
Appendix 11.B

NVC Survey Report Limekiln Wind Farm



Vegetation survey of Limekiln Wind Farm, Reay



Small area of broad-leaved planting near Meur an Fhuarain Gil

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EXECUTIVE SUMMARY

Background

A survey of the vegetation within a conifer plantation near Reay, called Limekiln, was carried out between 22nd and 26th September 2012. This was carried out as part of the Ecological Impact Assessment of the proposed development of the area as a wind farm and to identify sensitive habitats and plant communities which may be of local, regional or national importance.

Methods

Areas of homogeneous vegetation were mapped and classified into different types using the National Vegetation Classification (NVC) system using the methods described by Rodwell (2006). Where an area comprised an intimate mixture of different plant communities that could not be readily separated these were mapped as 'mosaic polygons' whereby the different plant communities and sub-communities in the polygon were assigned a percentage so that the total amounted to 100%. The locations of notable plant communities or species were recorded as target notes and the grid references from a hand-held GPS receiver used to ascertain the OS grid reference.

A list of the species of moss and liverwort as well as all vascular plants found was also compiled.

The condition of the blanket bog habitat was assessed using the Common Standards Monitoring (CSM) guidance published on the Joint Nature Conservation Committee's (JNCC) website.

Results

A total of 31 different plant communities were found that matched the descriptions in the NVC and within these a total of 37 sub-communities were recognized. None of the plant communities or sub-communities are particularly rare at the national level, but some of the fen communities that were found are possibly scarce locally or regionally. The presence of some base-rich groundwaters at the base of the valley slope to the east of the limekiln close to the Achvarasdal Burn support uncommon fen communities and species of plant. These calcareous groundwaters presumably come from the limestone in and around the abandoned limekiln at Aryleive.

The only remnant areas of relatively intact blanket bog vegetation present within the survey were found on the west sides of the clearings around Cnocan Dubh nan Eun and Cnocan nan Eun and in the saddle between Creag Leathan and Creag Bheag. The area of wettest blanket bog habitat with the greatest diversity of mosses and species of bog plant was around Lochan nan Eun, but even here the blanket bog habitat is not completely intact as it has been partly affected by past peat cutting.

The condition of the blanket bog was assessed at a total of seven locations. All of these failed the condition assessment on at least 4 of the 14 targets. Three of these are inevitable, i.e. the presence of alien trees at a cover of more than 1%, the cover of trees and shrubs exceeds 10% and more than 10% of the blanket bog habitat is affected by artificial drainage. The blanket bog habitat within the forestry rides has also been affected by drainage associated with the

forestry. Other negative impacts come from very significant damage to the heather from browsing by red deer and heather beetle or magpie moth caterpillars. The red deer have also caused localized heavy trampling, especially in wet areas where stags have used them for wallowing. Red deer have given rise to a significant deterioration in the quality of the blanket bog habitat.

Assessment

The remnant areas of blanket bog habitat within the Limekiln development area plantation does not make a contribution to this resource either locally or regionally. This also applies to the dry heath, wet heath and acid grassland habitats present within the area that was surveyed. The transition fen and rich-fen habitats may be of local importance, but they are very small in extent and fragmentary. None of the plant communities are rare nationally or regionally and only a few species of plant are locally uncommon or rare, such as greater tussock sedge.

Recommendations

The blanket bog habitat in the clearings around Cnocan Dubh nan Eun and Cnocan nan Eun should be avoided by construction vehicles as well as the installation of tracks, turbine bases or any other infrastructure associated with the proposed development. Any access tracks should avoid going through the centre of the area of blanket bog habitat in the saddle between Creag Leathan and Creag Bheag. The area of blanket bog habitat in the buffer zone on the north slope of Cnoc an Fraoich should also be avoided during construction as it abuts directly on to the internationally important area of blanket bog within the Caithness and Sutherland Peatlands SAC.

The blanket bog habitat would benefit from clear-felling of the trees, especially if they were mulched and drainage ditches/plough furrows were blocked to increase the wetness of the habitat.

The fen habitat along the margins of the Achvarasdal Burn and the marginal flushes and seepage areas should be avoided as these habitats are particularly sensitive to vehicular impacts. The area of very wet poor-fen habitat along the burn that drains from the north of Milton Moss into Achvarasdal Burn should also be avoided as it is exceedingly wet and supports some uncommon species of wetland plant.

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Vegetation survey of the area for a proposed wind farm within the Limekiln Plantation near Reay in Caithness.

1. INTRODUCTION

1.1 Background

PlantEcol was commissioned by Aquaterra Ecology on behalf of Infinergy Ltd. to carry out a vegetation survey using the National Vegetation Classification (NVC) system for an area of land for a proposed wind farm at Limekiln Plantation, near Reay in Caithness. This report also assesses the value of the habitats and plant communities present at this site at a national, regional and local level and the likely impact that the proposed development will have on them.

2. METHODS

2.1 Mapping

The vegetation at the site was recorded and mapped between the 22nd and 26th September 2011. The weather was mostly fine and dry with only the occasional shower of rain.

The general methods outlined in Rodwell (2006) were used to map areas of relatively homogeneous vegetation. Areas of apparently homogeneous vegetation were mapped on to a base map of the site at a scale of 1:10,000 as a polygon. Where an area or polygon had intimate mixtures of two or more different plant communities, especially where one or more of the communities occupied small patches within more extensive stands of another community they were mapped as 'mosaic polygons'. Approximate proportions (%) of a polygon covered by each NVC plant community and other components, e.g. streams/rivers; buildings and tracks, were estimated by field observations. It must be recognised these are relatively imprecise estimates as the estimation by surveyors of the cover contributed by plants within even small plots (e.g. 2m x 2m quadrats) typically have errors of 20% or more (Hurford 2007). Data on the location and percentage of each community contributing to each polygon was recorded on a PDA (HP iPAQ).

Areas with notable types of vegetation covering very small areas or other unusual conditions were recorded (target notes) with the grid reference within a spreadsheet on the PDA.

Notes on the species composition of the different types of vegetation were made where they did not clearly match the accounts of the most similar communities described in Rodwell *et al* (1991a, 1991b, 1992, 1995, 2000).

The nomenclature (scientific names) for the vascular plants and mosses in the plant community names follow that of Stace (2010) and Hill *et al.* (2008). The vernacular names for the mosses follow that of Smith (2004). A list was kept of all the mosses and liverworts that were found that could be readily identified in the field as part of the survey of the vegetation as well as all of the species of vascular plant that were seen.

The condition of the blanket bog habitat was assessed against the targets used in the Common Standards Monitoring (CSM) guidance for assessing the condition of Upland habitats (JNCC 2009). This involved using nominal 2m x 2m quadrats taken opportunistically where there was clearly blanket bog type vegetation and deep peat, i.e. more than 0.5 m deep and

assessing the condition of the habitat against the targets for blanket bog suggested in the guidance. This was done at a total of seven locations on 25th September 2011. Samples were taken from within the forestry rides rather than the open areas of blanket bog habitat at the edge of the development area. Where there was blanket bog habitat present in clearings that was clearly of 'good' quality there was no need to assess its condition. They would still inevitably fail two of the targets, i.e. cover of alien species being less than 1% and the cover of trees and shrubs being less than 10% from what is visible at the assessment point. The targets that are assessed using the Common Standards Monitoring guidance are as follows:

- At least six of the listed indicator species should be present within 4 m² quadrat;
- Cover from three of the listed indicator species should be more than 50% in 4 m² quadrat. Cover of bog-mosses should not consist only of flat-topped bog-moss;
- Cover of any one of hare's-tail cotton-grass, ericaceous species or deergrass should not exceed 75% within 4 m² quadrat;
- Cover of non-native species should be less than 1% visible from sample location within the blanket bog habitat;
- Cover of trees and shrubs (excluding *Betula nana* and *Myrica gale*) less than 10% for all of the blanket bog habitat visible from sample location;
- Cover of undesirable grassland species (common bent, Yorkshire fog, common reed, bracken and creeping buttercup) must be less than 1% within 4 m² quadrat and visible from sample location;
- Less than 33% of shoots of dwarf-shrubs should show signs of browsing within 4 m² quadrat. Where dwarf birch or bog myrtle are present the maximum level of browsing is 66%;
- There should be no burning into the moss, liverwort or lichen layer or exposure of peat surface due to burning visible from the sample location;
- There should be no burning or other disturbance visible from the sample location in the listed sensitive areas;
- Less than 10% of the blanket bog area visible from the sample location should be affected by drainage due to ditches or heavy trampling or tracking;
- The area of eroding peat or mineral soil should be less than the area of re-deposition of peat and re-vegetation of peat within the blanket bog visible from the sample location;
- Less than 10% of bog-moss cover should be crushed, broken and/or pulled-up within the 4 m² quadrat and all that is visible from the sample location;
- Less than 10% of the ground cover should be disturbed bare ground at both the 4 m² scale and the area of blanket bog habitat visible from the sample location;

The mapping of the polygons was done largely with respect to the forest rides marked on the Ordnance Survey 1:25,000 map of the area. Therefore, the polygons may well exaggerate the width of the forest rides as the trees appear to have grown significantly since the map was produced. Consequently the estimates of the area of habitats are very likely to be significantly greater than their actual extent. Therefore, the data on the areas of each community should be regarded as indicative of their relative extent rather than an accurate estimate of their real coverage. The maps were produced using ArcView 10.1.

2.1 Evaluation of the extent and conservation value of the plant communities

The information available for assessing the abundance of the various plant communities is largely restricted to the distribution maps provided in Rodwell (1991a, 1991b, 1992, 1995, 2000), Averis *et al.* (2004). Rarer plant communities tend to be of higher conservation value

than commoner ones, but this is not always the case. Whether particular plant communities are placed in particular habitats of conservation interest come from the Guidelines for the Selection of Biological SSSIs, Biodiversity Action Plan descriptions, Common Standards Monitoring Guidance (webpage 1) and the Interpretation Manual of European Union Habitats (EC DG Environment 2003).

A semi-subjective evaluation of the extent in distribution of the various communities at the national (across Britain), regional (the Highland region north of the Great Glen) and local scale (Caithness) for each community is given in Table 5. The terms common, widespread, infrequent, rare and absent refer more to the extent of the geographical distribution rather than abundance. The number of hectads (10 km x 10 km OS grid squares) in which each community has been found is available in a free downloadable spreadsheet (webpage 2) of the hectad distribution used to construct the maps in Averis *et al.* (2004). There are other freely downloadable spreadsheets from this same website, but the information is very limited. For example for lowland grasslands the spreadsheet indicates that the very common and widespread false oat-grass grassland of road verges is present only in Wales in a few hectads. The distribution map for this community in Rodwell (1991b) shows it to be widespread across the whole of Britain.

This analysis is only used as an indication of the extent of the habitats, but there are limits to this interpretation. Firstly the published distribution maps of the various NVC communities should and are probably widely recognised as being indicative. For instance, the published maps for the M2 type of bog pool community in Averis *et al.* (2004) suggests that this community has rarely if ever been recorded in Caithness or the region generally. However, this community is very common and it can be expected to be present on any blanket bog throughout the British Isles, especially given the widespread distribution of the two species of bog-moss (*Sphagnum*) that characterise this community. Secondly the recognition of the presence of different plant communities is very much influenced by the surveyor and levels of consistency in mapping communities between surveyors was low (Hearn *et al.* 2011). An example from this survey would include the M35 vegetation type, which is apparently confined to England and Wales in the published maps in Averis *et al.* (2004) and Rodwell (1991b) because the round-leaved crowfoot only reaches as far north as Glasgow in the British Isles. However, those runnels and water-tracks with blinks, lesser spearwort, bog pondweed and cow-horn bog-moss are best placed in this community and no other, despite the absence of round-leaved crowfoot.

3. FIELD OBSERVATIONS

3.1 Site Description and Habitats

The area surveyed is primarily a commercial plantation of Sitka spruce (*Picea sitchensis*) and lodgepole pine (*Pinus contorta*). The rides and tracks between the blocks of forestry have some remnant and modified forms of blanket bog, wet heath, dry heath and acid grassland. The only areas of relatively undisturbed semi-natural habitats are located on the low hills (Creag Leathan and Creag Bheag) or rock outcrops (Cnocan Dubh nan Eun, Cnocan nan Eun, Claperon) which are unplanted and along valleys with the larger streams (Reay Burn and Achvarasdal Burn). The unplanted hills and knolls mostly have a mixture of dry heath and wet heath with small areas of blanket bog in hollows. The better drained soils in the stream valleys typically have acid grassland which is dominated by bracken wherever the soil is sufficiently well drained and deep enough. The lower parts of stream valleys have wet heath

and marshy grassland where there is impeded drainage. In a few places, especially around Achvarasdal Leans and the part of Reay Burn near Breac-Leathad where there is a consistently high water-table, there are areas of fen habitat.

3.2 Plant Communities

The dominant plant communities in each polygon are shown in Figure 1 whilst Table 1 lists the scientific names of the various communities and sub-communities found and their approximate area. Target notes for small stands of particular vegetation types of interest are given in Table 2 and the location of these target notes are shown in Figure 1.

Because of the low number of species present, especially along the rides within the forestry plantation, significant areas of the wet heath and blanket bog vegetation could not be assigned to a particular sub-community. Many plant communities are not necessarily restricted to a particular habitat, but for clarity each will be reviewed with respect to a particular habitat, not all of which are used in the Phase 1 classification scheme.

3.2.1 Blanket bog communities

The types of vegetation typically found in the blanket bog habitat within the Limekiln wind farm development were:

- Cow-horn bog-moss bog pool community (M1);
- Flat-topped/feathery bog-moss bog pool community (M2);
- Round-leaved sundew – bog-moss sub-community of the deergrass – hare’s-tail cotton-grass blanket mire (M17a);
- Reindeer lichen sub-community of the deergrass – hare’s-tail cotton-grass blanket mire (M17b);
- Heath rush - little shaggy-moss sub-community of the deergrass – hare’s-tail cotton-grass blanket mire (M17c);
- Crowberry – reindeer lichen sub-community of the cross-leaved heath – bog-moss raised and blanket mire (M18b);
- Cross-leaved heath sub-community of the heather – hare’s-tail cotton-grass blanket mire community (M19a);
- Species-poor sub-community of the hare’s-tail cotton-grass blanket and raised mire (M20a); and
- Heather – reindeer lichen sub-community of the hare’s-tail cotton-grass blanket and raised mire (M20b).

The most widespread of these plant communities on blanket bog habitat is the heather – hare’s-tail cotton-grass blanket mire community (M19). This community is widespread throughout the survey area (Figure 2). The only sub-community recognised as being present was the cross-leaved heath sub-community (M19a). Grey dead heather bushes were found within the survey area, especially within the blanket bog habitat with this type of vegetation. A greater proportion of many of the polygons and more polygons would have had this vegetation type if many of the heather bushes had not been killed. The bleached heather bushes were most likely to have been killed by an outbreak of heather beetle (*Lochmaea suturalis*) or possibly magpie moth caterpillars (*Abraxas grossulariata*). Where the vast majority of the heather bushes were dead the vegetation was classed as either the hare’s-tail cotton-grass blanket and raised mire community (M20) or purple moor-grass – tormentil mire (M25). The areas with dead heather bushes were widespread but patchy in distribution.

The deergrass – hare’s-tail cotton-grass blanket mire community (M17) covers a similar proportion of the survey area as the M19 vegetation type (Table 1). The wetter stands of this vegetation are represented by the round-leaved sundew - bog-moss sub-community (M17a), but where there is better drainage, such as on steeper slopes it is replaced by the lichen sub-community (M17b). This latter sub-community would be more widespread if it were not for the high levels of trampling from red deer. In a few locations where the vegetation has been modified within the forestry rides there are small stands of the heath rush – little shaggy-moss sub-community (M17c). Most of the M17 vegetation is centred either around Cnoc nan Airigh where there is deep peat or around the edge of the forestry plantation below Cnoc an Fhraoich (Figure 3).

There are some areas of the hare’s-tail cotton-grass blanket and raised mire (M20) vegetation in the forest rides, often where there are much wetter conditions or where there was a lot of dead heather. Not surprisingly this vegetation is dominated by hare’s-tail cotton-grass and was usually classed as the species-poor sub-community (M20a), but where heather was present at a sufficiently high frequency the heather - lichen sub-community was recorded (M20b). The M20 vegetation is mostly found on the deep peat within the forestry blocks around Aryleive (Figure 3).

There were one or two isolated pockets of the cross-leaved heath – papillose bog-moss raised and blanket mire (M18) community. These are located around Lochan nan Eun and in the saddle between Creag Leathan and Creag Bheag where there is a very small bog pool with the cow-horn bog-moss (M1) vegetation (Figure 3). The feathery/flat-topped bog-moss bog pool (M2) vegetation is widely scattered around the site, but many of the bog-pools with this vegetation type have been disturbed by red deer stags using them as wallows.

3.2.2 *Wet heath communities*

Wet heath communities are the most widespread open-habitat communities within the survey area (Table 1). Much of the wet heath type vegetation is on deep peat that would have previously had blanket bog vegetation types. This change is almost certainly a result of the forestry activity which has changed the vegetation through drainage, shading and nutrient enrichment via the application of fertilisers. Drainage ditches and the presence of trees have partly dried out the peat, reducing the amount of bog-moss in the vegetation and favouring species that tolerate drier conditions, such as purple moor-grass and deergrass. Any fertilisation of the forestry will have also favoured the growth of purple moor-grass at the expense of the heather. This change in the composition of the vegetation will have also been helped by any browsing of heather in winter by deer and outbreaks of heather beetle.

The types of plant community characteristic of wet heath that are present at the Limekiln Plantation are:

- Deergrass – cross-leaved heath wet heath (M15) with the carnation sedge (M15a), typical (M15b) and reindeer lichen (M15c) sub-communities present;
- Cross-leaved heath – compact bog-moss wet heath heath rush – broom fork-moss sub-community (M16b); and
- Purple moor-grass – tormentil mire (M25), including the cross-leaved heath sub-community (M25a).

Although the manual for the classification of habitats using the Phase 1 places the purple moor-grass – tormentil mire (M25) vegetation in the marshy grassland category it can be found on deep peat in valley mires (e.g. Crymlyn Bog SAC) on modified blanket bog or on shallow peat with abiotic variables characteristic of wet heath. The M25 vegetation is mostly represented by the cross-leaved heath sub-community (M25a) and is found in the forest rides, stream valleys and on the piles of peat deposited alongside the tracks throughout the site (Figure 3).



Figure 1. An example of a wallow used by a red deer stag in one of the forest rides within the Limekiln Plantation.

The deergrass – cross-leaved heath wet heath (M15) vegetation is the second most abundant open vegetation type within the survey area (Table 1). All three of the sub-communities are present, but the most abundant of these is the Typical sub-community (Table 1). This vegetation type is again widespread throughout the survey area, but is more abundant in the central and southern part of the survey area, especially in the areas where there is more likely to be deeper peat (Figure 3).

One small patch of the cross-leaved heath – compact bog-moss wet heath (M16) vegetation was found at the edge of the forestry plantation where there are exposures of rock on the north-east flank of Cnoc an Fhraoich.

3.2.3 *Fens and flush communities*

Fens differ from bogs in that some of the water comes from the ground whilst bogs receive all of their water from precipitation (rain, snow and hail). Fens can be further sub-divided into those which are supplied with significant quantities of base nutrients (mostly calcium and magnesium), called ‘rich-fens’ and those with water supplying low concentrations of base nutrients, called poor-fens. Rich-fens typically have low levels of acidity or are slightly alkaline due to high concentrations of bicarbonate ions whilst poor-fens are slightly to moderately acidic.

Most of the fen vegetation is of the poor-fen type because the water coming off the surrounding peaty soils is very acidic and low in base nutrients. The soft rush sub-community of the star sedge - feathery/cow-horn bog-moss mire (M6c) is the predominant type of poor-

fen and is found alongside watercourses and seepage areas and drains alongside tracks. There are some patches of the star sedge sub-community (M6a) in some of the wetter areas near Achvarasdal Burn and other very wet areas in clearings and forest rides. There is only one small patch of the common sedge sub-community (M6b) that is present in a very wet area at the junction between polygons 30 and 31 close to the Achvarasdal Burn in the north-east corner of the survey area.

Where the soft rush has more flowering plants and little or no bog-moss and common hair-cap moss in the understorey it is usually assigned to the soft rush sub-community of the rush – marsh bedstraw rush-pasture (M23b) vegetation type. This vegetation type can be found inter-mixed with the M6c vegetation type and tends to be located around the margins of the tracks or close to some of the burns. The sharp-flowered rush sub-community (M23a) is much more localised in distribution at this site and is found in areas where there is clearly much greater base enrichment, such as the slope below the limekiln, and is intermediate with types of rich-fen vegetation.

The bottle sedge – flat-topped bog-moss mire (M4) is found around Achvarasdal Leans whilst the bottle sedge – spiky bog-moss mire (M5) and bottle sedge – pointed spear-moss mire (M9) community types are found slightly further upstream to the east of the limekiln. All of these plant communities are very small in extent (Table 1) and are regarded as being transition mire communities. The M9 vegetation was found in a very wet area close to the Achvarasdal Burn at target notes 4 and 5. There were several tussocks of greater tussock-sedge in the vegetation along with long-stalked yellow sedge. The M9 and M5 vegetation are where they are because of base enrichment of waters draining from the limestone area further upslope, around the limekiln.

The rich-fen is very restricted in distribution and area (Table 1) because of the scarcity of exposures of limestone and base-rich rocks within the survey area. This habitat type within the Limekiln survey area includes bottle sedge swamp (S9), dioecious sedge – common butterwort mire (M10) and yellow iris – meadowsweet mire (M28). The rush sub-community of the yellow iris - meadowsweet mire (M28a) is found mostly in the flood-plain of the Achvarasdal Burn downslope of the limekiln and in the area where the stream draining from Milton Moss enters the Achvarasdal Burn. The M10 vegetation was found further up the valley east of the limekiln at target notes 2 and 3.

3.2.4 *Grassland communities*

The grassland communities include examples characteristic of neutral, calcareous and acid soils. The acid grassland communities are the most widespread of these (Table 1). In contrast the calcareous grassland community is very small in extent (<0.05 ha) and was found at target note 12 and potentially in the bottom of the small quarry near to the limekiln near Aryleive. This vegetation type is represented by the flea sedge – carnation sedge sub-community of the sheep's fescue – common bent – thyme grassland (CG10b).

The false oat-grass (MG1) and Yorkshire fog – tufted hair-grass (MG9) grasslands are both types of neutral grassland. The former is represented by the red fescue sub-community (MG1a) and was found around the old quarry near the limekiln whilst the MG9 grassland was represented by the rough meadow-grass sub-community (MG9a). This latter community was found on the better drained soils scattered around the survey area, including the abandoned

house at Helshetter, the clearing around the limekiln, in the flood-plain of the Reay Burn and in the clearing south of the ruined dwelling just south of Creag Bheag.

The types of acid grassland vegetation present include the sheep's fescue – common bent – heath bedstraw grassland (U4), mat-grass – heath bedstraw grassland (U5) and heath rush – sheep's fescue grassland (U6). The latter community covers a very small amount of ground and is represented by the common bent – heath woodrush sub-community (U6d).

In contrast the U4 grassland is the most widespread type of grassland in the survey area (Table 1). It is found on the better drained soils, especially around rock outcrops, the high banks above streams or by and on the access tracks. This community is mostly represented by the typical sub-community (U4a) but the Yorkshire fog – white clover (U4b) and blaeberry – wavy hair-grass (U4e) sub-communities are also present (Table 1).

The U5 grassland is mostly found in the stream valleys at the southern part of the survey area. The sub-community that was recognised as being present was the velvet bent – common haircap sub-community (U5b).

Although bracken is usually placed in its own category in the Phase 1 survey manual it is placed in with the upland/acid grassland communities in the NVC and is included here for that reason. The bracken – heath bedstraw community (U20) is typically found where the soils are deeper and well-drained. Extensive and dense stands of bracken are present on the lower slopes of the hills in the northern part of the site as well as around Esvarasdalen, in the clearing with the limekiln and close to the Achvarsdalen Burn (Figure 3). Most of this community is of the species-poor sub-community (U20c), but the sweet vernal-grass (U4a) and blaeberry – broom fork-moss (U4b) sub-communities are also present.

3.3 Species of plant

A total of 197 different species of vascular plant, moss, liverwort and lichen were identified. Fifty four of these species were forbs and fifty three different species of moss were identified. None of the vascular plants, mosses or liverworts are scarce or rare in Britain, but greater tussock sedge is locally rare. However, care needs to be taken in the assessment of rarity of plants in the local area as the recording of vascular plants in Caithness appears to be particularly poor. This is indicated by the lack of post-1986 records for several common and widespread plants, such as wavy hair-grass and hare's-tail cotton-grass, for many hectads (10 km x 10 km OS grid squares) in Caithness (Preston *et al.* 2002).

3.4 Condition of remnant Blanket Bog habitat

The results of the CSM assessments of the blanket bog habitat are shown in Table 3. All of the sample plots failed on at least four of the 14 targets and three of these were always the same, two of which are inevitable. The inevitable failures were because of the presence of the non-native conifers having a cover of more than 1% and the cover of trees and shrubs visible from the point of observation being greater than 10%. All of the sample plots also failed because at least 10% of the blanket bog habitat that could be seen from the point of observation (visible) was affected by artificial drainage.

At all but one of the seven sample plots more than a third of last season's growth on the long-shoots of heather were browsed. This is almost certainly due to the red deer that were frequently seen within the plantation during the survey.

Figure 2. An example of significant trampling impact of bog-mosses (red patch in the centre of the photograph) in the forest rides and grey dead bushes of heather (top of the photograph). The latter is probably due to either heather beetle damage or magpie moth damage from several years ago.



Red deer have affected the condition of the blanket bog vegetation not only by moderately high levels of browsing, but through their trampling impacts. The most obvious of these is the use of bog pools by stags as wallows, but also tracking between different parts of the plantation. In half of the six sample plots where there was bog-moss present this was significantly disturbed through trampling by deer. It is likely that the abundance of reindeer lichens has also been reduced by the trampling impacts and consequently the coverage of M17b and M15c vegetation types is lower than in areas of similar vegetation outside of the forestry plantations where the author has carried out surveys of blanket bog around the Halladale and Strathy catchments.

The high levels of browsing by red deer combined with the outbreaks of heather beetle or magpie moth have clearly resulted in major reductions in the cover of heather so that it has been eliminated from significant parts of the survey area.

Drainage for the forestry planting has also resulted in the loss of cover of bog-mosses on the blanket bog habitat. The blanket bog habitat is for the most part highly modified within most, if not all, of the forestry plantation rides. Even the small areas of blanket bog around Cnocan Dubh nan Eun and Cnocan nan Eun have been partly damaged by past peat cutting. The only intact area of blanket bog habitat that has not been affected significantly by drainage and conifer planting is that within the buffer zone along the southern edge of the forestry plantation near Cnoc an Fhraoich.

4. INVASIVE ALIEN SPECIES

No invasive non-native species of vascular plant were seen during the survey of the site. Other than the Sitka spruce and lodgepole pines, the only species of alien plant that was seen

during the survey was heath star moss (*Campylopus introflexus*). This species is not listed on Schedule 9 of the Wildlife and Countryside Act (1981 as amended).

5. EVALUATION OF VALUE OF THE HABITATS AND PLANT COMMUNITIES

Although the assessment of the extent and/or abundance of a plant community was made as objective as possible the data on the number of hectads recorded for plant communities is very limited and poor in certain areas, especially in Caithness where the collection of data used in the NVC was very limited. Therefore, the assessment includes an element of assessment based on personal experience and knowledge.

Most of the communities that were observed within the survey area are at least widespread and common in the appropriate type of habitat.

The M1, M2, M17 and M19 plant community types are widespread and common throughout Britain. The M18 vegetation type is the one plant community of blanket bogs that is particularly indicative of consistently wet blanket bog habitat and is usually found in undisturbed parts of a blanket bog. This plant community is reasonably common locally and regionally. In contrast the M20 vegetation is considered to be indicative of heavily disturbed areas of blanket bog habitat from a combination of drainage, burning and air pollution and consequently it is rarely encountered either locally or regionally. However, this community can be found with good covers of bog-moss in parts of Scotland well away from significant air pollution in areas where water is draining directly off the blanket bog and is usually in areas which are very wet. Therefore, the presence of this community type may be natural, but may also indicate a localised area of nutrient enrichment and water tracking in surveys elsewhere locally.

The area around Lochan nan Eun has the best pocket of remnant blanket mire vegetation within the survey area, but even here it has been partly modified by past peat cutting south-west of the lochan and at the base of the hillock itself. The blanket bog around Cnocan Dubh nan Eun has also been cut-over in the north-west corner of the clearing.

Much of the blanket bog vegetation has also been disturbed by red deer, especially by stags using pools and wetter areas as wallows during the rutting season. As mentioned above the trampling impacts have also reduced the coverage by reindeer lichens. None of the blanket bog plant communities were seen to be particularly rich in species of vascular and non-vascular plants or to support rare or local species at the time of the survey. For instance long-leaved sundew would be expected to be present if there were particularly wet areas of blanket bog. The total area of relatively unmodified blanket bog within the Limekiln Plantation amounts to about 6.2 ha. This represents a tiny fraction that is present locally, probably less than 0.005% let alone regionally.

The M15 and M25 wet heath communities are very common and widespread and at this site they are floristically species-poor. Although the M16 vegetation is relatively infrequent and uncommon at the national level, it is relatively frequent regionally and locally. Within this survey area a small area of this vegetation was found at the very edge of the survey area and is unlikely to be affected by the development.

Some of the poor-fen and rich-fen community types are the most restricted in distribution and abundance locally or nationally. Although the M4, M5 and M9 vegetation types are indicated not to be present within Caithness in the publications they are almost certainly present elsewhere in Caithness as the nearby Broubster Leans SSSI (3.5 km to east) is designated as an SAC under the EU Habitats Directive for its transition mire habitat. In contrast the M6 and M23 vegetation types are exceedingly common in the uplands of Britain and they are plant communities of little interest for the conservation of plants. What is of greater botanical and conservation interest are the small areas of rich-fen vegetation, especially the M10 vegetation types. Although the M10 vegetation type is reasonably widespread in the uplands the flushes are nearly always very small covering only tens of square metres, but they can support a relatively large number of specialist species in a small area of ground, especially mosses and liverworts.

The proposed development will potentially have an insignificant effect on the blanket bog, wet heath, dry heath and grassland resource either nationally, regionally or locally. If anything the clear-felling of the forestry plantation should increase the area of blanket bog, wet heath and dry heath. The areas of blanket bog that should be avoided are those around Lochan nan Eun in the clearing around Cnocan nan Eun, the clearing around Cnocan Dubh nan Eun, the saddle between Creag Leathan and Creag Bheag and the area outside of the plantation to the north and east of Cnoc an Fhraoich (Figure 4). The CSM only assesses the condition of the habitat with respect to indicators of management activities appropriate for the maintenance of the habitat (e.g. trampling, burning, drainage, browsing) and not with respect to the quality of the habitat in terms of its biodiversity and structure. It is partly for this reason that CSM assessments were not carried out in the clearings as even though the blanket bog habitat around Lochan nan Eun is of good quality it would inevitably fail two of the CSM targets, namely cover of alien species and trees.

The area of moderately good-quality blanket bog habitat around Lochan nan Eun has a reasonable diversity of bog-mosses and is likely to be active. The blanket bog on the lower slopes around Cnocan Dubh nan Eun is of lesser value as it supports mostly M19 vegetation which may not necessarily be actively accumulating peat. Although the blanket bog in the saddle between Creag Leathan and Creag Bheag has both M1 and M2 type bog-pools it is for the most part an area of fairly dry blanket bog habitat. Although the blanket bog habitat on the northern and eastern slopes of Cnoc an Fhraoich is reasonably intact it is naturally dry due to the slope of the hill and does not support vegetation of particularly high quality or diversity, and it is presumably for this reason that it was not included within the Caithness and Sutherland Peatlands SAC.

The fen habitats are probably important at a local level and should be avoided with tracks and other infrastructure. These areas would cause significant logistical problems in constructing tracks and other infrastructure let alone the environmental damage to the vegetation, substrate and increase in the concentration of suspended sediment in burns draining these areas.

The western boundary of the survey area abuts directly on to part of the Caithness and Sutherland Peatlands SAC. This area, protected under the European Union's Habitats Directive, is of importance for its internationally recognised extensive area of blanket bog habitat as well as its naturally dystrophic lakes and ponds and oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea*. Other features for which the site is recognised, but that are not primary reasons for selection are otter, marsh saxifrage, wet heathland with cross-leaved heath,

depressions on peat substrates of the *Rhynchosporion* and transition mires and quaking bogs. The existing blanket bog habitat within the Limekiln Plantation does not add significantly to the peatland resource locally or regionally or complement that within the Caithness and Sutherland Peatlands SAC. The removal of the trees and restoration of blanket bog habitat within the felled area would complement and enhance the Caithness and Sutherland Peatlands SAC.

Other protected areas with similar habitats and in relatively close proximity to the Limekiln Plantation are: Broubster Leans SAC & SSSI (173 ha) which is only 3.5 km to the east and has an extensive area of transition fen habitat; Loch Lieurary SSSI (40 ha) which is 7.8 km to the east and is a basin fens site; and Westfield Bridge (8 ha) which is 6.6 km to east and is notified for its fen meadow habitat. There is therefore a much greater area of fen habitat within close proximity to the Limekiln Plantation. It is difficult to assess the value of the fen habitat at Limekiln. This in part depends on the extent of the rich-fen and transition fen habitats at the locally protected sites and the types of plant community they support. The information available on the types of plant community present or their extent at the nearby protected wetland sites of Broubster Leans, Loch Lieurary and Westfield Bridge SSSIs is not readily available. The area of rich-fen and transition fen is very small indeed, but they may be of importance locally, especially if they support plants not found at these other sites.

6. RESTORATION OF BLANKET BOG HABITAT

The remnant blanket bog habitat within the forest rides is in poor condition and will only deteriorate with the continued growth of the Sitka spruce. The removal of the trees would help improve the condition of the blanket bog vegetation within the rides even if there was some damage to the vegetation from the vehicles used to fell the trees. The infilling of ditches would also help to re-wet the peat and would almost certainly result in an increase in the cover of bog-moss in the rides as well as the areas that are to be felled.

After the mulching of moderately tall conifers on areas of former blanket bog in the Kielder Forest plants of hare's-tail cotton-grass have readily emerged (webpage 3). The mulching will also be beneficial to the regeneration of bog-mosses as these have been shown to regenerate and grow on cut-over bogs with bare peat in Canada after mulching the surface with straw (Johnson *et al.* 2000). This treatment has been successfully carried out at other wind farms as part of habitat management (Rothes, Morayshire - Fred Olsen Renewables, completed in 2005; Black Law - Scottish Power, completed in 2005; Beinn an Tuirc – Scottish Power, completed in 2001; Cruach Mhor, Argyll – Scottish Power, completed in 2004; Whitelee, Lanarkshire – Scottish Power, 2007 to 2009; Arcleoch, South Ayrshire – Scottish Power, 2008 to present).

7. RECOMMENDATIONS

The blanket bog habitat in the clearings around Cnocan Dubh nan Eun and Cnocan nan Eun should be avoided and any access tracks should avoid going through the centre of the area of blanket bog habitat in the saddle between Creag Leathan and Creag Bheag (Figure 4). The blanket bog between the Caithness and Sutherland Peatlands SAC and the proposed development area should also be avoided as it will provide a buffer zone and not because of its intrinsic habitat quality.

The fen habitat along the margins of the Achvarasdal Burn and the marginal flushes and seepage areas should be avoided, as these habitats are particularly sensitive to vehicular impacts. The area of very wet poor-fen habitat along the burn that drains from the north of Milton Moss into Achvarasdal Burn (Figure 4) should also be avoided as it is exceedingly wet and supports some uncommon species of wetland plant .

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9. TABLES

Table 1. The approximate area of each NVC plant community and sub-community surveyed within the Limekiln area.

Habitat	Community	Sub-community	Code	Area (ha)
Coniferous plantation				860
Broad-leaved plantings				0.2
Scrub	<i>Salix cinerea</i> – <i>Galium palustre</i> woodland		W1	0.06
	<i>Betula pubescens</i> – <i>Molinia caerulea</i> woodland	<i>Sphagnum</i>	W4c	0.53
	<i>Ulex europaeus</i> – <i>Rubus fruticosus</i> scrub	<i>Teucrium scorodonia</i>	W23c	3.1
			Total	3.7
Neutral grassland	<i>Arrhenatherum elatius</i> grassland	<i>Festuca rubra</i>	MG1a	0.07
	<i>Holcus lanatus</i> – <i>Deschampsia cespitosa</i> grassland	<i>Poa trivialis</i>	MG9a	4.5
			Total	4.6
Marshy grassland	<i>Holcus lanatus</i> – <i>Juncus effusus</i> rush pasture	Typical	MG10a	7.0
Calcareous grassland	<i>Festuca ovina</i> – <i>Agrostis capillaris</i> – <i>Thymus polytrichus</i> grassland	<i>Carex pulicaris</i> – <i>Carex panicea</i>	CG10b	<0.05
Acid grassland	<i>Festuca ovina</i> – <i>Agrostis capillaris</i> – <i>Galium saxatile</i> grassland	Typical	U4a	14
		<i>Holcus lanatus</i> – <i>Trifolium repens</i>	U4b	<0.05
		<i>Vaccinium myrtillus</i> – <i>Deschampsia flexuosa</i>	U4e	0.41
	<i>Nardus stricta</i> – <i>Galium saxatile</i> grassland	<i>Agrostis canina</i> – <i>Polytrichum commune</i>	U5b	0.7
	<i>Juncus squarrosus</i> – <i>Festuca ovina</i> grassland	<i>Agrostis capillaris</i> – <i>Luzula multiflora</i>	U6d	<0.05
	<i>Pteridium aquilinum</i> – <i>Galium saxatile</i>	Not determinable	U20	3.3
		<i>Anthoxanthum odoratum</i>	U20a	7.5
		<i>Vaccinium myrtillus</i> – <i>Dicranum scoparium</i>	U20b	6.8
		Species-poor	U20c	28
		Total	60	

Table 1 continued.

Habitat	Community	Sub-community	Code	Area (ha)
Dry heath	<i>Calluna vulgaris</i> – <i>Erica cinerea</i>	Not determinable	H10	4.4
		Typical	H10a	41
	<i>Calluna vulgaris</i> – <i>Vaccinium myrtillus</i>	<i>Calluna vulgaris</i> sub- community	H12a	0.01
			Total	45
Wet heath	<i>Trichophorum germanicum</i> – <i>Erica tetralix</i> heath	Not determinable	M15	23
		<i>Carex panicea</i>	M15a	0.12
		Typical	M15b	42
		<i>Cladonia</i>	M15c	9.0
	<i>Erica tetralix</i> – <i>Sphagnum compactum</i>	<i>Juncus squarrosus</i> – <i>Dicranum scoparium</i>	M16d	0.13
		<i>Molinia caerulea</i> – <i>Potentilla erecta</i>	Not determinable	M25
		<i>Erica tetralix</i>	M25a	36
		Total	160	
Blanket bog	<i>Sphagnum denticulatum</i> bog pool		M1	<0.01
		<i>Sphagnum cuspidatum/fallax</i> bog pool	M2	0.67
	<i>Trichophorum germanicum</i> – <i>Eriophorum vaginatum</i> blanket mire	Not determinable	M17	4.3
		<i>Drosera rotundifolia</i> – <i>Sphagnum</i>	M17a	4.3
		<i>Cladonia</i>	M17b	9.8
		<i>Juncus squarrosus</i> – <i>Rhytidiadelphus loreus</i>	M17c	0.3
	<i>Erica tetralix</i> – <i>Sphagnum papillosum</i> raised and blanket mire	<i>Empetrum nigrum nigrum</i> – <i>Cladonia</i>	M18b	0.2
	<i>Calluna vulgaris</i> – <i>Eriophorum vaginatum</i> blanket mire	Not determinable	M19	9.8
		<i>Erica tetralix</i>	M19a	14
	<i>Eriophorum vaginatum</i> blanket and raised mire	Not determinable	M20	1.9
		species-poor	M20a	2.2
<i>Calluna vulgaris</i> – <i>Cladonia</i>		M20b	0.45	
		Total	48	
Acid flush	<i>Carex echinata</i> – <i>Sphagnum fallax/denticulatum</i> mire	<i>Carex echinata</i>	M6a	1.4
		<i>Carex nigra</i>	M6b	0.06
		<i>Juncus effusus</i>	M6c	9.7
			Total	10
Marsh/ marshy grassland	<i>Juncus</i> – <i>Galium palustre</i> rush-pasture	<i>Juncus acutiflorus</i>	M23a	0.63
		<i>Juncus effusus</i>	M23b	4.8
	<i>Iris pseudacorus</i> – <i>Filipendula ulmaria</i> mire	<i>Juncus</i>	M28a	0.89
			Total	6.3

Table 1 continued.

Habitat	Community	Sub-community	Code	Area (ha)
Transition mire	<i>Carex rostrata</i> – <i>Sphagnum fallax</i> mire		M4	0.04
	<i>Carex rostrata</i> – <i>Sphagnum squarrosum</i> mire		M5	0.03
	<i>Carex rostrata</i> – <i>Calliergonella/Calliergon</i> mire	<i>Campylium stellatum</i> – <i>Scorpidium scorpioides</i>	M9a	0.07
			Total	0.1
Swamp	<i>Carex rostrata</i> swamp	<i>Menyanthes trifoliata</i> – <i>Equisetum fluviatile</i>	S9b	0.06
Basic flush and springs	<i>Carex dioica</i> – <i>Pinguicula vulgaris</i> mire	<i>Carex demissa</i>	M10a	0.03
	<i>Ranunculus omiophyllus</i> – <i>Montia fontana</i> rill		M35	<0.05
Lotic water (running water)				0.9
Lentic water (standing water)				0.9
Tracks				7.9
Exposed rock				0.6
Buildings				0.1

Table 2. Location and details recorded at target notes shown in Figure 1.

Note #	Date	Easting	Northing	NVC	Observations
L0	22/09/11	298897	960635	M15a	<i>Schoenus nigricans</i> in small spring
L1	22/09/11	299339	960977	M6/ M35	Bryophyte rich spring/runnel with <i>Rhizomnium punctatum</i> and <i>Potamogeton polygonifolius</i> abundant
L2	22/09/11	299364	960984	M10b	Base-rich flush with <i>Scorpidium cossonii</i> , <i>Campylium stellatum</i> , <i>Pinguicula vulgaris</i> , <i>Carex flacca</i> , <i>C. panicea</i> and <i>Chara</i> c.f. <i>vulgaris</i>
L3	22/09/11	299368	960957	M10b	Base-rich flush with <i>Palustriella commutata</i> , <i>Linum catharticum</i> and <i>Pedicularis palustris</i>
L4	22/09/11	299387	961092	M9a	Base-rich flush with <i>Carex lepidocarpa</i> and <i>C. paniculata</i>
L5	22/09/11	299387	961115	M9	Two large <i>Carex paniculata</i> tussocks
L6	22/09/11	298352	963302	M15a	Flush with <i>Schoenus nigricans</i> , <i>Pinguicula vulgaris</i> , <i>Sphagnum subnitens</i> and <i>Erica tetralix</i>
L7	22/09/11	298500	963307	M15a	Flush with <i>Schoenus nigricans</i> , <i>Myrica gale</i> , <i>Succisa pratensis</i> and <i>Erica tetralix</i>
L8	22/09/11	298602	963291	M10b	Base-rich flush with <i>Schoenus nigricans</i> , <i>Campylium stellatum</i> , and <i>Scorpidium scorpioides</i>
L9	22/09/11	297715	962907		Base-rich channel with <i>Carex lepidocarpa</i> , <i>Equisetum palustre</i> , <i>Potamogeton polygonifolius</i> and <i>Juncus acutiflorus</i>
L10	23/09/11	298285	962422		Pools in an area of very wet poor-fen
L11	23/09/11	298186	962410	S9	Pool (probably very deep) and runnel within area of poor-fen containing <i>Carex lasiocarpa</i> , <i>C. rostrata</i> , <i>Potamogeton polygonifolius</i> and <i>Menyanthes trifoliata</i>
L12	25/09/2011	298906	960011	CG10?	Area of calcareous grassland with <i>Carex flacca</i> , <i>C. pulicaris</i> , <i>Festuca rubra</i> , <i>Galium verum</i> , <i>Linum catharticum</i> , <i>Lotus corniculatus</i> , <i>Plantago lanceolata</i> and <i>Viola riviniana</i>

Table 3. Results of Common Standards Monitoring of blanket bog habitat.

Surveyor		A Headley						
Date		25/09/2011						
Waypoint code		1	2	3	4	5	6	7
Easting		298849	298862	298765	298707	298127	298520	298692
Northing		960069	960325	960478	960640	960977	960123	959989
NVC community		M17a	M17	M19a	M20b	M25a	M15c	M19a
Indicator	scale							
At least 6 indicator taxa present?	4m ²	Yes (7)	Yes (7)	Yes (6)	Yes (6)	No (4)	Yes (6)	Yes (7)
Cover ≥50% from 3 or more indicator taxa?	4m ²	Yes (100%)	Yes (100%)	Yes (100%)	Yes (100%)	Yes (50%)	Yes (99%)	Yes (100%)
The cover of bog-mosscoming not only from flat-topped bog-moss?	4m ²	Yes	Yes	Yes	Yes	not present	Yes	Yes
Cover of hare's-tail cotton-grass or ericaceous shrubs or deergrass <75%?	4m ²	Yes	Yes	No. <i>Calluna</i> 80%	Yes	Yes	Yes	Yes
Cover of aliens < 1%?	visible	No	No	No	No	No	No	No
Cover of trees/shrubs <10%?	visible	No	No	No	No	No	No	No
Cover of common bent, Yorkshire fog, common reed, bracken, creeping buttercup <1%?	4m ²	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	visible	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Browsing <33% of last complete growing season's dwarf-shrub shoots?	4m ²	Yes	No	No	No	No	No	No
Browsing <66% where pioneer stage or <i>Betula nana</i> or <i>Myrica</i> ?	4m ²	not present	not present	not present	not present	not present	not present	not present
No burning into the moss, liverwort or lichen layer or exposure of peat surface	visible	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No burning in sensitive areas	visible	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Eroding peat / mineral soil less than re-deposition /	visible	Yes	Yes	Yes	Yes	Yes	Yes	Yes

re-vegetated areas?								
< 10% with disturbed bare ground, or drained by ditches or trampling?	4m ²	No	Yes	Yes	Yes	Yes	Yes	Yes
	visible	No	No	No	No	No	No	No
< 10% of bog-moss crushed, broken or pulled-up?	4m ²	No	No	Yes	No	not present	Yes	Yes
<10% of ground cover disturbed bare ground?	4m ²	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	visible	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of fails		5	5	5	5	5	4	4

Table 4. The correspondence between different types of habitat listed either in the EU Habitats Directive, national and local Biodiversity Action Plans (BAP).

Habitat	EU Habitats Directive	Priority BAP habitat	Local BAP (Caithness)
Blanket bog	Blanket bog (active)	Blanket bog	Blanket bog
Wet heath	Northern Atlantic wet heaths with <i>Erica tetralix</i>	Upland heathland	Heather moor
Dry heath	European dry heaths		
Acid grassland			
Marshy grassland		Purple moor-grass and rush pastures	
Acid flush			
Transition fen	Transition mires and quaking bogs	Lowland fens	
Swamps		Upland flushes, fens and swamps	
Basic flushes and springs	Alkaline fens		
Running water	Water courses of plain to montane levels with the <i>Ranunculion fluitantis</i> and <i>Callitriche-Batrachion</i> vegetation	Rivers	
Lochans	Oligotrophic waters containing very few minerals of sandy plains (<i>Littorelletalia uniflorae</i>)	Oligotrophic and dystrophic lakes	

Table 5. The distribution/abundance of different plant communities at the national (Britain), regional (North Highlands) and local (Caithness) scale and the number of hectads (10 km x 10 km OS grid squares) from which they have been recorded based on published maps in Rodwell (1991a, 1991b, 1992, 1995) and Averis *et al.* (2004).

NVC code	# hectads	nationally	regionally	locally	comments
H10	1024	widespread	widespread	widespread	Probably the commonest type of heath community in Caithness
H12	1427	widespread	widespread	widespread	The commonest type of heath community in Scotland
M1	70	infrequent	widespread	widespread	More widespread than available data suggests
M2	115	infrequent	rare	absent?	Far more widespread than available data suggests
M4		infrequent	rare	absent?	Probably under-recorded, but still an infrequent community
M5		infrequent	absent	absent?	A very infrequent community
M6	696	widespread	widespread	widespread	A common and widespread community in the uplands
M9	56	infrequent	rare	absent	A naturally infrequent and often rare community
M10	354	infrequent	widespread	widespread	A widespread, but highly localised community strong
M15	648	widespread	widespread	widespread	The commonest type of wet heath in northern Scotland
M16	151	infrequent	frequent	frequent	A widespread community that may be under-recorded
M17	423	widespread	widespread	widespread	A very common community in northern Scotland
M18	267	infrequent	widespread	widespread	A common community in northern Scotland
M19	515	widespread	widespread	widespread	Probably the commonest blanket bog community in Scotland
M20	186	widespread	absent?	absent?	A locally common community in certain parts of Britain
M23	524	widespread	infrequent	infrequent	A very common and widespread community
M25	833	widespread	widespread	infrequent	A very common and widespread community
M28	73	infrequent	infrequent	rare	A widespread but infrequent community of coastal areas in northern and western Scotland
M35	17	rare	absent	absent	An under-recorded community that is poorly defined in the NVC
S9		infrequent	widespread	infrequent	An under-recorded community of loch margins
MG1		widespread	infrequent	infrequent	The commonest type of neutral grassland in Britain

MG9		widespread	absent	absent?	A common and widespread community that is almost certainly present elsewhere in Caithness
MG10	331	widespread	infrequent	rare?	A common and widespread community that is almost certainly more widespread in Caithness
U4	905	widespread	widespread	widespread	A common and widespread community across the whole of Scotland
U5	593	widespread	widespread	infrequent	A common and widespread community across the whole of Scotland
U6	372	widespread	widespread	widespread	A common community in the uplands of Scotland
U20	497	widespread	widespread	infrequent	A very common and widespread community across the whole of Scotland
CG10	369	widespread	rare	absent?	Almost certainly present locally, but under-recorded
W1	140	infrequent	absent?	absent?	May be present locally in areas of wet woodland
W4	338	widespread	infrequent	absent?	A very common and widespread type of wet woodland which will almost be certainly present elsewhere in Caithness

Table 6. A list of the scientific names of vascular plants, mosses, liverworts and some lichens found in the survey area with their vernacular names.

scientific name	life-form	vernacular name
<i>Achillea millefolium</i>	forb	yarrow
<i>Achillea ptarmica</i>	forb	sneezewort
<i>Agrostis canina</i>	grass	velvet bent-grass
<i>Agrostis capillaris</i>	grass	common bent-grass
<i>Agrostis stolonifera</i>	grass	creeping bent-grass
<i>Aira caryophyllea</i>	grass	silver hair-grass
<i>Aira praecox</i>	grass	early hair-grass
<i>Anthoxanthum odoratum</i>	grass	sweet vernal grass
<i>Arrhenatherum elatius</i>	grass	false oat-grass
<i>Aulacomnium palustre</i>	moss	bog bead-moss
<i>Bellis perennis</i>	forb	daisy
<i>Betula pubescens</i>	tree	downy birch
<i>Blechnum spicant</i>	fern	hard fern
<i>Brachythecium rutabulum</i>	moss	rough-stalked feather-moss
<i>Breutelia chrysocoma</i>	moss	golden-head moss
<i>Briza media</i>	grass	quaking grass
<i>Bryum caespiticium</i>	moss	tufted thread-moss
<i>Calliergonella cuspidata</i>	liverwort	pointed spear-moss
<i>Callitriche hamulata</i>	submerged aquatic macrophyte	intermediate water-starwort
<i>Calluna vulgaris</i>	dwarf-shrub	heather
<i>Caltha palustris</i>	forb	marsh marigold
<i>Calypogeia fissa</i>	liverwort	common pouchwort
<i>Calypogeia muelleriana</i>	liverwort	Mueller's pouchwort
<i>Campylium stellatum</i>	moss	yellow starry feather-moss
<i>Campylopus flexuosus</i>	moss	rusty swan-neck moss
<i>Campylopus introflexus</i>	moss	heath star-moss
<i>Cardamine pratensis</i>	forb	lady's smock
<i>Carex binervis</i>	sedge	green-ribbed sedge
<i>Carex curta</i>	sedge	white sedge
<i>Carex demissa</i>	sedge	common yellow-sedge
<i>Carex echinata</i>	sedge	star sedge
<i>Carex flacca</i>	sedge	glaucous sedge
<i>Carex lasiocarpa</i>	sedge	slender sedge
<i>Carex lepidocarpa</i>	sedge	long-stalked yellow-sedge
<i>Carex nigra</i>	sedge	common sedge
<i>Carex panicea</i>	sedge	carnation sedge
<i>Carex paniculata</i>	sedge	greater tussock-sedge
<i>Carex pulicaris</i>	sedge	flea sedge
<i>Carex rostrata</i>	sedge	bottle sedge

scientific name	life-form	vernacular name
<i>Cephalozia bicuspidata</i>	liverwort	two-horned pincerwort
<i>Cerastium fontanum</i>	forb	common mouse-ear chickweed
<i>Ceratodon purpureus</i>	moss	redshank
<i>Chamerion angustifolium</i>	forb	rosebay willowherb
<i>Chara</i> c.f. <i>vulgaris</i>	submerged aquatic macrophyte	common stonewort
<i>Cirsium arvense</i>	forb	creeping thistle
<i>Cirsium palustre</i>	forb	marsh thistle
<i>Cladonia arbuscula</i>	lichen	a reindeer lichen
<i>Cladonia chlorophaea</i>	lichen	a reindeer lichen
<i>Cladonia portentosa</i>	lichen	a reindeer lichen
<i>Cladonia uncialis</i>	lichen	a reindeer lichen
<i>Corylus avellana</i>	tree	hazel
<i>Cratoneuron filicinum</i>	moss	fern-leaved hook-moss
<i>Ctenidium molluscum</i>	moss	comb-moss
<i>Cynosurus cristatus</i>	grass	crested dogstail
<i>Dactylorhiza maculata</i>	forb	heath spotted-orchid
<i>Danthonia decumbens</i>	grass	heath grass
<i>Deschampsia cespitosa</i>	grass	tufted hair-grass
<i>Deschampsia flexuosa</i>	grass	wavy hair-grass
<i>Dicranum scoparium</i>	moss	broom fork-moss
<i>Didymodon fallax</i>	moss	false beard-moss
<i>Digitalis purpurea</i>	forb	foxglove
<i>Diplophyllum albicans</i>	liverwort	white earwort
<i>Drosera rotundifolia</i>	forb	round-leaved sundew
<i>Dryopteris dilatata</i>	fern	broad buckler-fern
<i>Eleocharis palustris</i>	sedge	common spike-rush
<i>Empetrum nigrum nigrum</i>	dwarf-shrub	crowberry
<i>Epilobium palustre</i>	forb	marsh willowherb
<i>Equisetum fluviatile</i>	horsetail	water horsetail
<i>Equisetum palustre</i>	horsetail	marsh horsetail
<i>Erica cinerea</i>	dwarf-shrub	bell heather
<i>Erica tetralix</i>	dwarf-shrub	cross-leaved heath
<i>Eriophorum angustifolium</i>	sedge	common cotton-grass
<i>Eriophorum vaginatum</i>	sedge	harestail cotton-grass
<i>Festuca ovina</i>	grass	sheep's fescue
<i>Festuca rubra</i>	grass	red fescue
<i>Filipendula ulmaria</i>	forb	meadowsweet
<i>Fontinalis antipyretica</i>	moss	greater water-moss
<i>Funaria hygrometrica</i>	moss	bonfire-moss
<i>Galium palustre</i>	forb	marsh bedstraw
<i>Galium saxatile</i>	forb	heath bedstraw

scientific name	life-form	vernacular name
<i>Galium verum</i>	forb	lady's bedstraw
<i>Geranium robertianum</i>	forb	herb robert
<i>Geum rivale</i>	forb	water avens
<i>Hieracium sp.</i>	forb	a hawkweed
<i>Holcus lanatus</i>	grass	Yorkshire fog
<i>Hydrocotyle vulgaris</i>	forb	common pennywort
<i>Hylocomium splendens</i>	moss	glittering wood-moss
<i>Hypericum pulchrum</i>	forb	slender St John's-wort
<i>Hypnum cupressiforme</i>	moss	cypress-leaved plait-moss
<i>Hypnum jutlandicum</i>	moss	heath plait-moss
<i>Hypnum lacunosum</i>	moss	great plait-moss
<i>Iris pseudacorus</i>	forb	yellow flag
<i>Juncus acutiflorus</i>	rush	sharp-flowered rush
<i>Juncus articulatus</i>	rush	jointed rush
<i>Juncus bulbosus/kochii</i>	rush	bulbous rush
<i>Juncus conglomeratus</i>	rush	compact rush
<i>Juncus effusus</i>	rush	soft rush
<i>Juncus squarrosus</i>	rush	heath rush
<i>Lemna minor</i>	floating-leaved aquatic macrophyte	common duckweed
<i>Leontodon autumnalis</i>	forb	autumnal hawkbit
<i>Linum catharticum</i>	forb	purging flax
<i>Lophocolea bidentata</i>	liverwort	bifid crestwort
<i>Luzula campestris</i>	rush	field woodrush
<i>Luzula multiflora</i>	rush	heath woodrush
<i>Luzula sylvatica</i>	rush	greater woodrush
<i>Lychnis flos-cuculi</i>	forb	ragged robin
<i>Marchantia polymorpha ssp. polymorpha</i>	liverwort	common liverwort
<i>Marsupella emarginata</i>	liverwort	notched rustwort
<i>Menyanthes trifoliata</i>	forb	bogbean
<i>Molinia caerulea</i>	grass	purple moor-grass
<i>Montia fontana</i>	forb	blinks
<i>Mylia taylorii</i>	liverwort	Taylor's flapwort
<i>Myosotis scorpioides</i>	forb	water forget-me-not
<i>Myrica gale</i>	dwarf-shrub	bog myrtle
<i>Myriophyllum alterniflorum</i>	submerged aquatic macrophyte	alternate water-milfoil
<i>Nardus stricta</i>	grass	mat-grass
<i>Narthecium ossifragum</i>	forb	bog asphodel
<i>Odontoschisma sphagnii</i>	liverwort	bog-moss flapwort

scientific name	life-form	vernacular name
<i>Oxalis acetosella</i>	forb	wood sorrel
<i>Palustriella commutata</i>	moss	curled hook-moss
<i>Pedicularis palustris</i>	forb	marsh lousewort
<i>Pellia epiphylla</i>	liverwort	overleaf peltia
<i>Pellia neesiana</i>	liverwort	Nees' peltia
<i>Peltigera membranacea</i>	lichen	dog tooth lichen
<i>Philonotis fontana</i>	moss	fountain apple-moss
<i>Pinguicula vulgaris</i>	forb	common butterwort
<i>Plagiomnium rostratum</i>	moss	long-beaked thyme-moss
<i>Plagiothecium undulatum</i>	moss	waved silk-moss
<i>Plantago lanceolata</i>	forb	ribwort plantain
<i>Plantago major</i>	forb	greater plantain
<i>Pleurozium schreberi</i>	moss	red-stemmed feather-moss
<i>Poa annua</i>	grass	annual meadow-grass
<i>Poa pratensis</i>	grass	soft meadow-grass
<i>Pogonatum urnigerum</i>	moss	urn haircap
<i>Polygala serpyllifolia</i>	forb	heath milkwort
<i>Polypodium vulgare</i>	fern	common polypody
<i>Polytrichastrum formosum</i>	moss	bank haircap
<i>Polytrichum commune</i>	moss	common haircap
<i>Polytrichum juniperinum</i>	moss	juniper haircap
<i>Polytrichum piliferum</i>	moss	bristly haircap
<i>Potamogeton polygonifolius</i>	floating-leaved aquatic macrophyte	bog pondweed
<i>Potentilla erecta</i>	forb	tormentil
<i>Potentilla palustris</i>	forb	marsh cinquefoil
<i>Prunella vulgaris</i>	forb	selfheal
<i>Pseudoscleropodium purum</i>	moss	neat feather-moss
<i>Pteridium aquilinum</i>	fern	bracken
<i>Ptilidium ciliare</i>	liverwort	ciliated fringewort
<i>Racomitrium ericoides</i>	moss	dense fringe-moss
<i>Racomitrium lanuginosum</i>	moss	woolly fringe-moss
<i>Ranunculus acris</i>	forb	meadow buttercup
<i>Ranunculus flammula</i>	forb	lesser spearwort
<i>Ranunculus repens</i>	forb	creeping buttercup
<i>Rhizomnium punctatum</i>	moss	dotted thyme-moss
<i>Rhytidiadelphus loreus</i>	moss	little shaggy-moss
<i>Rhytidiadelphus squarrosus</i>	moss	springy turf-moss
<i>Rhytidiadelphus triquetrus</i>	moss	big shaggy-moss
<i>Rumex acetosa</i>	forb	common sorrel
<i>Salix aurita</i>	shrub	eared sallow
<i>Salix cinerea</i>	shrub	grey willow

scientific name	life-form	vernacular name
<i>Scapania undulata</i>	liverwort	water earwort
<i>Schoenus nigricans</i>	sedge	black bog-rush
<i>Scorpidium cossonii</i>	moss	intermediate hook-moss
<i>Scorpidium scorpioides</i>	moss	hooked scorpion-moss
<i>Senecio aquaticus</i>	forb	marsh ragwort
<i>Senecio jacobaea</i>	forb	common ragwort
<i>Sonchus oleraceus</i>	forb	smooth sow-thistle
<i>Sorbus aria</i>	tree	whitebeam
<i>Sorbus aucuparia</i>	tree	rowan
<i>Sparganium angustifolium</i>	floating-leaved aquatic macrophyte	floating bur-reed
<i>Sphagnum capillifolium</i> ssp. <i>capillifolium</i>	moss	acute-leaved bog-moss
<i>Sphagnum capillifolium</i> ssp. <i>Rubellum</i>	moss	red bog-moss
<i>Sphagnum compactum</i>	moss	compact bog-moss
<i>Sphagnum cuspidatum</i>	moss	feathery bog-moss
<i>Sphagnum denticulatum</i>	moss	cow-horn bog-moss
<i>Sphagnum fallax</i>	moss	flat-topped bog-moss
<i>Sphagnum fimbriatum</i>	moss	fringed bog-moss
<i>Sphagnum inundatum</i>	moss	lesser cow-horn bog-moss
<i>Sphagnum palustre</i>	moss	blunt-leaved bog-moss
<i>Sphagnum papillosum</i>	moss	papillose bog-moss
<i>Sphagnum squarrosum</i>	moss	spiky bog-moss
<i>Sphagnum subnitens</i>	moss	lustrous bog-moss
<i>Sphagnum tenellum</i>	moss	soft bog-moss
<i>Stachys sylvatica</i>	forb	hedge woundwort
<i>Stellaria alsine</i>	forb	bog stitchwort
<i>Succisa pratensis</i>	forb	devilsbit scabious
<i>Thuidium tamariscinum</i>	moss	common tamarisk-moss
<i>Trichophorum germanicum</i>	sedge	deer-sedge
<i>Trifolium dubium</i>	forb	lesser trefoil
<i>Trifolium repens</i>	forb	white clover
<i>Ulex europaea</i>	shrub	common gorse
<i>Urtica dioica</i>	forb	stinging nettle
<i>Vaccinium myrtillus</i>	dwarf-shrub	bilberry
<i>Vaccinium vitis-idaea</i>	dwarf-shrub	cowberry
<i>Viola palustris</i>	forb	marsh violet
<i>Viola riviniana</i>	forb	common dog-violet
<i>Warnstorfia exannulata</i>	moss	ringless hook-moss
<i>Warnstorfia fluitans</i>	moss	floating hook-moss

Table 7. Composition of ‘mosaic’ polygons. See Table 1 for the names of the communities and sub-communities. Explanation of abbreviations: UID = polygon number; rw = running water; sw = standing water; b-l p = broad-leaved plantation; <1 = less than 1%.

UID	date																
1	22/09/2011	Easting	299476	code	track	H10a	U4a	M25a									
		Northing	957763	%	40	35	20	5									
2	22/09/2011	Easting	299592	code	M17b	M6c	M15b	M15c	U4a	U4e	lw						
		Northing	957849	%	69	10	5	5	5	5	1						
3	22/09/2011	Easting	299409	code	M17b	M15c	M17a	M19a	U5b								
		Northing	958035	%	64	20	10	5	1								
4	22/09/2011	Easting	299577	code	U4a	M6c	MG10a	U4e	M35	rw							
		Northing	958181	%	38	30	20	10	1	1							
5	22/09/2011	Easting	299514	code	track	M15b	M19a	M17b	H10a	MG10a	U20c	M6c	rock				
		Northing	958157	%	30	25	20	10	5	5	2	2	1				
6	22/09/2011	Easting	299161	code	U20c	M6c	M15b	M19a	H10a	U20b	M17b	track	rw				
		Northing	958525	%	27	20	20	10	10	5	5	2	1				
7	22/09/2011	Easting	299486	code	U4a	M6c	M19a	U4e	M25a	rw							
		Northing	958699	%	51	30	10	5	3	1							
8	22/09/2011	Easting	298918	code	U4a	U20c	U20a	MG9a	H10a	MG10a	M28a	MG1a	M6c	U4e	track	buildings	rock
		Northing	960869	%	40	20	10	10	10	5	2	1	1	1	<1	<1	<1
9	22/09/2011	Easting	299198	code	M25a	M20a	M6c	M6a	M19a	U20a	M23a						
		Northing	960771	%	29	20	20	10	10	10	1						
10	22/09/2011	Easting	299383	code	M25a	MG10a	U20a	M6c	U4a	M28a	M9	M5	rw	M10a			
		Northing	961002	%	31	20	20	10	10	5	2	1	1	<1			
11	22/09/2011	Easting	298411	code	M15b	M25a	track	M2									
		Northing	961727	%	40	30	30	<1									
12	22/09/2011	Easting	297425	code	U20c	H10a	U4a	U5b	U20b	b-l p							
		Northing	962715	%	48	30	10	5	5	2							
13	22/09/2011	Easting	297664	code	M15b	U4a	H10a	M25a									
		Northing	962611	%	70	20	5	5									

14	22/09/2011	Eastings	298362	code	H10a	U20b	M15b	M19a	U4a	U5b	rock							
		Northings	963171	%	76	10	10	1	1	1	1							
15	22/09/2011	Eastings	298515	code	U20c	H10a	U20b	M15b	M25a	U4a								
		Northings	963297	%	39	30	20	5	5	1								
16	22/09/2011	Eastings	298808	code	H10a	U20c	U20b	M15b	M25a	rock	M19a	M2						
		Northings	962904	%	40	33	20	5	1	1	<1	<1						
17	22/09/2011	Eastings	298528	code	M19a	M15b	M17a	H10a	M2	M18b	M1							
		Northings	963017	%	40	38	15	5	1	1	<1							
18	22/09/2011	Eastings	298062	code	M15b	H10a	rock											
		Northings	963191	%	70	30	<1											
19	22/09/2011	Eastings	297714	code	M25a	MG10a	M23a	U4a	M9									
		Northings	962906	%	40	35	20	5	<1									
20	23/09/2011	Eastings	297552	code	M25a	M15b	track	MG10a	U4a	U20c	W23c	W4c						
		Northings	961633	%	47	25	20	5	1	1	1	<1						
21	23/09/2011	Eastings	298175	code	M17b	M17a	sw	M18b	M19a	M2								
		Northings	961292	%	40	20	20	10	5	5								
22	23/09/2011	Eastings	298283	code	M15b	H10a	U20c	rock										
		Northings	961407	%	88	10	1	1										
23	23/09/2011	Eastings	298040	code	M15b	H10a	M15c	M17a	U4a	U20	rock							
		Northings	961757	%	40	33	20	4	1	1	1							
24	23/09/2011	Eastings	298074	code	M19a	M15b	M17b	M17a	M2	M18b								
		Northings	961803	%	44	30	20	5	1	<1								
25	23/09/2011	Eastings	298237	code	M25a	MG10a	U4a	M15b	H10a	track								
		Northings	961917	%	30	30	20	10	5	5								
26	23/09/2011	Eastings	298837	code	U20c	U20a	M25a	MG9a	U4a	rock								
		Northings	961834	%	67	20	10	1	1	1								
27	23/09/2011	Eastings	298953	code	U20c	M25a	U20a	H10a	rw	rock	sw							
		Northings	962133	%	48	30	20	1	1	<1	<1							
28	23/09/2011	Eastings	298876	code	MG10a	M28a	U4a	U20	MG9a	U20a	rw							

		Northing	962510	%	59	10	10	10	5	5	1							
29	23/09/2011	Easting	298873	code	H10a	U20c	U20a	M19a	rw									
		Northing	962781	%	73	20	5	1	1									
30	23/09/2011	Easting	299097	code	U20c	U20a	rw											
		Northing	963266	%	89	10	1											
31	23/09/2011	Easting	299065	code	M15b	M25a	M6a	M15a	M35	W1	W4c							
		Northing	963320	%	41	35	10	10	2	1	1							
32	23/09/2011	Easting	298687	code	H10a	M25a	U20c	M15b	MG10a	U20a	U20b	W23c	W1	rock	rw	U4a		
		Northing	963680	%	20	20	20	10	10	10	5	1	1	1	1	1	1	
33	23/09/2011	Easting	298707	code	MG10a	buildings												
		Northing	962633	%	99	1												
34	23/09/2011	Easting	298686	code	U4a	MG9a	H10a	M15b										
		Northing	962481	%	69	20	10	1										
35	23/09/2011	Easting	298436	code	M25a	M15b	M23b	U4a	M6a	H10a	M6b	M6c	M19a	M28a	S9b	rw	sw	buildings
		Northing	962414	%	72	5	5	5	5	1	1	1	1	1	1	1	1	1
37	23/09/2011	Easting	298901	code	M19a	M17a	track	U4a	H10a	M6c	M2							
		Northing	959900	%	35	30	10	10	10	5	<1							
38	23/09/2011	Easting	297332	code	U4a	W23c	track	U20c	MG10a	H10a	M25a	buildings						
		Northing	962849	%	25	20	15	14	10	10	5	1						
39	23/09/2011	Easting	297199	code	H10a	M15b	U20c	W23c	MG10a	U4a								
		Northing	962993	%	20	20	20	20	10	10								
40	23/09/2011	Easting	297353	code	M15b	M23b	M6a	M6c	H10a	M35	U4a							
		Northing	962964	%	47	20	10	10	10	2	1							
41	23/09/2011	Easting	297496	code	H10a	U20b	U20c	U4a	rock									
		Northing	962945	%	78	10	10	1	1									
42	24/09/2011	Easting	297126	code	U20c	W23c	M15b	H10a	U20a	M6a	rw							
		Northing	962936	%	58	20	10	5	5	1	1							
43	24/09/2011	Easting	296885	code	H10a	M15b	M15c	W4c	M6c	conifers	M6a	MG10a	U20c					
		Northing	963209	%	60	10	10	10	5	2	1	1	1					

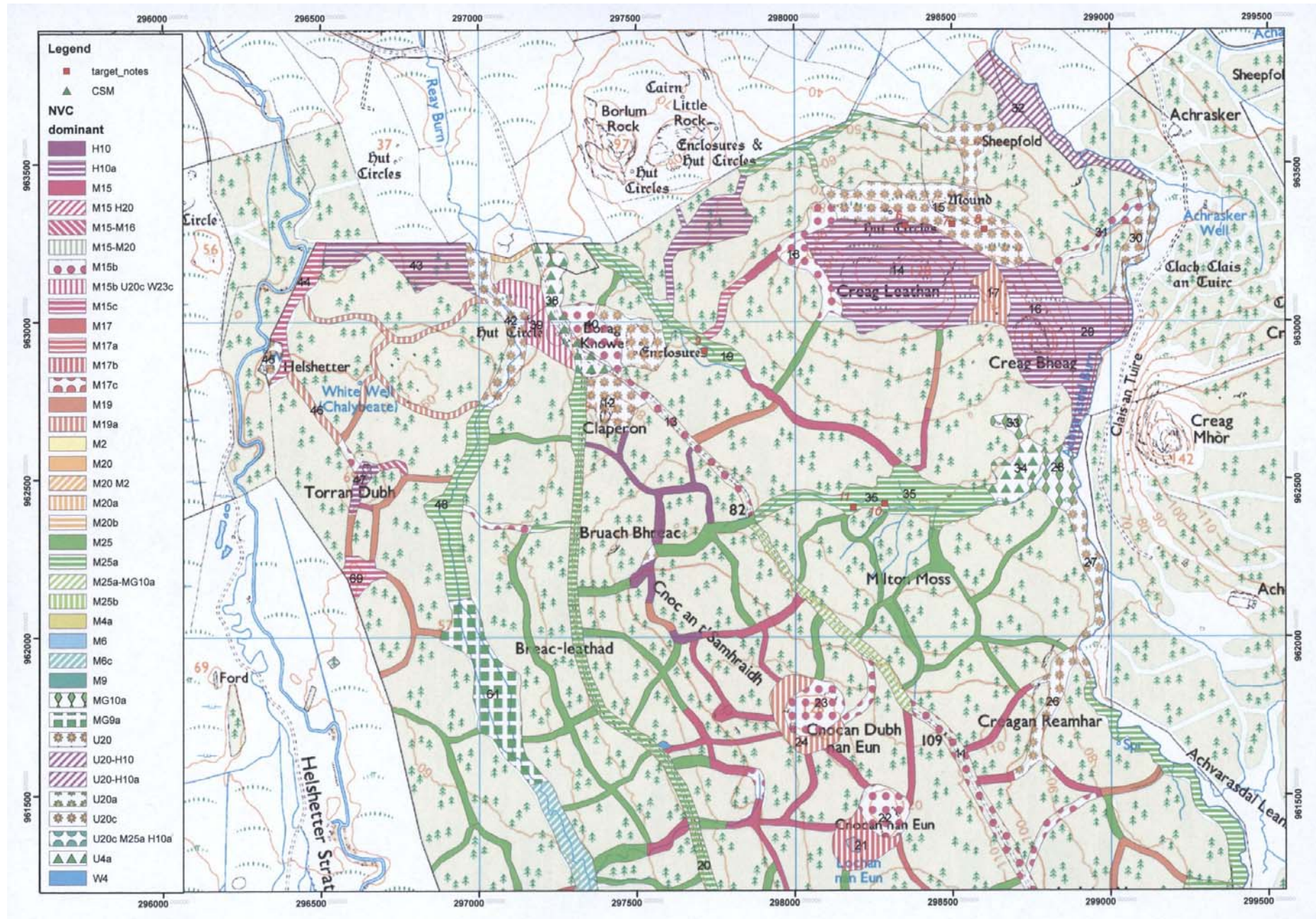
44	24/09/2011	Eastings	296372	code	M15c	conifers	H10a	M15b	M2								
		Northing	962920	%	79	10	5	5	1								
45	24/09/2011	Eastings	296356	code	U20c	U4a	MG10a	buildings	H10a	MG9a							
		Northing	962850	%	62	25	5	5	2	1							
46	24/09/2011	Eastings	296562	code	M19a	M15b	M2										
		Northing	962599	%	94	5	1										
47	24/09/2011	Eastings	296627	code	H10a	M15b	U20a	U20b	U20c	rock							
		Northing	962478	%	79	5	5	5	5	1							
48	24/09/2011	Eastings	296929	code	M25a	H10a	M15b	M19a	M23b	M6c	MG9a	rw					
		Northing	962432	%	49	10	10	10	10	5	5	1					
49	24/09/2011	Eastings	298319	code	M15b	M6c	M25a	U5b	U20c	M2	M20a	U4a	rw				
		Northing	959433	%	71	10	5	5	5	1	1	1	1				
50	24/09/2011	Eastings	297987	code	M15b	M20a	M6c	M15c	M17b	M19a	M25a	U4a	U5b	U20b	U20c	rw	M2
		Northing	959435	%	39	20	10	10	10	5	1	1	1	1	1	1	1
51	24/09/2011	Eastings	298131	code	M15b	U20c	M23b	H10a	M6c	M25a	U20b	rw	rock				
		Northing	959964	%	39	25	10	10	5	5	5	1	<1				
52	24/09/2011	Eastings	298739	code	H10a	U20b	U20c	M15b	M16d	H12a							
		Northing	959017	%	48	20	20	10	1	1							
53	24/09/2011	Eastings	298376	code	M17b	M15c	M19a	H10a	M20a								
		Northing	958924	%	48	30	20	1	1								
54	24/09/2011	Eastings	299045	code	M17b	M15b	M15c	M19a	M20a								
		Northing	958754	%	39	20	20	20	1								
55	25/09/2011	Eastings	298883	code	U20a	track	H10a	M23b	M25a	M6a	CG10b	U4a					
		Northing	959987	%	20	20	20	15	10	5	5	5					
56	25/09/2011	Eastings	299220	code	M25a	M15b	M17a	H10a	M2	M6c	M19a	M20a	U20c				
		Northing	960276	%	28	25	20	10	5	5	5	1	1				
57	25/09/2011	Eastings	299474	code	M15b	U20a	M25a	U20c	M6c	M19a	M23b	U4a	rw				
		Northing	960547	%	25	24	20	10	5	5	5	5	1				
58	25/09/2011	Eastings	299539	code	U20c	U20a	H10a	M15b	M19a	M25a	MG10a	U4a	rw	buildings			

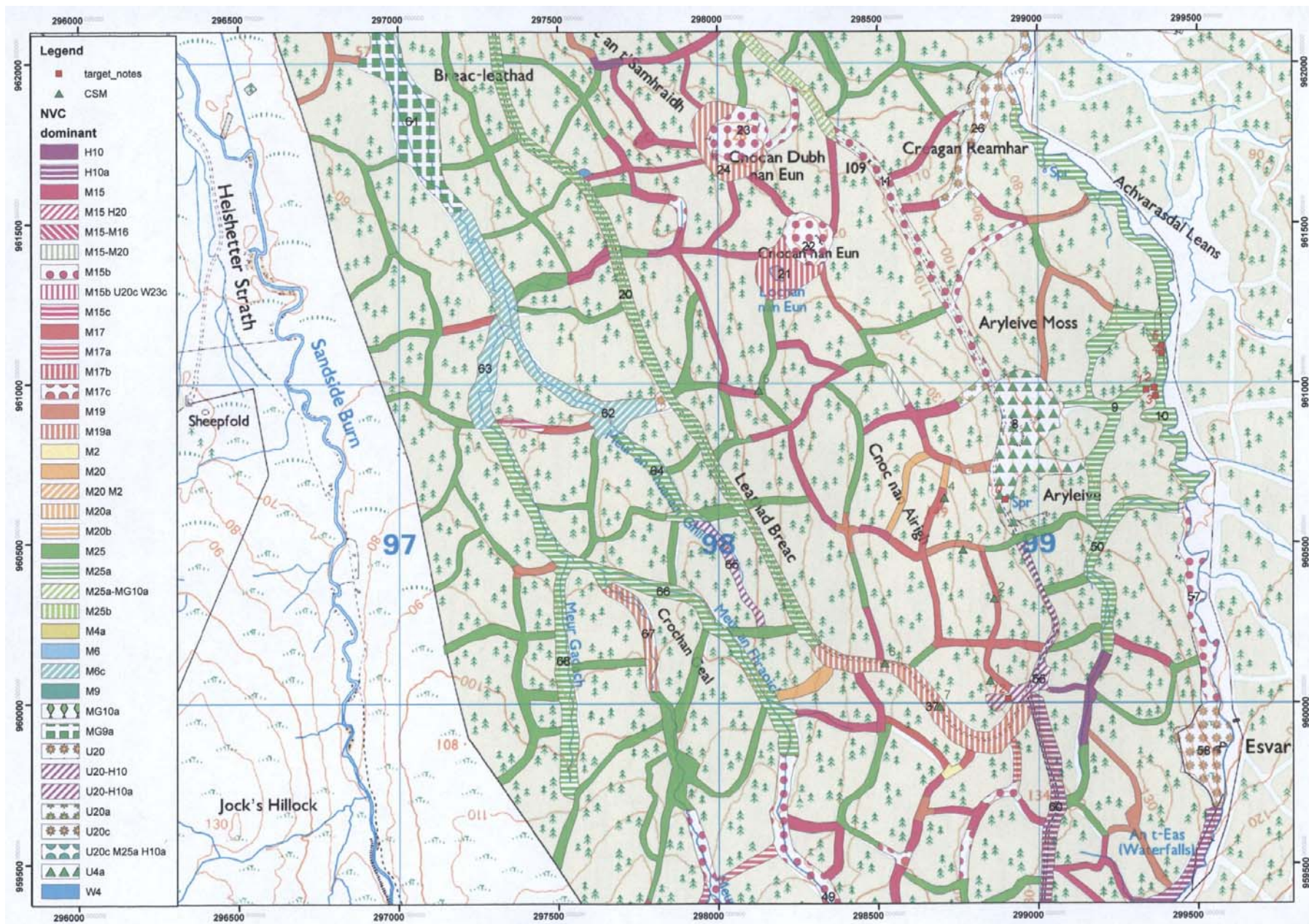
		Northing	959912	%	48	25	20	2	1	1	1	1	1	<1				
59	25/09/2011	Easting	299536	code	H10a	U20a	M15b	M19a	M25a	U20c	U4a	rw	M2	M6c	M20a	M23b	rock	
		Northing	959600	%	28	20	10	10	10	10	5	2	1	1	1	1	1	
60	25/09/2011	Easting	299223	code	H10a	track	M25a	M23b	M15b	MG10a	U4a	rock	M2	sw				
		Northing	958930	%	20	20	18	15	10	5	5	5	1	1				
61	26/09/2011	Easting	296952	code	MG9a	M23b	M6c	M15b	M25a	M28a	MG10a	H10a	rw	M4				
		Northing	962014	%	47	20	10	5	5	5	5	2	1	<1				
62	26/09/2011	Easting	297575	code	M6c	M25a	M15b	M23b	H10a	M19a	MG10a	U4a	M6a	rw	b-l p			
		Northing	960937	%	30	28	10	10	5	5	5	5	1	1	<1			
63	26/09/2011	Easting	297265	code	M6c	U4a	M15b	M23b	M25a	U20a	H10a	MG10a	U5b	M6a	rw			
		Northing	960867	%	23	20	10	10	10	10	5	5	5	1	1			
64	26/09/2011	Easting	297885	code	M25a	M19a	M6c	rw										
		Northing	960585	%	85	10	5	<1										
65	26/09/2011	Easting	297987	code	H10a	U20c	U20b	M6c	M15b	M25a								
		Northing	960544	%	44	40	10	2	2	2								
66	26/09/2011	Easting	298097	code	M25a	U20c	M19a	H10a	M6c	M15b	M6a	U4a	U20a	rw				
		Northing	960094	%	31	30	15	10	5	5	1	1	1	1				
67	26/09/2011	Easting	297803	code	M19a	M25a	U20c	M6c	M23b	H10a	U20b	U4a	rw					
		Northing	960122	%	24	20	20	10	10	10	5	1	<1					
68	26/09/2011	Easting	297543	code	M25a	M19a	M15b	U20c	M6c	H10a	U20b	U4a	rw					
		Northing	960084	%	29	25	15	10	10	5	5	1	<1					
69	26/09/2011	Easting	296607	code	M15c	H10a	M2	M19a	rock									
		Northing	962195	%	87	10	1	1	1									

10. MAPS

Figure 3. Maps showing the distribution of the dominant plant communities in each of the polygons within the Limekiln survey area.

Numbers in black refer to polygon numbers shown in Table 7 where more detailed descriptions of the proportions of the different plant communities present are given. Red squares indicate the location of target notes and their respective numbers in Table 2 are shown in red. Green triangles indicate the location of condition assessment locations of the blanket bog habitat and their respective numbers in Table 3 are shown in green.





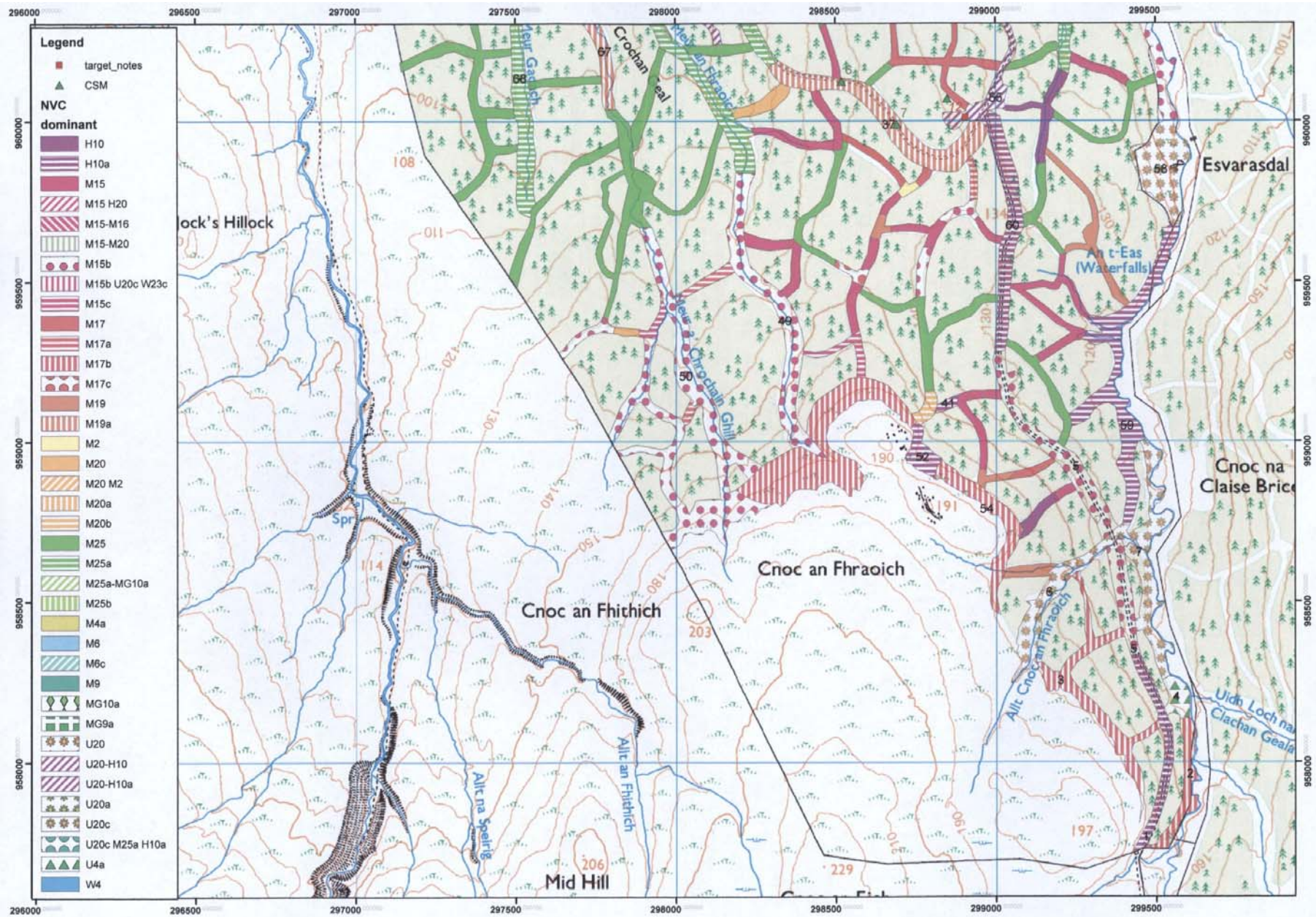


Figure 4. Areas of quality habitat within the Limekiln Plantation survey area that should be avoided by the proposed development.

