a drainage scheme in the area (Boyne Arterial Drainage Scheme dug in 1981). Other peripheral drains were opened by local landowners. These water-courses mainly drain the narrow zone within the cutover areas. The deepest sections (2.5-4m) are found along the northern and eastern sides of the site. Hydrological monitoring at the site over five years prior to the Kelly survey in 1992, show that this drain was affecting the hydrology of the bog and causing subsidence in the marginal areas. During 1992 a marginal area to the west was reclaimed, with the clearing of scrub and the digging of drains.

Cross (1990) stated that arterial drainage directed at improving agricultural land has unintentionally affected Raheenmore bog, where cutting was relatively insignificant.

According to Cross (1990), no actions were carried out to halt this water loss and it continues to be a threat to the high bog habitat's integrity.

In addition drain maintenance have taken place within SAC (approx. 2007), in the southeast of the site (southwest of dam1). This involved the installation of new shallow shores in the field and cleaning surrounding drains, according to NPWS regional staff (Malone pers. comm., 2012).

Bog margin drainage is considered to have a high importance/impact on high bog habitats and is the main impacting activity negatively affecting these habitats. No restoration works have taken place in the 2004/5 – 2011 reporting period to mitigate or reverse the negative impact from this drainage system.

Fire history

No evidence of fire events taken place in 2004/5 – 2011 period were noted in the 2011 survey. Latest recorded fire event took place along the north-eastern section of the high bog prior to 1992.

Problematic native species

Occasionally *Betula pubescens* and *Pinus sylvestris* seedlings and saplings (1-2 m) are seen along the southern margin of the high bog (GR 243896/231682). Scattered *P. sylvestris* are also seen at the northeast of the high bog in the blocked drain section (drain dD).

Problematic native species are assessed as having a low importance/impact in all high bog habitats.

Afforestation and forestry management

No forestry plantations are present on the cutover land adjacent to Raheenmore Bog.

Other impacting activities

No other activities negatively impacting high bog vegetation at Raheenmore Bog were noted during the 2011 survey.

Conservation activities

A Raised Bog Restoration Project commenced in 1994 and ran up to the end of 1999. This project was assisted by the EU Cohesion Fund. Both Clara and Raheenmore Bogs were included in the programme. Conservation works on Raheenmore involved the blocking of drains (drains dE and dD in 1994/5), construction of dams (dam complexes 1, 2 and 3) and research and monitoring activities (see Map 3).

Fernandez *et al*. (2005) reported the minimum impact on the high bog hydrology conditions from drain network dD. Infilling process have continued on blocked drains dE and dD, as described in section 6.2.1 above.

Dams 1 and 3 failed after a period of time as reported in Fernandez *et al.* (2005). Evidence of water running (i.e. bare peat and erosion channels) towards dam 1 were noted during the 2011 survey. The high bog remains very wet and active peat forming vegetation has developed towards dams 1 and 3, as a result of the considerable amount of water running off the high bog. The construction of dam 2 has had considerable positive effects, such as the development of active peat forming vegetation on the area immediately adjacent to the open water pond on the high bog since the 2004 survey (see F1 in Map 1).

Both high bog drainage blocking and construction of dams on the cutover are reported as positive management actions under Restoring/Improving the hydrological regime (4.2) within table 6.1.

Conservation status assessment

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

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

STRUCTURE & FUNCTION - comparison of central ecotope and active flush area (i.e. the higher quality wetter vegetation communities) for Active Raised Bog, and marginal and face

bank ecotope area (i.e. the lower quality and drier vegetation communities) for Degraded Raised Bog against favourable reference values to assess their status and changes in their area in the reporting period to assess their trend. Community complex descriptions were also taken into account to evaluate changes in ecotope quality together with an analysis of the indicators recorded in the quadrats.

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

Active Raised Bog (7110)

Area

Table 8.1 indicates that there has been a slight increase (0.81ha) in the area of Active Raised Bog. The increase of area has taken place at **F1** (0.41ha), and at the south-eastern and western sections of **Sc1** towards dams 1 and 3 (approx. 0.4ha) (see table 8.2).

Two new habitat sections not previously recorded (**Sc3** & **Sc4**), which the overall area is 0.51ha have been also reported. These sections are the result of a more accurate survey rather than any actual change. A more comprehensive surveying and accurate mapping in 2011 has also resulted in changes in the boundary of **Sc1** and **Sc2** (see Map1).

The favourable reference value (FRV) for Area is considered to be the sum of Active Raised Bog (central, sub-central ecotopes and active flush) plus sub-marginal ecotope when the Habitats Directive came into force in 1994 (see table 8.4). Therefore, Active Raised Bog Area FRV is 119.12ha (based on 1992 Kelly (1993) 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 (52.31ha) is 56.09% below the FRV. A current Area value more than 15% below FRV falls into the **Unfavourable Bad** assessment category.

Active Raised Bog would not reach a favourable assessment until its Area reaches the FRV. The current characteristics of the high bog at Raheenmore (i.e. steep slopes caused by peat cutting and drainage) make the development of the targeted Active Raised Bog FRV on the high bog difficult. Thus, cutover and particularly the southern cutover, should also be taken into account to develop Active Raised Bog at the site.

Although a long term (19 years; 1992-2011) trend indicates a reduction in the area of Active Raised Bog at the site (8.18ha) (see table 8.1). A more recent and short term trend analysis (7 years; 2004-2011) gives a more optimistic result with a 0.81ha (1.57%) increase of Active Raised Bog. Therefore, the habitat Area is given an **Increasing** trend assessment.

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

Structure & Functions

The FRV for S&Fs is for at least half of the active raised bog area to be made up of central and active flush, i.e. the higher quality wetter vegetation communities. This value is 26.16ha (half of 52.31ha, the current area of Active Raised Bog). The current value is 1.68ha which is 93.58% below the FRV. A current value more than 25% below FRV falls into the Unfavourable Bad assessment category.

Although a long term (19 years; 1992-2011) trend indicates a reduction in the area of central ecotope and active flush at the site (14.08ha) (see table 8.1). A more recent and short term trend analysis (7 years; 2004-2011) shows a 0.41ha (113.88%) increase on active flush area. Therefore, S&Fs are given an **Improving** trend assessment.

Quadrats analysis (**Qsc1** &**Qsc2**) indicates the following:

Qsc1: a reduction of the cover of pools and the absence of *Sphagnum cuspidatum*, as well as an increase of lawn cover and overall *Sphagnum* cover. These changes may be the result of lack of precision in relocating of the quadrat (up to 2m) between both year surveys, rather than actual change.

Qsc2: a slight variation of quadrat data: an increase of overall *Sphagnum* cover and particularly hummocks, and decrease of lawn cover. This could be the result of lack of precision in relocating of the quadrat, rather than actual change.

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

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

Future Prospects

Although the Area of Active Raised Bog has slightly increased and its S&Fs also slightly improved (new active flush developed). Both parameters are considerably below FRVs. In addition, the expansion of sub-central ecotope within Sc1 is associated with a high amount of water running off towards failed dams 1 and 3. Cutover drainage continues to pose a threat to the habitat and therefore hindering the achievement of FRVs. Thus, not further increases in habitat Area or improvement on S&Fs are expected.

Habitat **Area** is currently 56.09% below FRV (see table 8.4) and a Stable trend is foreseen. The habitat Area is expected to be more than 15% below FRV in the following two reporting periods (12 years). Thus, habitat's **Area Future Prospects** are assessed as **Unfavourable Bad-Stable**. Habitat's **S&Fs** are currently 93.58% 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).

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

Table 8.1 Changes in Active Raised Bog area

Active Ecotopes	1992 [1]	2004 [2]	2004 (amended)	2011	Change (2004-2011)	
	Area (ha)	Area (ha)	Area (ha)	Area (ha)	Area (ha)	%
Central	15.76	0.85	0.91	0.91	0.00	0.00
Sub-central	44.73	51.00	50.23	50.63	(+)0.40	(+)0.80
Active flush	0.00	0.00	0.36	0.77	(+)0.41	(+)113.88
Total	**60.49**	**51.85**	**51.50**	**52.31**	**(+)0.81**	**(+)1.57**

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

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

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

Table 8.2 Assessment of changes in individual Active Raised Bog areas

Area	Quadrats	Trend	Comment	Quadrats analysis
C1	Qc1	Stable	Very similar area to 2004. No major changes of vegetation description.	Qc1 – New 2011 quadrat
Sc1	Qsc1	Expanding	Slight changes along this section boundary as a result of more accurate mapping in the 2011 survey. Likely to be getting wetter towards dams 1 and 3, as the expansion of sub-central ecotope towards these dams illustrates (see map1). South-eastern section of SC1 (E 243952-N 232052) contains patches of sub-marginal ecotope (complex 9/7/6).	Qsc1– Reduction in algae hollows; no pools present, but increase of lawn cover; *S. cuspidatum* not recorded in 2011; higher overall *Sphagnum* cover. The *Sphagnum* cover given in 2004 for Qsc1, very low compared to the actual complex description. The quadrat has been classified into a different complex; this is likely to be the result of re-allocating this area to a different vegetation ecotope in 2011, rather than any actual change. Qsc3,Qsc4 – New 2011 quadrat
Sc2	Qsc2	Stable	This section was considered to be previously part of the larger sub-central ecotope area (current Sc1). Thus any ecotope map changes here are due to more accurate mapping in the 2011 survey, which has resulted in an improved ecotope boundary.	Qsc2 – Very similar description, only an increase in overall *Sphagnum* cover, particularly hummocks, and a decrease of lawn cover. The quadrat has been classified into a different complex; this is likely to be the result of re-allocating this area to a different vegetation ecotope in 2011, rather than any actual change.
Sc3	None	Unknown	This specific area was not surveyed in 2004. Thus any ecotope map changes	

			here are due to more accurate mapping in the 2011 survey.	
Sc4	None	Unknown	This specific area was not surveyed in 2004. Thus any ecotope map changes here are due to more accurate mapping in the 2011 survey.	
F1	None	Newly developed	Re-wetting has taken place in this location as a result of the construction of dam 2. The comparison of 2004/5 and 2011 aerial photographs indicate that open water pond adjacent to dam is infilling.	
F2	None	Stable	This active flush was mapped as sub-central ecotope (complex 9/6/7) in 2004. The active peat forming section is smaller than in 2004. This is likely to be the result of re-allocating this area to a different vegetation ecotope in 2011. Complex 9/6/7 featured low *Sphagnum* cover in 2004 is currently mostly considered sub-marginal ecotope.	
F3	None	Stable	This active flush was mapped as sub-central ecotope (complex 9/7) in 2004. The flush is now considered to correspond more with active flush rather than sub-central ecotope.	

Degraded Raised Bog (7120)

Area

The Degraded Raised Bog FRV for Area is 11.42ha at Raheenmore Bog. This value corresponds with the difference between the current high bog area (130.55ha) and Active Raised Bog FRV (119.12ha) 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 585.03% bigger than FRV and therefore the habitat Area is given an **Unfavourable Bad** assessment (see table 8.4).

Table 8.3 indicates that there has been a decrease (0.81ha) in the Area of Degraded Raised Bog. The decrease is the result of expansion of Active Raised Bog (see table 8.2). Therefore the habitat is given a **Decreasing** trend due to the decrease of its area. However, this should be taken as positive.

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

Structure & Functions

The FRV for S&Fs is for a maximum 25% of the Degraded Raised Bog area to be made up of marginal and face bank, i.e. the lower quality and drier vegetation communities. This value is 19.56ha (25% of 78.32ha, the current area of Degraded Raised Bog). The current marginal and face bank ecotopes area value (15.24ha) is below FRV (in the particular case of Degraded Raised Bog a current area value equal or smaller than FRV is desirable) (see Table 8.4). Thus S&Fs are assessed as **Favourable**.

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). As table 8.4 indicates, there has not been any change of its area in the reporting period. Thus, the DRB's S&Fs at Raheenmore are given a **Stable** trend.

The mapping of boundary between marginal and sub marginal is difficult and decreases/increases are only recorded where major changes in the vegetation are evident. Therefore, where no changes are shown, more subtle effects cannot be ruled out, and therefore positive changes (i.e. decrease in marginal ecotope due to rewetting) may have been underestimated. In addition, Fernandez *et al*. (2005) reported improvement on the habitat quality on those sections where drains where blocked and particularly drains dD. This trend has continued in the latest reporting period (2004 – 2011) with infilling continuing to take place.

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

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

Future Prospects

Degraded Raised Bog is not significantly threatened at Raheenmore Bog. However, further decrease in habitat Area or improvements on it S&Fs are not expected in the following two reporting periods (12 years) unless further restoration works are undertaken.

Habitat **Area** is currently 585.03% above FRV (see table 8.4) and a Stable trend is expected in the following two reporting periods. 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 22.08% below FRV (see table 8.4). A Stable trend is foreseen in the following two reporting periods, **S&Fs** are expected to remain below FRV. Thus, habitat's **S&Fs Future Prospects** are assessed as **Favourable-Stable**.

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

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

Table 8.3 Changes in Degraded Raised Bog area

Inactive Ecotopes	**1992** [1]	**2004** [2]	**2004 (amended)**	**2011**	**Change (2004-2011)**	
	Area (ha)	Area (ha)	Area (ha)	Area (ha)	Area (ha)	%
Sub-marginal	58.63	64.23	63.52	62.71	(-)0.81	(-)1.28
Marginal	8.90	9.53	12.59	12.59	0.00	0.00
Face bank	4.2	4.66	2.65	2.65	0.00	0.00
Inactive flush	0.00	0.00	0.02	0.02	0.00	0.00
Open water	0.00	0.26	0.26	0.26	0.00	0.00
Total	**71.73**	**78.68**	**79.04**	**78.23**	**(-)0.81**	**(-)1.02**

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

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

Note: Table 8.3 includes 2004 figures and 2004 amended figures. The latter shows the ecotope area believed to be present in 2004 after surveying improvements in 2011. The comparison between 2004 (amended) and 2011 illustrates the actual changes in ecotope area in the 2004-2011 period. Any change in ecotope area between the 2004 and the 2004

(amended) values is due to improvement in mapping accuracy and/or the result of a more comprehensive survey in 2011.

Depressions on peat substrates of the Rhynchosporion (7150)

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

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

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

The habitat's Area Future Prospects status is equally based on the Active Raised Bog Area Future Prospects status assessment and the Area Future Prospects trend is based on the trend expected for Active Raised Bog and sub-marginal ecotope in the following two reporting periods. Active and Degraded Raised Bog are not under significant threat from impacting activities and the prospects for its future are Stable. 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. Nevertheless the improvement in Active Raised Bog habitat quality is due to the development of a new active flush (F1), where *Rhynchospora alba* is not frequently found. 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 Raheenmore Bog is assessed as Unfavourable Bad-Stable (see table 8.5).

Table 8.4 Habitats favourable reference values

Habitat	Area Assessment			Structure & Functions Assessment		
	FRV Target (ha) [1]	2011 value (ha) [2]	% below target	FRV 2011 Target (ha) [3]	2011 value (ha) [4]	% below target
7110	119.12	52.31	56.09	26.16	1.68	93.58

[1] 1992 central, sub-central, active flush, bog woodland and sub-marginal ecotope area.

[2] 2011 central, sub-central ecotope, active flush and bog woodland area.

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

[4] 2011 central ecotope and active flush area.

	FRV Target (ha) [5]	2011 value (ha) [6]	% above target	FRV 2011 Target (ha) [7]	2011 value (ha) [8]	% below target
7120	11.42	78.32	585.03	19.56	15.24	22.08

[5] 1992 high bog area minus 7110 area FRV.

[6] 2011 Degraded Raised Bog area.

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

[8] Current marginal and face bank ecotopes area.

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

- **Active Raised Bog is assessed as being Unfavourable Bad–Improving.**
- **Degraded Raised Bog is assessed as being Unfavourable Bad–Improving,** despite the decrease in habitat area as this is due to restoration to Active Raised Bog and is considered to be a positive development.
- **Rhynchosporion depressions is assessed as being Unfavourable Bad–Stable.**

Table 8.5 Habitats conservation status assessments

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

Conclusions

Summary of impacting activities

There have not been major changes in the intensity or influence of impacting activities:

- Peat cutting is no longer present at the site. However, open face banks may still continue to drain the high bog.
- Only a few drains on the high bog remain functional (drain A at the edge of the high bog near dam 3). Overall high bog drains have continued to infill.
- Cutover drainage (peripheral drainage) continues to be the highest impacting activity on high bog vegetation (see Fernandez *et al*. 2005 for further detail).
- No fire events have damaged the high bog in the reporting period.
- Scots pine (*Pinus sylvestris*) although present do not seem to have spread in the reporting period and are not considered a major threat.

Changes in active peat forming areas

- Three new peat forming areas (**Sc2**, **Sc3** and **Sc4**) have been described at the site (see table 8.2). These new sub-central ecotope areas are likely to be the result of improvements of mapping accuracy rather than actual changes in Active Raised Bog.
- Active Raised Bog seems to have continued to expand towards dams 1 and 3, as a result of water running off towards the failed dams.
- A new active peat forming flush (**F1**) has developed around dam 2 to the north of the bog.

Other changes

The new ecotope map (Map 1) shows a new inactive flush (F4). This flush is the results of an increase of mapping accuracy rather than an actual change.

Quadrats analysis

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

Restoration works

- Restoration works (blocking of high bog drainage and peat dams construction) continue to have a positive effect on the high bog vegetation. Infilling processes continue in the blocked drains and dam 2 has triggered the formation of a new peat forming area (flush **F1**).
- Dams 1 and 3 failed in the past (see Fernandez *et al*. 2005), and although Active Raised Bog vegetation has expanded towards the edge of the high bog at these dams, this may not necessary indicate a positive trend, as this active peat forming vegetation may be the result of a considerable amount of water running off towards the failed dams rather than an indication that the dams are working efficiently. Nevertheless, these failed dams are likely to have reduced water loss.

Summary of conservation status

- **Active Raised Bog** has been given an overall **Unfavourable Bad-Improving** conservation status at Raheenmore Bog. Habitat Area has slightly increased and quality (S&Fs) improved in the reporting period, however both values are below the FRVs. Future Prospects are considered Unfavourable Bad-Stable as cutover drainage continues to hinder the restoration of active peat forming communities and thus the habitat is not expected to reach FRV in the following two reporting periods.
- **Degraded Raised Bog** has been given an overall **Unfavourable Bad-Improving** conservation status at Raheenmore Bog. Habitat Area has slightly decreased due to an increase of Active raised Bog and quality (S&Fs) has not changed in the reporting period. Habitat Area is above the FRV. Future Prospects are considered Unfavourable Bad-Stable as the habitat is not expected to reach FRV in the following two reporting periods.
- **Depressions on** peat s**ubstrates of the Rhynchosporion** has been given an overall **Unfavourable Bad-Stable** conservation status at Raheenmore Bog. Habitat Area and quality (S&Fs) are considered to have increased and improved in the reporting period. Future Prospects are considered Favourable as there has been no further drying of the high bog.

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

Recommendations

- **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** both on the high bog and cutover in order to assess the effectiveness of restoration works.
- **An Impact assessment** of maintenance works on adjacent land drainage with a view to the potential of blocking these drains.

References

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

Appendix I Detailed vegetation description of the high bog

Active Raised Bog (7110)

Central Ecotope Complexes

COMPLEX 10/15

- **Location**: this complex was found at the centre of the bog and dominates **C1**.
- **Ground**: quaking
- **Physical indicators:** absent
- ***Calluna* height:** <30cm
- ***Cladonia* cover:** <5%
- **Macro-topography:** depression
- **Pools**: regular pools <5%
- ***Sphagnum* cover:** 60-70%
- ***Narthecium* cover:** <5%
- **Micro- topography**: lawns/ hummocks/pools
- **Tussocks**: absent
- **Degradation or regeneration evidence:** absent
- **Species cover**: Calluna vulgaris (10-20%), *Erica tetralix* (5%), *Eriophorum vaginatum* (10-20%), *E. angustifolium* (<5%), *Rhynchospora alba* (10-20%), *Drosera rotundifolia* (<1%), *D. anglica* (<1%), *Andromeda polifolia* (<1%), *Sphagnum capillifolium* (10-20%), *S. papillosum* (10-20%), *S. magellanicum* (10-20%), *S. cuspidatum* (4-10%), *S. fuscum* (<1%), *S. austinii* (<1%).
- **Additional comments**: this area was classified as complex 14 (central ecotope) in 2004, now is considered to be complex 10/15. However, no actual changes seem to have taken place and this is the result of vegetation reclassification.

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

Sub-Central Ecotope Complexes

COMPLEX 10/9

- **Location**: this complex was found along the northwest section of **Sc1**.
- **Ground**: very soft

- **Physical indicators:** absent
- ***Calluna* height:** <30cm
- ***Cladonia* cover:** <5%
- **Macro-topography:** flat
- **Pools**: interconnected pools 10-20%
- ***Sphagnum* cover:** 50-60%
- ***Narthecium* cover:** <5%
- **Micro- topography**: tall hummocks/lawns/pools/hollows
- **Tussocks**: absent
- **Degradation or regeneration evidence:** absent
- **Species cover**: *Calluna vulgaris* (20-30%), *Erica tetralix* (2%), Eriophorum vaginatum (10-20%), *E. angustifolium* (2%), *Rhynchospora alba* (<10%), Narthecium ossifragum (<5%), *Drosera rotundifolia* (<1%), *D. anglica* (<1%), *Sphagnum magellanicum* (20%), *S capillifolium*(10-20%), *S. papillosum* (10-20%), *S. subnitens* (<5%), *S. cuspidatum* (<5%), *S. fuscum* (<1%), *S. austinii* (<1%).
- **Additional comments**: This complex features central ecotope characteristics (e.g. presence of *Menyanthes trifoliata* and *Sphagnum* dominated pool) at (GR: 243594/232220).

COMPLEX 9/10

- **Location**: this complex was found along the north and south section of **Sc1**, as well as, within **Sc3**.
- **Ground**: very soft
- **Physical indicators:** absent
- ***Calluna* height:** 20-30cm
- ***Cladonia* cover:** <5%
- **Macro-topography:** flat
- **Pools**: regular pools <5%
- ***Sphagnum* cover:** 50-60%
- ***Narthecium* cover:** <5%
- **Micro- topography**: low hummocks/lawns/pools
- **Tussocks**: *Trichophorum germanicum* <2%
- **Degradation or regeneration evidence:** absent
- **Species cover**: *Calluna vulgaris* (10-20%), *Erica tetralix* (<2%), *Eriophorum vaginatum* (20-30%), *E. angustifolium* (<5%), *Narthecium ossifragum* (<5%), *Trichophorum germanicum* (<2%), *Drosera*

rotundifolia (<1%), *D. anglica* (<1%), *Vaccinium oxycoccos* (<1%), *Sphagnum capillifolium* (20-30%), *S. papillosum* (10-20%), *S. magellanicum* (10-20%), *S. cuspidatum* (<5%).

- **Additional comments**: where *Eriophorum angustifolium* becomes dominant complex is named 9a/10. This variant is found along the north-western and south-western section of **Sc1** and dominating **Sc4**.

COMPLEX 10/4

- **Location**: this complex was found along the northern section of **Sc1**, as well as, to the west of **C1**.
- **Ground**: very soft
- **Physical indicators**: bare peat present in places (<5%)
- ***Calluna* height:** 20-30cm
- ***Cladonia* cover:** <5%
- **Macro-topography:** depression
- **Pools**: absent
- ***Sphagnum* cover:** 40-50%
- ***Narthecium* cover:** <5%
- **Micro- topography**: low hummocks/lawns/hollows
- **Tussocks**: absent
- **Degradation or regeneration evidence:** absent
- **Species cover**: *Calluna vulgaris* (10-20%), *Erica tetralix* (2%), *Eriophorum vaginatum* (5-10%), E. angustifolium (<2%), *Rhynchospora alba* (10-20%), *Narthecium ossifragum* (<5%), *Drosera rotundifolia* (<1%), *D. anglica* (<1%), *Vaccinium oxycoccos* (<1%), *Andromeda polifolia* (<1%), *Sphagnum capillifolium*(10-20%), *S. papillosum* (10-20%), *S. magellanicum* (10%), *S. fuscum* (<1%), *S. austinii* (<1%).
- **Additional comments**: quadrats **Qsc1** and **Qsc3** were recorded within this complex.

COMPLEX 9/7/10

- **Location**: this is the most widespread sub-central complex found on Raheenmore Bog. It covers large section of **Sc1**, **Sc2** and **Sc3.**
- **Ground**: soft
- **Physical indicators:** absent
- ***Calluna* height:** 40cm
- ***Cladonia* cover**: very variable (0-40%)
- **Macro-topography:** flat

- **Pools**: mostly absent but regular pools <5% in places
- ***Sphagnum* cover:** >50%
- ***Narthecium* cover:** <5%
- **Micro- topography**: low hummocks/hollows
- **Tussocks**: *Trichophorum germanicum* <2%
- **Degradation or regeneration evidence:** absent
- **Species cover**: *Calluna vulgaris* (20-30%), *Erica tetralix* (5%), *Eriophorum vaginatum* (20-30%), *E. angustifolium* (<10%), *Rhynchospora alba* (<5%), *Narthecium ossifragum* (<5%), *Trichophorum germanicum* (<2%), *Drosera rotundifolia* (<1%), *Andromeda polifolia* (<1%), *Sphagnum capillifolium*(20-30%), *S. papillosum* (10-20%), *S. magellanicum* (10-20%), *S. tenellum* (<5%), *S. subnitens* (<5%), *S. cuspidatum* (<5%).
- **Additional comments:** quadrats **Qsc2** and **Qsc4** were recorded within this complex.

Active Flushes

FLUSH 1 (F1)

- **Location**: northeast section near dam 2
- **Ground**: very soft
- **Physical indicators:** absent
- ***Calluna* height:** 30cm
- ***Cladonia* cover:** absent
- **Macro-topography:** flat
- **Pools**: interconnected pools near open water in dam 2
- ***Sphagnum* cover:** 70%
- ***Narthecium* cover:** <5%
- **Micro- topography**: low hummocks/lawns
- **Tussocks**: *Eriophorum vaginatum* (40-50%)
- **Degradation or regeneration evidence**: regeneration associated with dam construction
- **Species cover**: *Calluna vulgaris* (10%), *Erica tetralix* (5%), *Eriophorum vaginatum* (40-50%), *Eriophorum angustifolium* (2%), *Molinia caerulea* (1%), *Narthecium ossifragum* (<5%), *Andromeda polifolia* (<1%), *Sphagnum magellanicum* (20-30%), *S. papillosum* (10-20%), *S. capillifolium* (10-20%), *S. cuspidatum* (10-20%).
- **Additional comments**: active peat forming flush. Re-wetting is likely to be taking place in this location as a result of the construction of dam 2.

FLUSH 2 (F2)

- **Location**: northeast along axes of a set of drains within dD complex
- **Ground**: soft
- **Physical indicators:** absent
- ***Calluna* height:** 40-50cm
- ***Cladonia* cover:** <5%
- **Macro-topography:** gentle slope
- **Pools**: only within old drain
- ***Sphagnum* cover:** 70-80%
- ***Narthecium* cover:** absent
- **Micro- topography**: low *Sphagnum* hummocks/*Sphagnum* lawns
- **Tussocks**: *Eriophorum vaginatum* (40-50%)
- **Degradation or regeneration evidence:** absent
- **Species cover**: *Calluna vulgaris* (10-20%), *Erica tetralix* (5%), *Eriophorum vaginatum* (40-50%), Vaccinium *oxycoccos* (<1%), *Andromeda polifolia* (<1%), *Sphagnum magellanicum* (30-40%), *S. capillifolium* (20-30%), *S. papillosum* (<10%), *S. subnitens* (<5%), *Polytrichum strictum* (<1%), *Hypnum jutlandicum* (<1%), *Aulacomnium palustre* (<1%), *Pinus sylvestris* (1 individual <1.5m tall), *Betula pubescens* (2 individual <3m tall).
- **Additional comments**: active peat forming flush. **F2** was mapped as sub-central ecotope (complex 9/6/7) in 2004. However it has been re-allocated to a different vegetation ecotope in 2011. This flush is much smaller than mapped in 2004 as a result of increase in mapping accuracy and vegetation reclassification (i.e. area to NWS of flush previously mapped as 9/6/7 (sub-central complex) is deemed to be 9/7, sub-marginal rather than sub-central ecotope.

FLUSH 3 (F3)

- **Location**: southern section
- **Ground**: very soft but firm in some sections
- **Physical indicators:** absent
- ***Calluna* height:** 75cm
- ***Cladonia* cover:** 5-10%
- **Macro-topography:** gentle slope
- **Pools**: absent
- ***Sphagnum* cover:** 40-50%
- ***Narthecium* cover:** absent

- **Micro- topography**: large *Sphagnum* hummocks/tall *Calluna vulgaris* hummocks/hollows
- **Tussocks**: absent
- **Degradation or regeneration evidence:** absent
- **Species cover**: *Calluna vulgaris (70%), Erica tetralix (5%), Eriophorum vaginatum (20%), E. angustifolium* (2%), *Vaccinium oxycoccos* (<1%), *Andromeda polifolia* (<1%), *Empetrum nigrum* (<1%), *Sphagnum capillifolium* (20-30%), *S. papillosum* (<10%), *S. magellanicum* (<5%), *Leucobryum glaucum* (<1%), *Polytrichum strictum* (<1%), *Hypnum jutlandicum* (<1%), *Aulacomnium palustre* (<1%), Hylocomium splendens (<1%).
- **Additional comments**: active peat forming flush. **F3** was mapped as sub-central ecotope (complex 9/7) in 2004. However it has been re-allocated to a different vegetation ecotope in 2011.

Degraded Raised Bog (7120)

Sub-Marginal Ecotope Complexes

COMPLEX 9/7

- **Location**: this is the most widespread sub-marginal complex found on Raheenmore Bog.
- **Ground**: soft
- **Physical indicators:** absent
- ***Calluna* height:** 40cm
- ***Cladonia* cover:** 5-20%
- **Macro-topography**: gentle slope towards margin
- **Pools**: absent
- ***Sphagnum* cover:** 30-40%
- ***Narthecium* cover:** <5%
- **Micro- topography**: low hummocks/hollows
- **Tussocks**: *Trichophorum germanicum* <5% more frequent towards margin
- **Degradation or regeneration evidence:** absent
- **Species cover**: *Calluna vulgaris* (20%), *Erica tetralix* (5%), *Eriophorum vaginatum* (10-20%), *E. angustifolium* (<1%), *Rhynchospora alba* (<1%), *Narthecium ossifragum* (<5%), *Trichophorum germanicum* (<5%), *Drosera rotundifolia* (<1%), *Sphagnum capillifolium* (10-20%), *S. papillosum* (<10%), *S. tenellum* (<5%), *S. subnitens* (<5%), *S. magellanicum* (<5%), *S. fuscum* (<1%), *Leucobryum glaucum* (<1%).

- **Additional comments**: area of blocked drains dD *Calluna vulgaris* becomes taller (50cm) and more dominant (50%). *Drosera anglica* is found in *S. magellanicum* lawns in blocked drains.
  Where *Narthecium ossifragum* increases to 10-20% complex is named 9/7/6. Where *Rhynchospora alba* cover increases to 10-20% complex is named 9/7/6/4. This later complex is slightly wetter than 9/7 or 9/7/6. *Carex panicea* covers 20-30% of the ground in places and them complex is named 9/7/3.

COMPLEX 9/7/2

- **Location**: this complex was found along the northern section of the bog near dam 2.
- **Ground**: soft
- **Physical indicators:** bare peat 5%
- ***Calluna* height:** 30-40cm
- ***Cladonia* cover:** absent
- **Macro-topography**: gentle slope towards margin
- **Pools**: absent
- ***Sphagnum* cover:** 30-40%
- ***Narthecium* cover:** <5%
- **Micro- topography**: low hummocks/flats/hollows
- **Tussocks**: *Trichophorum germanicum* 5-10%
- **Degradation or regeneration evidence**: regeneration evidence (*Sphagnum* lawns in places)
- **Species cover**: *Calluna vulgaris* (10-20%), *Erica tetralix* (2%), *Eriophorum vaginatum* (10-20%), *Narthecium ossifragum* (<5%), *Rhynchospora alba* (5%), *Trichophorum germanicum* (5-10%), *Sphagnum capillifolium* (10-20%), S. *magellanicum* (5-10%), *S. tenellum* (<5%), *S. cuspidatum* (<5%), *S. subnitens* (<5%).
- **Additional comments:** no comments

COMPLEX 7/6

- **Location**: this complex was found along the eastern section of Raheenmore Bog and dominates the vegetation within drain network dD.
- **Ground**: soft
- **Physical indicators:** bare peat 2%
- ***Calluna* height:** <40cm
- ***Cladonia* cover:** 5-10%
- **Macro-topography**: gentle slope towards margin

- **Pools**: absent
- ***Sphagnum* cover:** 10-20%
- ***Narthecium* cover:** 10-20%
- **Micro- topography**: low hummocks/hollows
- **Tussocks**: *Trichophorum germanicum* <5%
- **Degradation or regeneration evidence:** absent
- **Species cover**: *Calluna vulgaris* (20-30%), *Erica tetralix* (5%), Eriophorum vaginatum (<5%), *E. angustifolium* (2%), *Rhynchospora alba* (<1%), *Narthecium ossifragum* (20-30%),*Trichophorum germanicum* (<5%), *Drosera rotundifolia* (<1%), *Sphagnum capillifolium*(10%), *S. papillosum* (<10%), *S. subnitens* (<5%), *Leucobryum glaucum* (<1%), *Dicranum scoparium* (<1%).
- **Additional comments:** no comments

COMPLEX 6/9

- **Location**: this complex was found along the northern and southern section of the bog adjacent to marginal ecotope.
- **Ground**: soft
- **Physical indicators:** bare peat <5%
- ***Calluna* height:** <30cm
- ***Cladonia* cover:** 10-20%
- **Macro-topography:** gentle slope
- **Pools**: absent
- ***Sphagnum* cover:** 10-20%
- ***Narthecium* cover:** 20-30%
- **Micro- topography**: flats/ low hummocks/hollows
- **Tussocks**: *Trichophorum germanicum* <2%
- **Degradation or regeneration evidence:** absent
- **Species cover**: *Calluna vulgaris* (20-30%), *Erica tetralix* (2%), *Eriophorum vaginatum* (10-20%), *E. angustifolium* (2%), *Narthecium ossifragum* (20-30%), *Trichophorum germanicum* (2%), *Drosera rotundifolia* (<1%), *Andromeda polifolia* (<1%), *Sphagnum capillifolium* (5%), *S. papillosum* (<5%), *S. tenellum* (<5%), *S. subnitens* (<5%), *Leucobryum glaucum* (<1%).
- **Additional comments:** no comments

Marginal Ecotope Complexes

COMPLEX 6/7/2

- **Location**: this complex was found along the southern section of the bog.
- **Ground**: firm
- *Physical indicators:* bare peat <5%
- *Calluna height:* 40cm
- *Cladonia cover:* <5%
- *Macro-topography:* steep slope
- **Pools**: absent
- *Sphagnum cover:* 20-30%
- *Narthecium cover:* 10%
- **Micro- topography**: *Calluna vulgaris* hummocks/flats/ hollows
- **Tussocks**: *Trichophorum germanicum* <5%
- **Degradation or regeneration evidence:** absent
- **Species cover**: *Calluna vulgaris* (20-30%), *Eriophorum vaginatum* (<5%), *Narthecium ossifragum* (20-30%), *Trichophorum germanicum* (<5%), *Drosera rotundifolia* (<1%), *Sphagnum capillifolium* (5%), *S. tenellum* (<5%), *S. subnitens* (<5%), *Leucobryum glaucum* (<1%).
- **Additional comments:** no comments

COMPLEX 7/2

- **Location**: this complex was found along the entire margin of the bog
- **Ground**: firm
- **Physical indicators:** bare peat <5%
- ***Calluna* height:** 30-40cm
- ***Cladonia* cover:** 20-30%
- **Macro-topography:** gentle slope
- **Pools**: absent
- ***Sphagnum* cover:** 10-20%
- ***Narthecium* cover:** 5-10%
- **Micro- topography**: *Calluna vulgaris* hummocks/*Narthecium ossifragum* hollows
- **Tussocks**: *Trichophorum germanicum* 10%
- **Degradation or regeneration evidence:** absent
- **Species cover**: *Calluna vulgaris* (30-40%), *Erica tetralix* (<5%), *Eriophorum vagi*natum (10-20%), *Narthecium ossifragum* (5-10%), *Trichophorum germanicum* (10-20%), *Sphagnum capillifolium* (10-20%), *S. tenellum* (<5%), *S. subnitens* (<5%).

- **Additional comments:** no comments

COMPLEX 7+BP

- **Location**: this complex was mostly found along the northern section of the bog near dam 2.
- **Ground**: firm
- **Physical indicators:** bare peat 20-30%
- ***Calluna* height:** 40cm
- ***Cladonia* cover:** <5%
- **Macro-topography**: steep slope towards margin
- **Pools**: absent
- ***Sphagnum* cover:** <5%
- ***Narthecium* cover:** absent
- **Micro- topography**: *Calluna vulgaris* hummocks/flats with bare peat
- **Tussocks**: absent
- **Degradation or regeneration evidence:** absent
- **Species cover**: *Calluna vulgaris* (20-30%), *Erica tetralix* (<5%), *Eriophorum vaginatum* (10-20%), *Rhynchospora alba* (<5%), *Narthecium ossifragum* (<5%), *Trichophorum germanicum* (5-10%), *Drosera rotundifolia* (<1%), Sphagnum capillifolium(<10%), S. tenellum (<5%), *Hypnum jutlandicum* (<1%), *Campylopus introflexus* (5-20%), *Cladonia floerkeana* (<1%).
- **Additional comments:** no comments

Face bank Complexes

COMPLEX 1

- **Location**: this complex was found along the bog margin
- **Ground**: firm
- **Physical indicators:** absent
- ***Calluna* height:** 75cm
- ***Cladonia* cover:** <5%
- **Macro-topography:** steep slope
- **Pools**: absent
- ***Sphagnum* cover:** <5%
- ***Narthecium* cover:** absent
- **Micro- topography:** absent

- **Tussocks**: absent
- **Degradation or regeneration evidence:** absent
- **Species cover**: *Calluna vulgaris* (<100%), *Hypnum jutlandicum* (<1%), *Hylocomium splendens* (<1%).
- **Additional comments**: this complex was not thoroughly surveyed and was mapped mainly based on the 2010 aerial photographs and previous 2004 survey map

Inactive Flushes

FLUSH 4 (F4)

- **Location**: northeast section of the bog
- **Ground**: soft
- **Physical indicators:** absent
- ***Calluna* height:** 40cm
- ***Cladonia* cover:** <5%
- **Macro-topography:** gentle slope
- **Pools**: absent
- ***Sphagnum* cover:** <10%
- ***Narthecium* cover:** <10%
- **Micro- topography**: *Calluna vulgaris* hummocks
- **Tussocks:** na
- **Degradation or regeneration evidence:** absent
- **Species cover**: *Calluna vulgaris* (40%), *Eriophorum angustifolium* (10-20%), Narthecium ossifragum (<10%), *Pinus sylvestris* (10 individuals 1.5-5m tall), *Betula pubescens* (10 individuals 1.5-4m tall).
- **Additional comments**: inactive flush. F4 was mapped as sub-marginal ecotope in 2004.

Depressions on peat substrates of the Rhynchosporion (7150)

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

R. alba is found in all ecotopes except the face bank in Raheenmore Bog, such as: central ecotope (complex 10/15); sub-central ecotope (10/4; 9/7/10); sub-marginal ecotope (9/7; 9/7/6/4; 9/7/2; 7/6) and marginal ecotope (7+BP).

The species becomes very frequent within complexes 10/4 (central ecotope) and 9/7/6/4 (sub-marginal).

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

Appendix II Photographical records

Photograph Number	Aspect	Type	Feature	Date
102-0400	NW	Overview	Qsc2	03/08/2011
102-0401	SE	Overview	Qsc3	03/08/2011
102-0402	SW	Overview	Qc1	03/08/2011
102-0404	W	Overview	Qsc1	04/08/2011
102-0405	SW	Overview	Qsc4	04/08/2011

Appendix III Quadrats

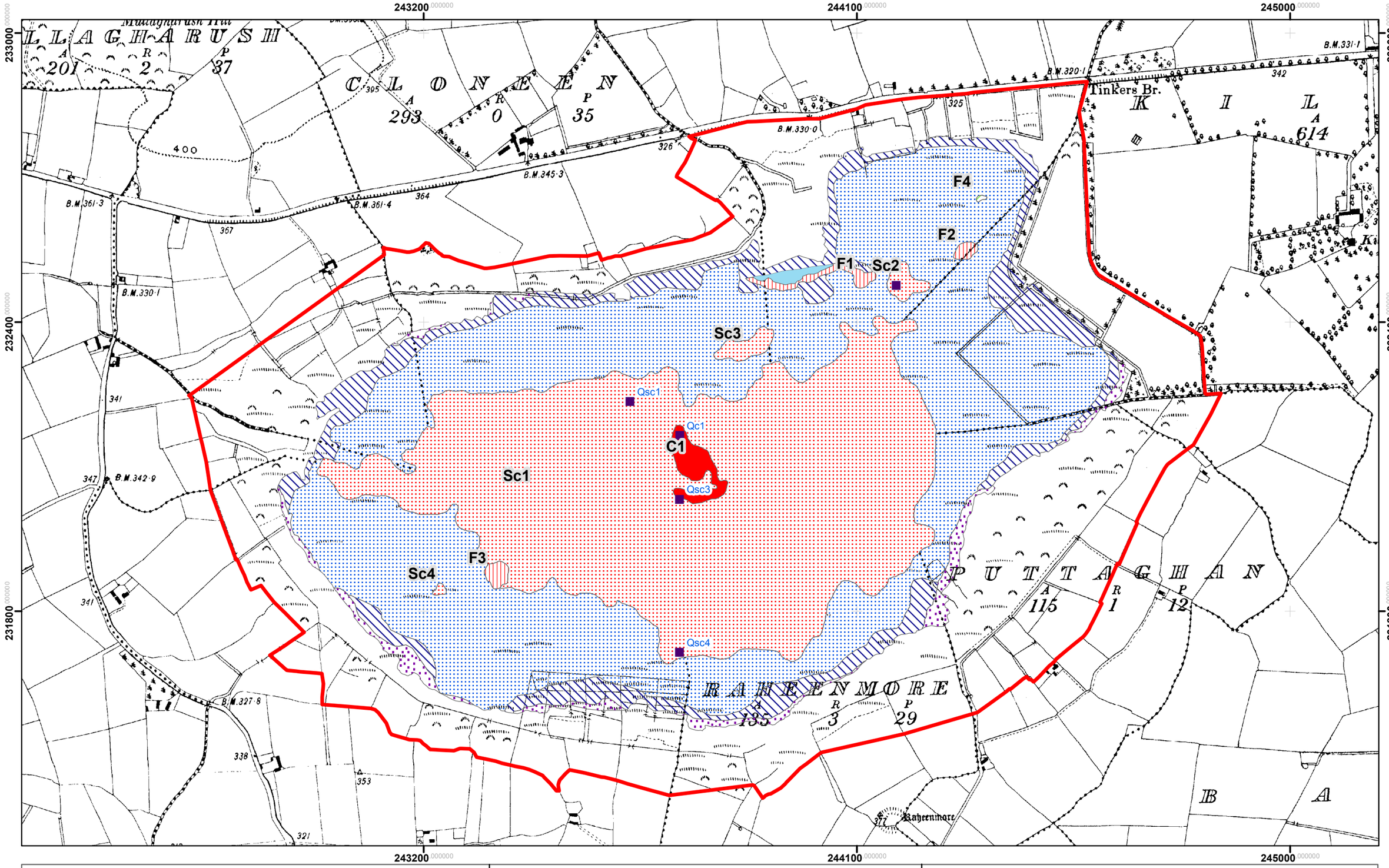
Ecotope type	Sub-central	Sub-central	Sub-central	Sub-central
Complex Name	10/9	10/4	10/9	9/7/10
Quadrat Name	Qsc1	Qsc1	Qsc2	Qsc2
Easting	243619	243628	244175	244181
Northing	232233	232234	232472	232476
Firmness	Very soft	Very soft	Very soft	Soft
Burnt	No	No	No	No
Algae in hollows %	4-10	Absent	Absent	Absent
Algae in pools %	Absent	Absent	Absent	Absent
Bare peat %	Absent	Absent	Absent	Absent
High hummocks %	Absent	Absent	Absent	Absent
Low hummocks %	11-25	26-33	26-33	51-75
Hollows %	4-10	4-10	4-10	4-10
Lawns %	Absent	11-25	11-25	Absent
Pools %	4-10	Absent	Absent	Absent
Pool type	Regular	Absent	Absent	Absent
S.austinii hum type	Absent	Absent	Absent	Absent
S.austinii hum %	Absent	Absent	Absent	Absent
S.austinii height(cm)	Absent	Absent	Absent	Absent
S.fuscum hum type	na	na	Absent	Absent
S.fuscum hum %	4-10	11-25	Absent	Absent
S.fuscum height(cm)	na	11-20	Absent	Absent
Leucobryum glaucum	Absent	Absent	Absent	Present
Trichophorum type	Flats	Absent	Flats	Tussocks
Trichophorum %	4-10	Absent	11-25	4-10
S.magellanicum %	4-10	11-25	11-25	11-25
S.cuspidatum %	4-10	Absent	Absent	Absent
S.papillosum %	4-10	11-25	4-10	4-10
S.denticulatum %	Absent	Absent	Absent	Absent
S.capillifolium %	4-10	na	11-25	26-33

S.tenellum %	na	na	na	na
S.subnitens %	na	na	na	4-10
R.fusca %	Absent	Absent	Absent	Absent
R.alba %	11-25	26-33	Absent	Absent
N.ossifragum %	4-10	4-10	4-10	4-10
Sphag pools %	4-10	11-25	Absent	Absent
Dominant pool Sphag	S.cuspidatum	Absent	Absent	Absent
Sphag lawns %	Absent	11-25	11-25	Absent
Sphag humm %	11-25	26-33	26-33	51-75
Sphag holl %	4-10	4-10	4-10	4-10
Total Sphag %	11-25	51-75	34-50	51-75
Hummocks indicators	S.fuscum	S fuscum&S.austinii	Absent	Absent
Cladonia portent %	4-10	4-10	11-25	4-10
Other Cladonia sp	Absent	Absent	Absent	Absent
C. panicea %	Absent	Absent	Absent	Absent
Calluna cover %	11-25	11-25	26-33	26-33
Calluna height(cm)	21-40	11-20	21-40	21-40
Other NotableSpecies	na	D. anglica,E. angustifolium	na	E. tetralix, A. polifolia
Other comment	Drier	Potentially improved		Miss-classified in 2004 as 10/9.
Date	18/08/2004	04/08/2011	18/08/2004	03/08/2011

Ecotope type	Sub-central	Sub-central	Central
Complex Name	10/4	9/7/10	10/15
Quadrat Name	Qsc3	Qsc4	Qc1
Easting	243731	243731	243731
Northing	232031	231713	232164
Firmness	Very soft	Very soft	Quaking
Burnt	No	No	No
Algae in hollows %	Absent	Absent	Absent
Algae in pools %	Absent	Absent	Absent
Bare peat %	4-10	Absent	Absent
High hummocks %	Absent	Absent	Absent
Low hummocks %	4-10	51-75	4-10
Hollows %	4-10	4-10	Absent
Lawns %	34-50	Absent	51-75
Pools %	Absent	Absent	4-10
Pool type	Absent	Absent	Regular
S.austinii hum type	Absent	Absent	Active
S.austinii hum %	Absent	Absent	4-10
S.austinii height(cm)	Absent	Absent	0-10
S.fuscum hum type	Absent	Absent	Active
S.fuscum hum %	Absent	Absent	4-10
S.fuscum height(cm)	Absent	Absent	0-10
Leucobryum glaucum	Absent	Absent	Absent
Trichophorum type	Absent	Absent	Absent
Trichophorum %	Absent	Absent	Absent
S.magellanicum %	26-33	4-10	26-33
S.cuspidatum %	4-10	Absent	4-10
S.papillosum %	26-33	26-33	26-33
S.denticulatum %	Absent	Absent	Absent
S.capillifolium%	4-10	Na	na
S.tenellum %	na	Na	na
S.subnitens %	4-10	Na	na
R.fusca %	Absent	Absent	Absent

R.alba %	11-25	4-10	4-10
N.ossifragum %	4-10	4-10	4-10
Sphag pools %	Absent	Absent	4-10
Dominant pool Sphag	Absent	Absent	S.cuspidatum
Sphag lawns %	34-50	Absent	51-75
Sphag humm %	4-10	51-75	4-10
Sphag holl %	4-10	4-10	Absent
Total Sphag %	51-75	76-90	76-90
Hummocks indicators	Absent	Absent	S fuscum&S.austinii
Cladonia portent %	4-10	4-10	Absent
Other Cladonia sp	C.uncialis	Absent	Absent
C. panicea %	Absent	Absent	Absent
Calluna cover %	4-10	26-33	11-25
Calluna height(cm)	11-20	21-40	11-20
Other NotableSpecies	D.anglica, V.oxycoccos, E.angustifolium	D.rotundifolia, E.angustifolium	D.anglica, A.polifolia, E.angustifolium,Polytrichum strictum
Other comment			
Date	03/08/2011	04/08/2011	03/08/2011

Appendix IV Survey maps



Raised Bog Monitoring Survey 2011

Map 1: Ecotopes Map and Quadrats

Ecologic Environmental & Ecological Consultants Ltd.

Raheenmore Bog SAC (000582)
Co. Offaly

1:7,500

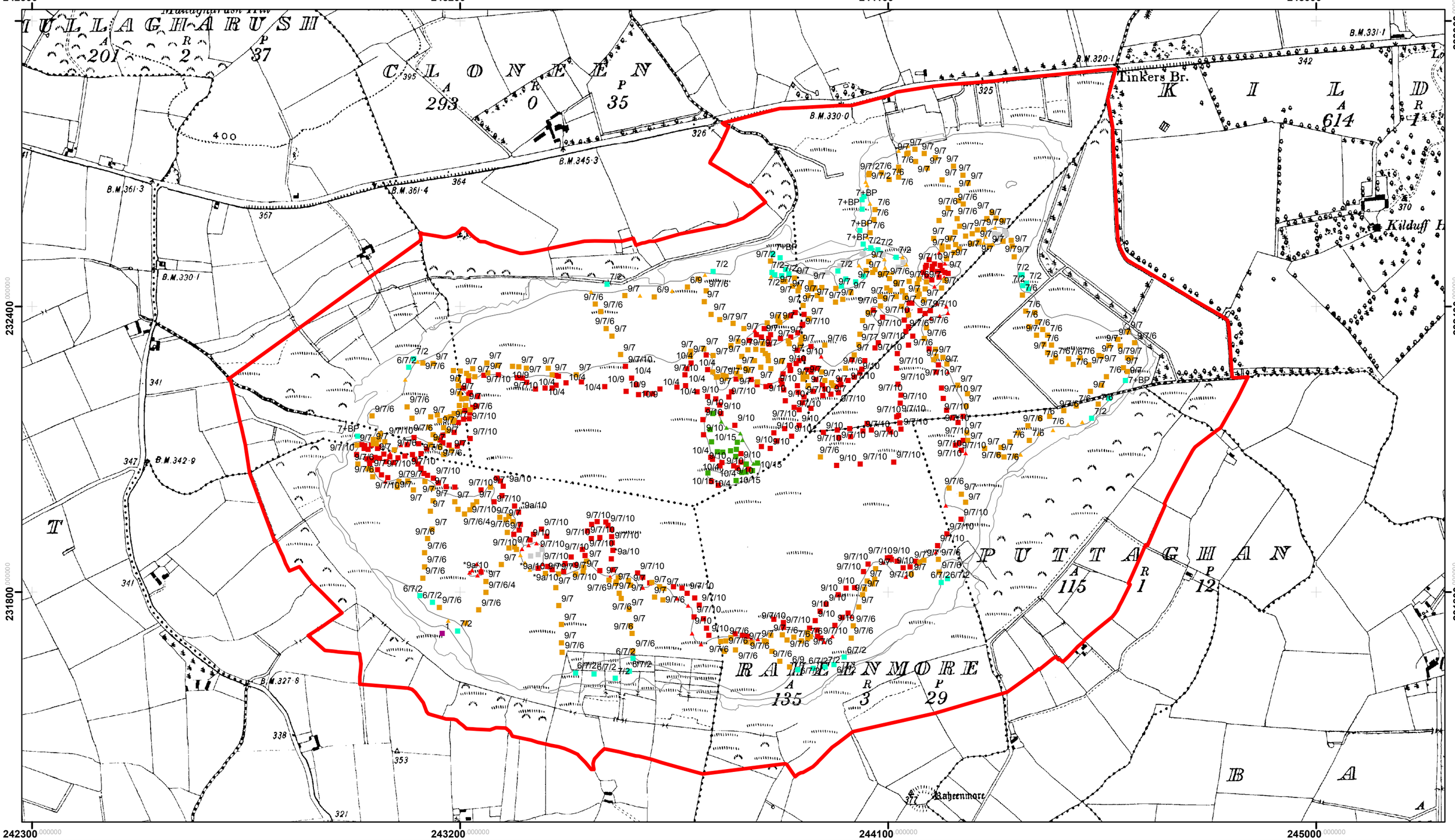
N

0 90 180 360 540 720 Meters

Legend

Ecotope type

- Central
- Sub-central
- Bog Woodland
- Active Flush
- Open water
- Sub-marginal
- Inactive Flush
- Marginal
- Face bank
- Quadrat
- SAC



Raised Bog Monitoring Survey 2011

Map 2: Vegetation community complexes

Ecologic Environmental & Ecological Consultants Ltd.

Raheenmore Bog SAC (000582)
Co. Offaly

1:7,500

0 95 190 380 570 760 Meters

N

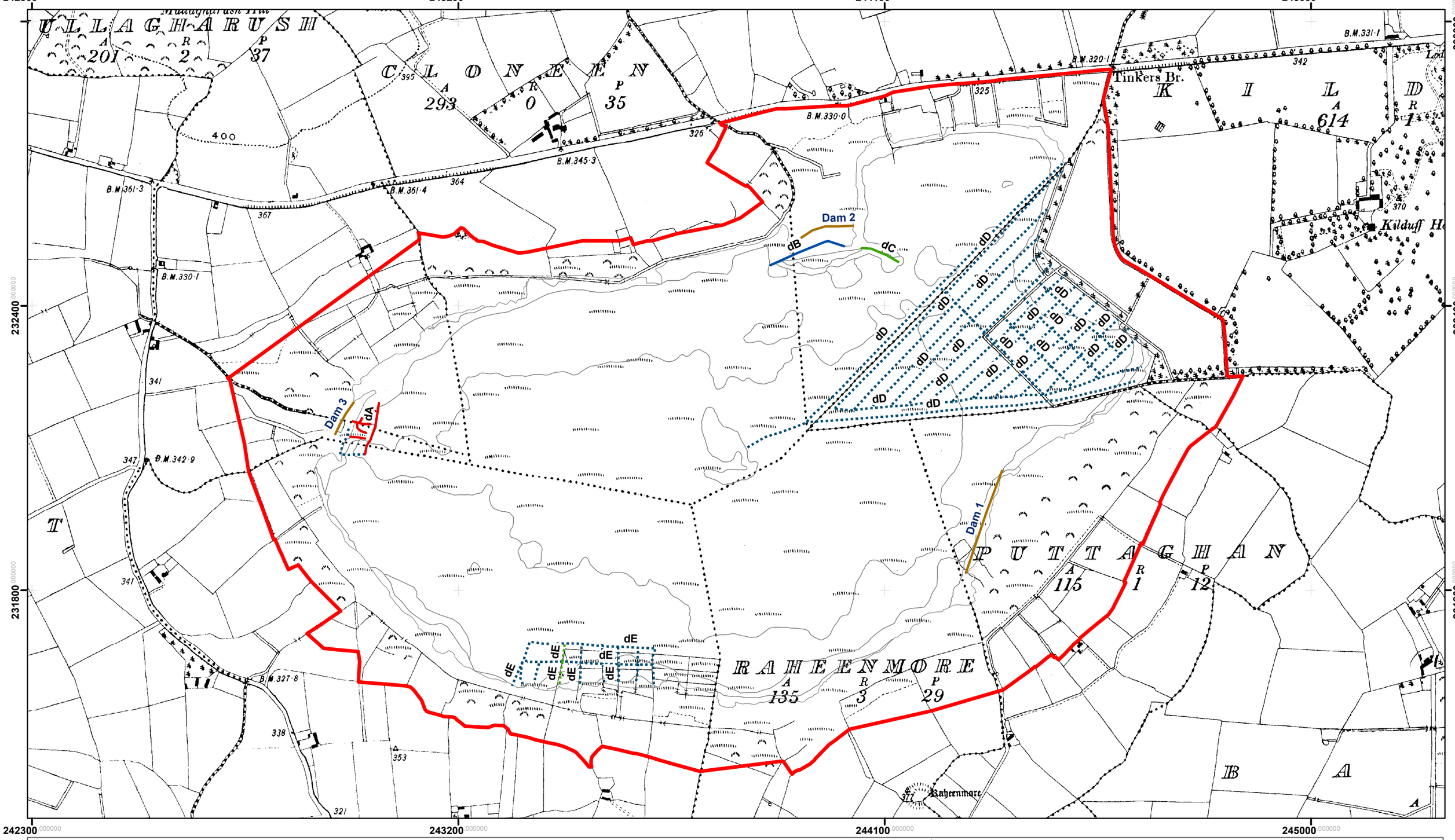
Legend

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 Survey 2011

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

Ecologic Environmental & Ecological Consultants Ltd.

Raheenmore Bog SAC (000582)
Co. Offaly

1:7,500

N

0 95 190 380 570 760 Meters

Legend

High Bog drainage

- Blocked:non-functional
- Blocked:reduced functional
- Not blocked:functional
- Not blocked:non-functional
- Not blocked:reduced functional
- Dams
- Ecotopes
- SAC