

Appendix 9

Vegetation

**Realignment of Penrhyn Quarry
Environmental Impact Assessment**

Ecological Survey Report : VEGETATION SURVEYS

November 2010

Cynefin Consultants Ltd
1 New York Cottages • Bangor Road •
Penmaenmawr • Conwy • LL34 6NP
(01492) 622272
info@cynefin.co.uk

The logo for Cynefin Consultants, featuring the word "Cynefin" in a green, serif font above the word "Consultants" in a smaller, green, sans-serif font.

Background

- 1.1 Cynefin Environmental Consultants Ltd (Cynefin) has been appointed to undertake ecological surveys to inform the Environmental Impact Assessment (EIA) in relation to a proposal to re-align the quarry workings at Penrhyn Quarry, Bethesda. This would involve increasing the permitted quarry area by 8.6 ha into open mountain moorland which forms part of a statutory nature conservation area, namely the Eryri Special Area of Conservation (SAC) and its associated Site of Special Scientific Interest (SSSI). The site is also situated just outside the northern boundary of the Snowdonia National Park.
- 1.2 As part of the scoping of the EIA it was identified that it is necessary to conduct surveys of the vegetation on the site. In the present context, this includes detailed vegetation mapping at a National Vegetation Classification (NVC) level and an assessment of what plant species are present on the site, these to include bryophytes. Lichens and fungi are dealt with elsewhere in this EIA. A qualified and experienced fieldworker, Dr Rod Gritten PhD, PGCE, CBiol, MSB was appointed to undertake the fieldwork associated with regard to this aspect and this was completed between April and October 2010. The results of the survey are set out in the remainder of this report.

Key findings

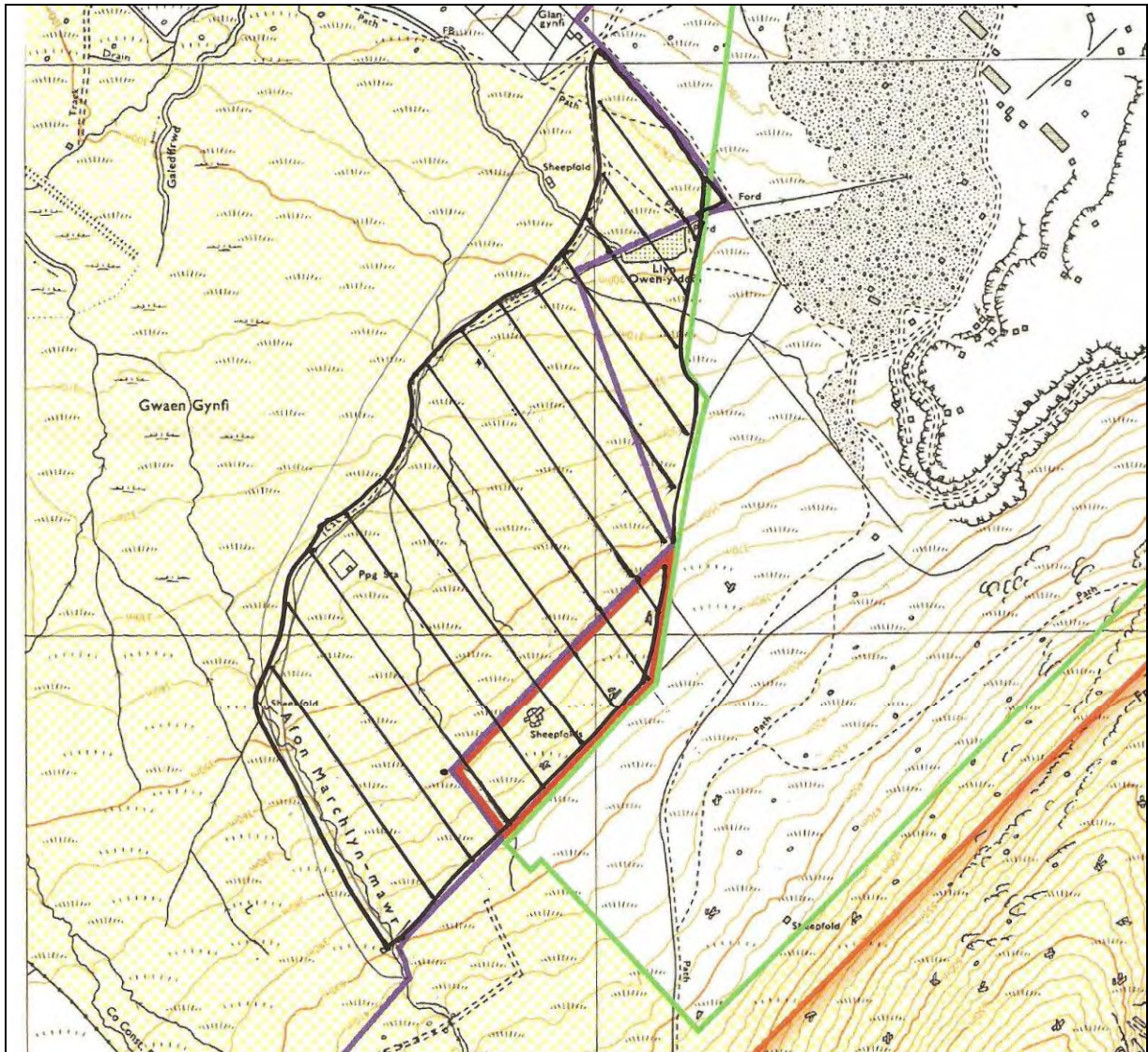
- A detailed NVC survey of the realignment area and an area of the extensive mire known as Gwaen Gynfi to the east of the Afon Marchllyn-mawr below the realignment area was undertaken.
- The 8.6 hectare realignment area is mostly composed of relatively uninteresting grazed acid grassland interspersed with large boulders and patches of bracken.
- A small (c1 hectare) section of mire to the extreme western end of the realignment area is considerably more species-rich. Lesser Twayblade (*Listera cordata*) was found here. This mire represents the southern tip of a large blanket bog known as Gwaen Gynfi, part of which lies within the search area. An option to avoid this area altogether is discussed.
- The presence of *Eriophorum vaginatum*, thinly scattered over the whole of Gwaen Gynfi including the mire within the realignment area, suggests a complex history of past peat extraction, grazing and burning management.
- The most interesting vegetation within that part of Gwaen Gynfi that lies within the survey area is more-or-less confined to springs and seepages that arise from

the middle of the mire before eventually flowing into Llyn Owen-y-ddol. These springs and seepages are considered to be the most likely habitat for the rare moss *Hamatocaulis (Drepanocladus) vernicosus* on that part of Gwaen Gynfi that lies within the survey area but despite several detailed searches for this species, it was not found. This moss is known from similar habitats on Llanllechid common to the northeast of the site but Gwaen Gynfi is probably too acidic.

- During previous surveys of Gwaen Gynfi conducted in 1993-1995 for a previous planning application by Alfred McAlpine Slate Products Ltd, the extremely rare moss *Hypnum imponens* was found in only one quadrat. Despite repeated surveys of the mire, this moss was not re-found.
- The most likely damage to the blanket bog vegetation below the realignment area is likely to be as a result of hydrological changes caused by the creation of quarry voids in both the extension area as well as the realignment area.
- Mitigation for the potential loss of surface water run-off into the upslope area of Gwaen Gynfi below the realignment area is discussed. This will be achieved by the construction of an interception leat following the 470mOD contour above the current quarry void and the extension area.

Survey protocols

- 1.3 The 8.6 hectare realignment area is the area subject to the present planning application. Since it is envisaged that the proposal to extract slate from this area could have an impact on the hydrology of Gwaen Gynfi, the large blanket bog below the realignment area, a wider area of search was also included within the present vegetation surveys. This is illustrated in **Map 1** below.



Map 1. The survey area is hatched in black with the realignment area bordered in red.

This wider survey area is bordered by the Afon Marchlyn-mawr to the west, its main tributary that flows into Llyn Owen-y-ddol to the north and the Quarry to the

east and south. A small area of wet heath to the north of the lake was also included in the search area. It is estimated that the area of blanket bog included in the survey area represents some 10% of Gwaen Gynfi.

Several survey protocols were used during the vegetation surveys. Firstly, a comprehensive walk-over of the entire site was conducted in order to obtain a broad idea of the different vegetation communities present. This was carried out on two separate occasions during the survey season and a plant species list was made. Then, each of the main communities that were composed of homogenous vegetation were subjected to the standardised National Vegetation Classification (NVC) survey protocols. For the sake of consistency, five 2 x 2 metre quadrats randomly selected within each of these communities were marked out, photographed and all plants identified with their cover measured using the Domin scale. Results were analysed using MATCH (Version 4: 2004) and each community ascribed according to the best fit.

Additional in-stream and riparian vegetation surveys were made of the Afon Marchllyn-mawr, the streams running down through Gwaen Gynfi within the search area and the littoral zone of Llyn Owen-y-ddol.

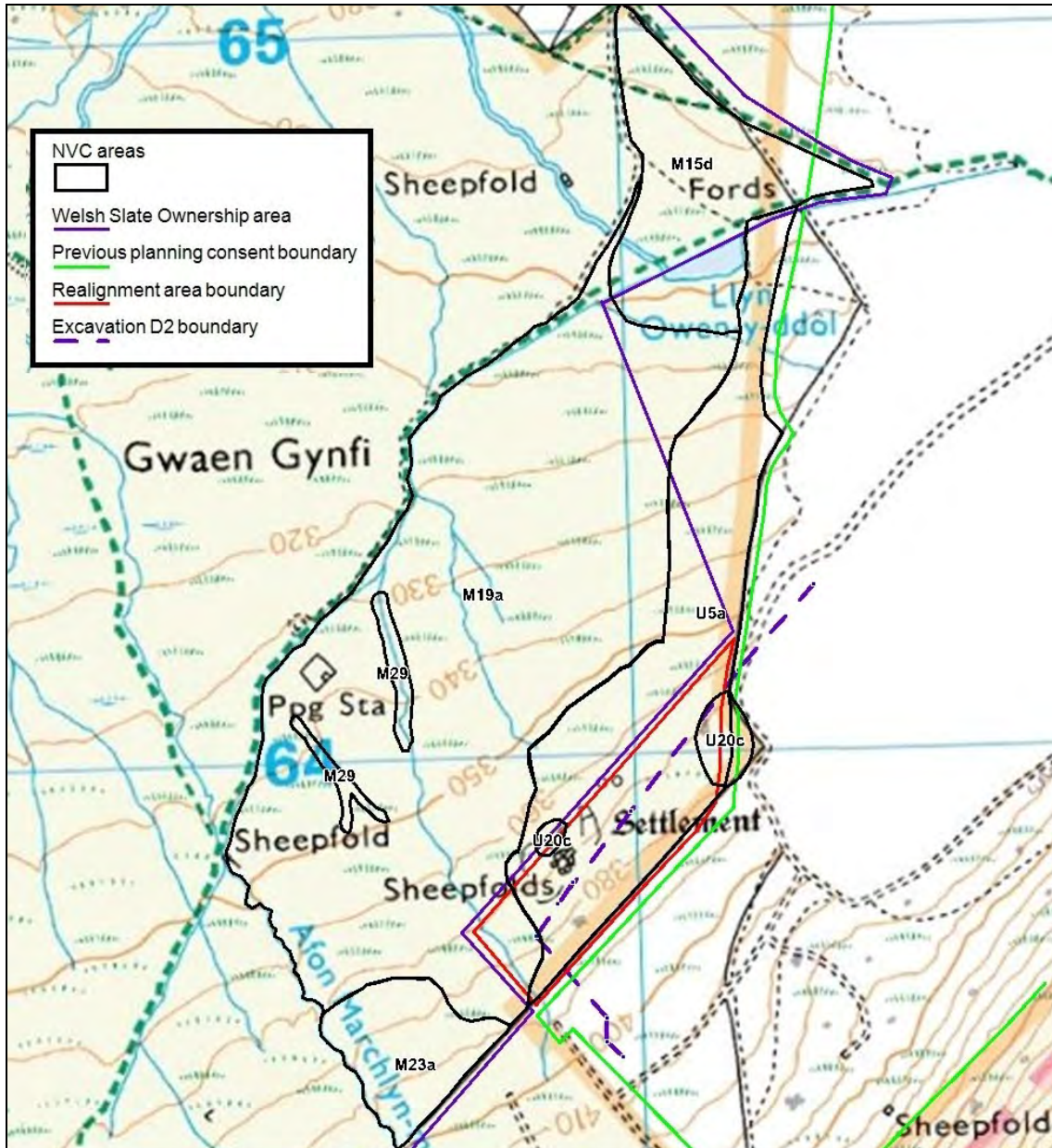
A dedicated survey was also conducted for bryophytes with special attention being paid to the boulder field within the realignment area itself.

Site description

- 2.0 The realignment area lies at an altitude of approximately 380 metres above the village of Mynydd Llandegai to the west of the existing Penrhyn Slate Quarry. It is broadly composed of two more-or-less level platforms, with the Settlement and stone-built sheep pen complex dominating the lower of the two platforms (see **Map 1**). An 11 KV overhead power line runs from east to west across the lower edge of the top platform at the break of slope. The realignment area is separated from the main Quarry by a drystone wall to the south. This wall is not stock-proof. The lower platform eventually falls away into the blanket bog of Gwaen Gynfi to the north and west. The lower edge of the survey area lies at approximately 290 metres. A number of small streams, springs and seepages arise from within Gwaen Gynfi below the realignment area and eventually drain into Llyn Owen-y-ddol along a man-made leat. Gwaen Gynfi itself is somewhat featureless with a disused pumping station dominating the view at the north western corner of the wider search area. It is entirely treeless. Its gradient is more-or-less uniform throughout the search area. Both the realignment area and the wider search area lie within the Eryri Special Area of Conservation (SAC) and is some 500 metres away from the Snowdonia National Park boundary to the south.

Results: the NVC survey

- 3.0 The map (**Map 2**) that was generated by the NVC survey can be found below. Each of the NVC tables and the MATCH results can be found in the Appendices. Three communities were represented within the realignment area itself and five outside it within the wider search area. These will be described separately below. A full species list of all the plants found during the surveys can be found in **Appendix 8**.



Map 2. NVC map of the realignment and wider survey areas.

- 3.1 **Bracken dominated stands within the realignment area.** Two Bracken (*Pteridium aquilinum*) dominated stands are found within the realignment area (see **Map 2**). These correspond to the **NVC:U20c *Pteridium aquilinum-Galium saxatile*** species poor sub-community and clearly lie on slightly well-drained deeper soils. Most of the plants found beneath the Bracken were graminoids, notably *Holcus lanatus*, *Agrostis capillaris* and *Festuca ovina* with thinly scattered stands of *Juncus effusus* where the drainage is more impeded. Forbs were few in number, notably *Oxalis acetosella*, *Galium saxatile* and *Potentilla erecta*. Mosses most commonly seen within the Bracken stands were *Rhytidiadelphus squarrosus* and *Kindbergia praelonga*. Since the **U20c** areas only represent a small proportion of the search area (and are species-poor), it was considered that detailed quadrat analysis was unnecessary.
- 3.2 **U5 acid grassland.** The results of the NVC survey of the acid grassland together with the results of the MATCH analysis can be found in **Appendix 1**. **Map 1** shows the extent of the acid grassland on the site. Most of the realignment area is made up of this grassland which extends to a wide strip along the eastern side of the wider search area down to the edge of Llyn Owen-y-ddol to the north east. According to the MATCH analysis, this community can best be described as **U5a *Nardus stricta-Galium saxatile*** grassland, the species-poor sub-community. **Photo 1** below shows a typical example of this acid grassland sward.



Photo 1. U5a acid grassland within the realignment area looking north east.

Several large boulder fields are found within the acid grassland of the realignment area itself and here, the grassy sward is somewhat limited. Indeed, the sward is by no means uniform throughout this grassland. There are small areas of Bracken (too small to be mapped) on the deeper soils and some of the flora within the boulder fields, where the fern *Cryptogramma crispera* was noted, have affinities with the **NVC:U21 *Cryptogramma crispera-Deschampsia flexuosa*** (scree) community. And areas of impeded drainage within this grassland are dominated by *Juncus effusus*.

While most of the species typical of this grassland appeared within the five quadrats, a number of additional species were noted growing elsewhere. These included *Agrostis stolonifera*, *Sedum anglicum*, *Dryopteris oreades* and *Polypodium vulgare*.

A careful survey of bryophytes found growing on and in the crevices between rocks and boulders within the realignment area was also made. No rarities were noted and the following species suggested quite a low diversity due to the rocks being acidic in nature: *Polytrichum piliferum*, *Racomitrium lanuginosum*, *R. fasciculare*, *Hypnum andoi*, *H. jutlandicum*, *Barbilophozia floerkei*, *Diplophyllum albicans*, *Campylopus flexuosus*, *Scapania gracilis*, *Pogonatum aloides*, *Andreaea rothii* subsp. *rothii*, *Saccogyna viticulosa*, *Lepidozia reptans*, *Bryum capillare*, *Pseudotaxiphyllum elegans*, *Ptychomitrium polyphyllum*, *Lophozia ventricosa*, *Dicranum scoparium* and *Douinia ovata* (det. Peter Benoit).

As has already been mentioned, this acid grassland is not particularly species rich and is a typical example of such grasslands which are ubiquitous in Snowdonia. However, it is worth noting the number of heath species found within the grassland, namely *Vaccinium myrtillus*, *Calluna vulgaris* and *Empetrum nigrum*. Their presence suggests that heath may have been more widespread at some time in the past. The entire area of the Gwaen is registered as Common Land (C.L. 106) and is sheep grazed. Grazing in the main mire area of the Gwaen Gynfi blanket bog below is likely to be light, with the main pressure concentrated on the drier areas of acid grassland above and to the east. Heath may well have been more extensive here in the past with only the remnant species mentioned above remaining. The presence of *Molinia caerulea* and the moss *Rhytidiadelphus loreus* would also confirm this suggestion. Indeed, the presence and abundance of the rush *Juncus squarrosus* is also an indication of the high (historical) grazing pressure.

- 3.2 **Blanket bog within the realignment area.** An area of blanket bog extends up into the realignment area at its western extremity (see **Map 2**). This forms the upper section of Gwaen Gynfi and drains into it. Since this mire is quite demonstrably the most interesting plant community within the realignment area, it has been treated separately from the rest of the Gwaen. The results of the NVC survey of this (upper) part of the blanket bog together with the results of the MATCH analysis can be found in **Appendix 2**. The MATCH analysis at

community level gives fairly similar probabilities for this habitat at **NVC M15, M17** and **M19**. However, the analysis at sub-community level suggests that this is most closely akin to the **M19a *Erica tetralix*** sub-community of the ***Calluna vulgaris-Eriophorum vaginatum*** blanket mire. The constancy of *Eriophorum vaginatum* throughout this mire would confirm this diagnosis. (**M15 *Scirpus cespitosus (Trichophorum cespitosum)-Erica tetralix*** wet heath has considerably less *Eriophorum vaginatum* present).

Since this area of blanket bog lies within the realignment area, it was carefully paced and measured. It covers an area of just over one hectare, representing a little over 11% of the realignment area. Its species diversity can be readily seen from an analysis of the NVC table in **Appendix 2**. The lack of homogeneity of this section of blanket bog can be seen by comparing **Photo 2** (Quadrat 1) and **Photo 3** (Quadrat 5) below.



Photo 2. M19a blanket bog in Quadrat 1 within realignment area.



Photo 3. M19a blanket bog in Quadrat 5 within realignment area.

While flowering heads of *Eriophorum vaginatum* can be seen in both pictures, it is the dominance of *Calluna vulgaris* in Quadrat 5 (**Photo 3**) as compared with Quadrat 1 (**Photo 2**) that is striking. The relative abundance of graminoids is also striking. Such variation in the relative proportions of heath and graminoids within mire communities of this sort is not unusual, especially when considering the past history of burning and, possibly, peat extraction (see Cynefin's March 1991 Ecological Assessment of the area, part of the EIA submitted for a previous planning application for the Quarry extension).

Apart from its intrinsic ecological value, this mire is also of interest for the presence of Lesser Twayblade (*Listera cordata*) three spikes of which were found in Quadrat 1. Despite very careful search, no other plants were found either in this mire within the realignment area nor within the wider search area. This is not a particularly unusual species to find in this habitat in Snowdonia and it may well be under-recorded due to its habit of lurking under the shade of heath within such habitats. Nevertheless, it must be considered quite a notable orchid and an indicator of the ecological interest of this mire.

- 3.3 **Blanket bog in the wider search area.** As has already been mentioned, the small area of mire within the realignment area is part of a considerably larger area of blanket bog known as Gwaen Gynfi. The part of this mire within the wider search area (see **Map 1**) was also surveyed in some detail, subjected to both quadrat analysis as well as MATCHED. The results of this survey and analysis can be found in **Appendix 3**.

Interpretation of the results of the MATCH analysis are somewhat problematic since it suggests that this mire is most closely akin to **NVC: M15 or M17** than an **M19**. However, ascribing an exact community definition may not be all that helpful or necessary in the present context. There is no doubt that there is some variation in the sward characteristics from one part of the mire to another, as can be seen from **Photo 4** but this patchiness merely reflects that there is a mosaic of subtly different vegetation types within the mire. Indeed, previous surveys of the area are often quite contradictory in their NVC mapping (see Cynefin's March 1991 Ecological Assessment of the area, part of the EIA submitted for a previous planning application for the Quarry extension, for example). Needless to say, while there may well be subtle differences in the swards, these almost certainly reflect a complex past history of varying management: peat extraction, burning, grazing densities and timings and perhaps even different grazing stock. (Of more significance ecologically are the **NVC: M29** soakways and springs lines within the mire and these will be dealt with in the next section).

Despite the subtle variation within the swards of this large mire complex, it is convenient and probably more useful to ascribe the whole of the mire into one **NVC** community, namely **M19a**, apart from anything else because it forms a natural downhill extension to the same mire that lies to the western end of the realignment area as has already been described in **3.2** above.



Photo 4. The mire below the realignment area within the wider search area. It forms about 10% of a much larger mire – Gwaen Gynfi to the north and west.

Despite the evident vegetation mosaic present within the mire as a whole, the plant species noted during the quadrat surveys reflect almost exactly the species found during the wider more generalised plant surveys. These are almost all indicators of the quite acidic nature of the soils and could therefore be considered as relatively impoverished in that regard. Nevertheless, this part of Gwaen Gynfi (and the Gwaen as a whole) is undoubtedly a reasonably good example of this type of blanket bog, despite its history of agricultural management and probably peat extraction. Indeed, the Countryside Council for Wales (CCW) Eryri SAC Management Plan and Conservation Objectives (March 2008) categorise Gwaen Gynfi as a “Key Habitat” (Feature 11 with an EU Habitat Code of 7130) but consider it to be in “Unfavourable Condition” due to past drainage, overgrazing and burning.

The complex variation in swards within the blanket bog are as much due to varying peat depths and water table levels as past management. Thus, some areas are much wetter as evidenced by the abundance and diversity of *Sphagnum* species. For example, *S. papillosum*, *S. capillifolium*, *S. subnitens*, *S. tenellum* and *S. compactum* occur in the drier areas while *S. palustre*, and *S. fallax* are found in wetter areas. *S. cuspidatum* occurs in areas which are more or less permanently inundated. To some extent too, the distribution and relative abundance of heath and graminoid species within the blanket bog are also a reflection of varying degrees of wetness.

It is worth noting here that during Cynefin’s 1991 quadrat surveys of Gwaen Gynfi, the very rare moss *Hypnum imponens* was found in (only) one of the quadrats. This moss was specifically searched for during the present surveys but not found. Unfortunately there is no detailed record of the exact location of this moss and discussion with A. J. E. Smith (*pers. com.*) who found and identified the original specimen, was unable to remember its exact location. It could well have been found in a part of the Gwaen outside of the present search area.

- 3.4 **Soakways within the blanket bog.** The area of Gwaen Gynfi below the realignment area is located on a gentle slope down to the stream that drains into Llyn Owen-y-ddol. Inevitably, water flowing down this slope becomes channelled into quite discrete spring lines, soakways and eventually streams. The vegetation along these soakways is perhaps the most interesting within this part of the Gwaen. It was therefore surveyed and MATCHED separately (see **Appendix 4** for a detailed species list and analysis). This analysis suggests that the best fit for these communities was **NVC: M29 *Hypericum elodes*-*Potamogeton polygonifolius***. See **Photo 5**.



Photo 5. An M29 soakway towards the bottom of the wider search area. *Potamogeton polygonifolius* can be clearly seen.

The two largest of these soakways (flushes) were located to the west of the survey area (see **Map 2**). While much smaller soakways were found to the east of the survey area, these were considerably smaller and far less flushed. The two main soakways were dominated by *Potamogeton polygonifolius* with other forbs of varying levels of abundance. The lack of *Hypericum elodes* is somewhat problematic but it is by no means unusual in NVC treatments for a constant species typical of a community to be entirely absent. *Festuca vivipara* was found at the edges of these flushed areas.

Judging by the species composition of the two main soakways, the water that feeds them is likely to be both oligotrophic and quite acidic. In contrast, a much smaller soakway located to the east of the two larger flushes is likely to be flushed with more eutrophic (calcareous) water since a small number of plants of *Carex dioica* were noted growing here. *C. viridula ssp. oedocarpa* was also found here. However, such examples of even modest base-enrichment are extremely unusual within that part of the Gwaen that lies within the wider search area. *C. pulicaris* was also found within the blanket bog immediately below the sheepfold complex, again suggesting some modest and very localised base-enrichment.

The presence of the moss *Warnstorfia exannulata* within the **M29** soakways, albeit in very small quantity is of some interest since it is quite closely related to

the moss *Hamatocaulis (Drepanocladus) vernicosus*. The latter species is rare in Britain but has been found in base-rich flushes not far away on Llanllechid Common. *H. vernicosus* is regarded as a feature (19; EU Habitat Code 1393) within CCW's Eryri SAC Management Plan and Conservation Objectives (March 2008). Careful search for this species within the flushes failed to reveal its presence but it must be concluded that this part of Gwaen Gynfi, at least, must be too acidic for it.

The **M29** soakways are closely akin to 'Feature 12' (depressions on peat substrate of the Rhynchosporion) within CCW's Eryri SAC Management Plan and Conservation Objectives (March 2008) (EU Habitat Code 7150) and as such are considered as highly vulnerable to drainage. However, within the same document, their condition is regarded as 'favourable/maintained'.

- 3.5 **Wet Heath area around Llyn Owen-y-ddol.** It has already been mentioned above that parts of Gwaen Gynfi within the wider search area, though generally ascribed to **NVC: M19a** have similar affinities to **NVC: M15** wet heath. However, the absence of *Trichophorum cespitosum* in the mire suggests otherwise. This plant is much more evident in an area to the north and south of Llyn Owen-y-ddol where the vegetation sward is much drier. This area (see **Map 2**) was separately MATCHED (see **Appendix 5** for a full species list) and ascribed to **NVC: M15d *Trichophorum cespitosum-Erica tetralix*** wet heath, the *Vaccinium myrtillus* sub-community.

The area to the north of the lake is even drier than the equivalent area to the south, as evidenced by the abundance of *Sphagnum papillosum*. Being somewhat drier in comparison with the rest of the Gwaen, the diversity of plants within the wet heath area is relatively poor being subjected to higher grazing pressure. Within this area of wet heath, there are small areas of **NVC: U5a** acid grassland (10%) and **M23a** rush pasture (15%).

- 3.6 ***Juncus effusus* dominated wetland to the west of the realignment area.** Bordered by the small stream that effectively forms the western boundary of the realignment area and the Afon Marchllyn-mawr further west, is an area of *Juncus effusus* dominated rush pasture. This was separately mapped (see **Map 2**) and MATCHED (see **Appendix 6** for a full species list). It was ascribed to **NVC: M23a *Juncus effusus/acutiflorus-Galium palustre*** rush pasture, the *Juncus acutiflorus* sub-community. Scrutiny of **Photo 6** below shows how prevalent



Photo 6. The *Juncus effusus*-dominated rush pasture to the west of the realignment area.

the rush *J. effusus* is within this community. As such, it is relatively species poor with no notable species having been found. However, small areas within this community are considerably wetter where springs arise. These have an interesting flora, additional species being found here include *Ranunculus flammula*, *R. omiophyllus*, *Myosotis secunda*, *Juncus bulbosus*, *Potamogeton polygonifolius*, *Montia fontana* and the bryophytes *Sphagnum fallax*, *S. palustre*, *Dichodontium palustre*, *Philonotis fontana* and *Warnstorfia exannulata*. Of particular note was the abundance of *Saxifraga stellaris*. These communities within the rush pasture are best described as **NVC: M32 *Philonoto-Saxifragetum stellaris*** springs and also **M35 *Ranunculus omiophyllus*-*Montia fontana*** rills. It is interesting to note that these springs and rills eventually manifest as the **M29** soakways immediately downhill but were too small to map.

Results: the vegetation of the streams and Llyn Owen-y-ddol

4.0 Vegetation of the streams. The Afon Marchllyn–mawr is the largest watercourse in the wider search area and forms its western boundary. Close to the sheepfold in the north western corner of the wider search area (see **Map 1**), a tributary of this stream runs eastwards until it drains into the Llyn Owen-y-ddol. This represents the northern boundary of the wider search area and it is into this stream that all the water from Gwaen Gynfi drains down slope. There are a

number of smaller streams and soakways (see 3.4 above) that run more-or-less parallel to each other that cross the Gwaen, eventually draining into this tributary. All the streams within this catchment are small, open, shallow and fast-flowing riffle-pool watercourses but the Afon Marchllyn-mawr (see **Photo 7**) itself is the most botanically diverse since its flora suggests a (limited) measure of base enrichment. For example *Jungermannia exsertifolia* ssp. *cordifolia* is generally found in circumneutral waters. In contrast, the tiny streams that flow across the blanket bog (sometimes disappearing altogether beneath a layer of encroaching vegetation) are far less botanically diverse as is the tributary draining into the lake whose waters are once again less mineral rich. There is little point in describing these various watercourses separately and the following description covers them all.

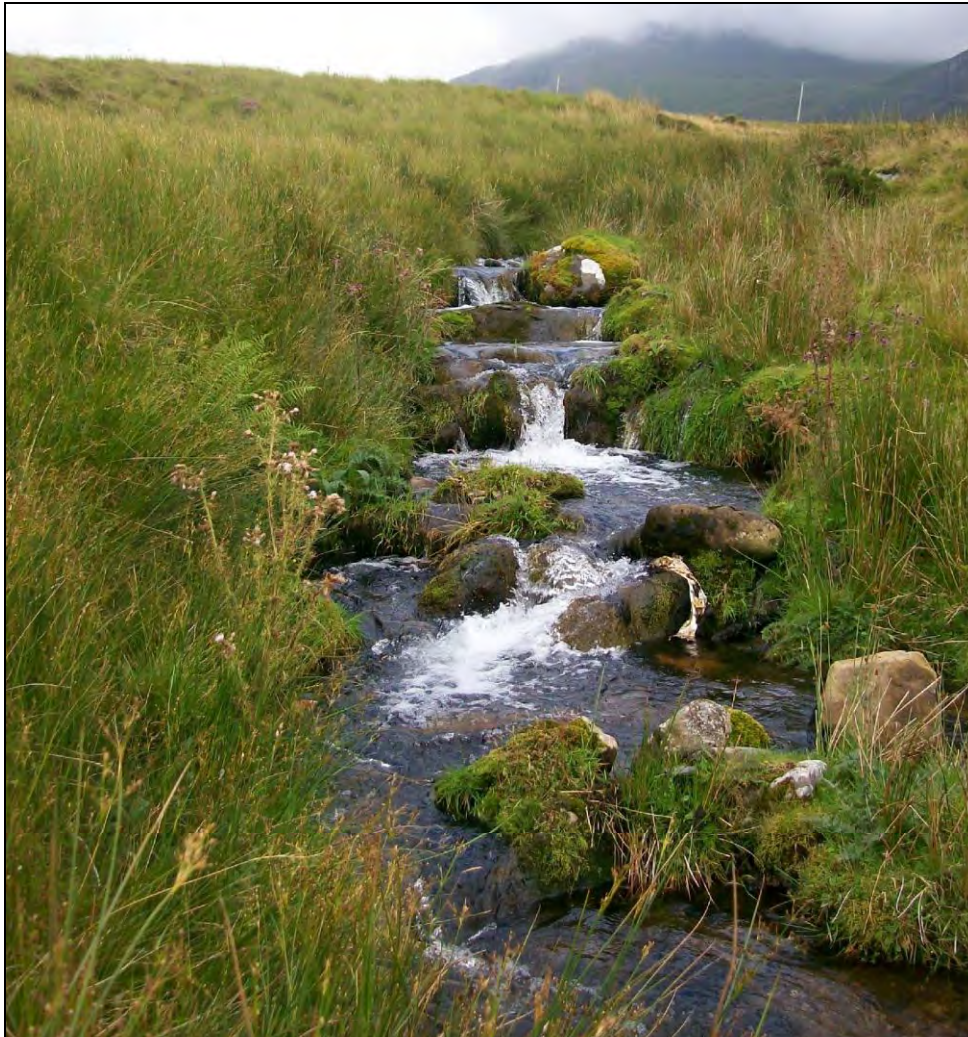


Photo 7. Typical riffle-pool communities on the Afon Marchllyn-mawr.

Being fast flowing, the in-stream vegetation is almost entirely confined to a bryophyte assemblage that is adapted to such extreme conditions. The

exception to this is the presence of *Callitriche hammulata* which forms quite extensive patches in the tributary before it reaches the lake. Perched precariously on in-stream rocks just out of reach of all but the most violent spates, an attractive flora has often developed, typified by *Saxifraga stellaris*, *Scutellaria minor*, *Sagina procumbens*, *Myosotis secunda*, *Euphrasia nemorosa* and *Oreopteris limbosperma*. Where the water velocity is slightly reduced, the aquatic form of *Montia fontana* is often found in some abundance. Even slower seepages dripping into the main streams are often dominated by the beautiful *Chrysosplenium oppositifolium*. The bryophyte flora is not particularly diverse and no rarities were found but several species were very abundant and luxuriant. Most moss and liverwort species found within these streams clinging to the rocks are adapted to fast-flowing conditions and rely for their survival on being permanently immersed in water. Being open in aspect, the bryophytes that are often associated with more enclosed riverine habitats (ceunentydd) elsewhere in Snowdonia are generally absent. A full species list of the bryophytes found in-stream and along the riparian zones can be found in **Appendix 7**.

- 4.1 **Vegetation in and around Llyn Owen-y-ddol.** The final discrete communities noted within the study area are to be found around the small lake Llyn Owen-y-ddol though these cover too small an area to be mapped on **Map 2**. Apart from the **M15** wet heath that surrounds the lake, small patches of the **NVC: A24 *Juncus bulbosus*** community were noted. This community is typical of oligotrophic, base-poor, shallow standing water and its margins within acid mires. These merged somewhat into another community as the water depth deepened, namely the **S9a *Carex rostrata*** swamp, the *Carex rostrata* sub-community. This latter community is characterised by the pondweed *Potamogeton natans* which grew outwards from the southern shores and tended to cover almost the entire lake by the end of the summer. Additional species noted within the two communities, which somewhat blurred into each other around the southern margins of the lake were *Glyceria fluitans*, *Juncus effusus*, *Ranunculus flammula*, *R. omiophyllus*, *P. polygonifolius*, *Eleocharis palustris*, *J. articulatus*, *Epilobium brunnescens*, *Cardamine pratensis*, *Carex viridula* subsp. *oedocarpa*, *C. echinata*, *C. panicea*, *Myosotis secunda*, *Galium palustre*, *Hydrocotyle vulgaris*, *Eleogiton fluitans* floating on the surface of the lake, *Agrostis stolonifera*, *Viola palustris* and *Eriophorum angustifolium*. Bryophytes found here included *Philonotis fontana*, *Calliergonella cuspidata*, *Aneura pinguis*, *Sphagnum fallax* and *S. denticulatum*. Neither of these two communities was subjected to MATCH analysis.

Results: COFNOD Local Records Centre search.

- 5.0 A COFNOD Local Record Centre search was requested centred on NGR: SH605642 (the centre of the wider search area) covering a perimeter around that point of 1 kilometre, with particular focus on their records of vegetation. No plant records were found within that area but all the records provided of other taxa can be found in **Appendix 9**.

Mitigation

- 6.0 In order to reduce the impact of the realignment area quarry void on the vegetation interest, two broad areas need to be discussed.

- 6.1 It has already been stated above that the main vegetation interest within the realignment area itself is more or less confined to the one hectare mire at the far western end. At the time of writing, it is understood that three different quarrying proposals within the realignment area are being discussed. One of these, option D2 would confine slate extraction to the eastern side of the realignment area, avoiding this mire altogether. The line of the D2 option has been included within **Map 2** in Section **3.0** above. Clearly by avoiding direct damage to this mire, this option must be considered as the most favourable in conserving the main vegetation interest within the realignment area.

Option D2 will avoid direct damage to the mire but quarrying right up to the edge of it may cause secondary damage to this habitat from dust and any fines that might leach into it from surface water runoff from the close proximity of the quarry workings and haul roads. It was noticed during the vegetation surveys that dust and leachates have already caused some impact on acid grassland areas close to the new extension workings and haul road. New quarry workings within the (D2) realignment area must be carried out in such a way as to prevent damage to the adjacent mire from airborne dust and surface water leachates, for example by the early and judicious construction of appropriate bunds.

It must also be appreciated that the condition of this mire, and indeed the rest of Gwaen Gynfi, must also be strongly influenced by the current grazing levels. This is not something that Welsh Slate Ltd, as the Quarry owners, can have very much influence over, since most of the Gwaen (certainly outwith the realignment area) is in separate ownership. As has already been stated above, it is also part of Common Land 106. However, it is assumed that for Health and Safety reasons, the realignment area will be fenced off from grazing. Careful vegetation condition monitoring will have to be undertaken of the mire within the realignment area to determine whether the future cessation of grazing will have a deleterious influence on the condition of this mire.

- 6.2 The most critical mitigation considerations, however, must be given to the large mire below the realignment area which represents some 10% of the Gwaen Gynfi blanket bog. The vegetation interest here depends almost entirely on it receiving adequate water to remain saturated enough to sustain the moisture dependent communities within it. Of particular note in this respect are the **M29** soakways described in **3.4** above.

In the Hydrology, Hydrogeology, Water Quality and Flood Risk section of this EIA, it is stated that the already permitted quarry extension above the realignment area will result in a reduction of 15% of current surface water flow to the blanket bog immediately down slope of it, without mitigation. The addition of the realignment area only stands to reduce flows by a further 2%. The same report suggests that adequate mitigation for this water loss to the blanket bog can be achieved by the construction of an interception leat around the whole of the upslope area of the current quarry void as well as the extension area following the 470mOD contour. The report continues: "This leat was to convey surface runoff water from up-catchment of this elevation, around the extension area and discharge it via a series of sympathetically designed settlement lagoons back into the original watercourse to the north west of the extension area. Continuation of the leat around the head of the current quarry void was to produce mitigation for the incident rainfall falling on the extension void...By constructing the ditch around the top of the whole of the current void it would also provide a net increase in flows to the wet heathland (blanket bog below)...". It is worth adding that there is no proposal to re-direct groundwater flow, just surface runoff water. The report emphasises that the area is dominated by surface water flow due to the high rainfall. Groundwater, if present, forms only a tiny proportion of flow in the area.

The way in which this interception leat discharges water onto Gwaen Gynfi must be carefully engineered so as to a) avoid soil erosion and b) to ensure that water re-entering the blanket bog system is evenly distributed over the whole upslope area of the bog. Details of how the discharge aspects of this leat will be constructed and an even (percolating) flow achieved will be dealt with elsewhere in this EIA.

APPENDIX 1
NVC: Acid Grassland

Waymark: NGR	Q1 61023 63922	Q2 60983 63879	Q3 6093263844	Q4 60905 63920	Q5 60908 63742	Total
SPECIES						
<i>Nardus stricta</i>	8	6	4	4	8	V(4-8)
<i>Vaccinium myrtillus</i>	5	3	4	1	6	V(1-6)
<i>Juncus squarrosus</i>	4	5	7	4	4	V(4-7)
<i>Hylocomium splendens</i>	5	4	7	6	5	V(4-7)
<i>Festuca ovina</i>	6	6	6	5	5	V(5-6)
<i>Agrostis capillaris</i>	3	4	4	4	4	V(3-4)
<i>Galium saxatile</i>	4	2	6	4	4	V(2-6)
<i>Pleurozium schreberi</i>	5	3	3	2	2	V(2-5)
<i>Polytrichum commune</i>	5	1	3	1	2	V(1-5)
<i>Rhytidiadelphus squarrosus</i>	4	6	3	5	0	IV(3-6)
<i>Potentilla erecta</i>	4	5	2	3	0	IV(2-5)
<i>Luzula campestris</i>	3	3	4	0	2	IV(2-4)
<i>Anthoxanthum odoratum</i>	0	3	3	2	3	IV(2-3)
<i>Empetrum nigrum</i>	3	0	0	0	2	II(2-3)
<i>Rhytidiadelphus loreus</i>	3	1	0	0	0	II(1-3)
<i>Holcus lanatus</i>	0	0	0	2	2	II(2)
<i>Pteridium aquilinum</i>	0	0	0	7	0	I(7)
<i>Sphagnum palustre</i>	3	0	0	0	0	I(3)
<i>Aulacomnium palustre</i>	3	0	0	0	0	I(3)
<i>Polygala serpyllifolia</i>	2	0	0	0	0	I(2)
<i>Calluna vulgaris</i>	3	0	0	0	0	I(3)
<i>Molinia caerulea</i>	4	0	0	0	0	I(4)
<i>Danthonia decumbens</i>	0	2	0	0	0	I(2)
<i>Rumex acetosella</i>	0	0	0	1	0	I(1)
<i>Carex panicea</i>						I
<i>Hypnum jutlandicum</i>						I
<i>Campylopus flexuosus</i>						I
<i>Juncus effusus</i>						I
<i>Oxalis acetosella</i>						I
<i>Mylia taylorii</i>						I

MATCH based on aggregate data from 5 (2m x 2m) quadrats

1.	U5	coefficient = 66.8	5 sub-communities
2.	U20	coefficient = 57.3	3 sub-communities
3.	H18	coefficient = 56.8	3 sub-communities
4.	U4	coefficient = 53.6	5 sub-communities
5.	U6	coefficient = 49.8	4 sub-communities
6.	H12	coefficient = 47.6	3 sub-communities
7.	H10	coefficient = 45.7	4 sub-communities
8.	U16	coefficient = 44.1	3 sub-communities
9.	CG11	coefficient = 43.9	2 sub-communities
10.	U3	coefficient = 43.8	0 sub-communities

NVC Communities most closely matching test data for acid grassland

Sub-community	Coefficient
U5a	70.8
U4e	69.1
U5	66.8

MATCHES against sub-communities.

APPENDIX 2

NVC: Blanket Bog in Realignment area

	Q1	Q2	Q3	Q4	Q5	Total
Waymark: NGR	60861 63773	60829 63731	60806 63747	60787 63802	60752 68795	
SPECIES						
<i>Erica tetralix</i>	9	8	8	9	5	V(5-9)
<i>Vaccinium myrtillus</i>	4	7	8	2	3	V(2-8)
<i>Potentilla erecta</i>	5	3	3	4	3	V(3-5)
<i>Eriophorum vaginatum</i>	2	5	7	6	5	V(2-7)
<i>Sphagnum palustre</i>	3	3	5	4	4	V(3-5)
<i>Sphagnum fallax</i>	4	4	4	1	4	V(1-4)
<i>Juncus squarrosus</i>	5	2	4	1	0	IV(1-5)
<i>Hypnum jutlandicum</i>	3	3	0	3	2	IV(2-3)
<i>Rhytidiadelphus loreus</i>	3	3	0	2	2	IV(2-3)
<i>Hylocomium splendens</i>	3	5	5	0	2	IV(2-5)
<i>Sphagnum capillifolium</i>	4	2	4	0	2	IV(2-4)
<i>Festuca ovina</i>	3	4	4	0	2	IV(2-4)
<i>Calluna vulgaris</i>	5	4	0	0	8	III(4-8)
<i>Trichophorum cespitosum</i>	5	0	0	2	1	III(1-5)
<i>Polygala serpyllifolia</i>	2	0	0	1	1	III(1-2)
<i>Eriophorum angustifolium</i>	0	2	0	2	2	III(2)
<i>Polytrichum commune</i>	0	3	3	0	2	III(2-3)
<i>Carex panicea</i>	0	2	0	3	2	III(2-3)
<i>Drosera rotundifolia</i>	3	1	0	0	0	II(1-3)
<i>Empetrum nigrum</i>	2	0	0	3	0	II(2-3)
<i>Molinia caerulea</i>	5	0	1	0	0	II(1-5)
<i>Juncus effusus</i>	0	2	2	0	0	II(2)
<i>Pleurozium schreberi</i>	0	0	2	0	2	II(2)
<i>Narthecium ossifragum</i>	0	0	0	2	2	II(2)
<i>Aulacomnium palustre</i>	2	0	0	0	0	I(2)
<i>Listera cordata</i>	1	0	0	0	0	I(1)
<i>Agrostis canina</i>	0	2	0	0	0	I(2)
<i>Galium saxatile</i>	0	0	2	0	0	I(2)
<i>Deschampsia flexuosa</i>	0	0	3	0	0	I(3)
<i>Anthoxanthum odoratum</i>	0	0	2	0	0	I(2)
<i>Nardus stricta</i>	0	0	2	0	0	I(2)

Racomitrium lanuginosum	0	0	0	0	1	I(1)
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MATCH based on aggregate data from 5 (2m x 2m) quadrats)

1.	M15	coefficient = 64.1	4 sub-communities
2.	M17	coefficient = 58.8	3 sub-communities
3.	M19	coefficient = 53.7	3 sub-communities
4.	M18	coefficient = 49.1	2 sub-communities
5.	U5	coefficient = 47.4	5 sub-communities
6.	M16	coefficient = 46.6	4 sub-communities
7.	H12	coefficient = 46.6	3 sub-communities
8.	H10	coefficient = 45.3	4 sub-communities
9.	M6	coefficient = 45.2	4 sub-communities
10.	M21	coefficient = 40.3	2 sub-communities

NVC Communities most closely matching test data for blanket bog in realignment area

Sub-community	Coefficient
M19a	64.9
M15	64.1
M15d	63.7

MATCHES against sub-communities.

APPENDIX 3
NVC of blanket bog in wider search area

	Q1	Q2	Q3	Q4	Q5	Total
Waymark: NGR	60914 64571	60890 64488	60819 64336	60755 64189	60645 64005	
SPECIES						
Calluna vulgaris	9	5	6	6	5	V(5-9)
Erica tetralix	5	9	5	6	6	V(5-9)
Eriophorum vaginatum	4	5	3	5	6	V(3-6)
Vaccinium myrtillus	5	3	5	5	5	V(3-5)
Molinia caerulea	6	4	5	5	1	V(1-6)
Sphagnum capillifolium	4	3	1	2	4	V(1-4)
Rhytidiadelphus loreus	2	1	2	2	2	V(1-2)
Sphagnum palustre	0	3	3	4	4	IV(3-4)
Deschampsia flexuosa	1	1	1	0	4	IV(1-4)
Potentilla erecta	1	4	4	3	0	IV(1-4)
Eriophorum angustifolium	2	2	3	3	0	IV(2-3)
Hylocomium splendens	4	0	2	3	0	III(2-4)
Polytrichum commune	3	0	3	0	4	III(3-4)
Hypnum jutlandicum	2	0	2	0	4	III(2-4)
Pleurozium schreberi	1	0	0	2	1	III(1-2)
Agrostis canina	0	2	1	0	2	III(1-2)
Carex echinata	3	0	0	3	0	II(3)
Carex panicea	0	3	0	2	0	II(2-3)
Drosera rotundifolia	0	2	0	0	2	II(2)
Nardus stricta	0	1	0	2	0	II(1-2)
Sphagnum papillosum	0	0	2	1	0	II(1-2)
Juncus squarrosus	0	0	1	0	1	II(1)
Aulacomnium palustre	0	0	0	2	2	II(2)
Odontoschisma sphagni	2	0	0	0	2	II(2)
Polytrichum strictum	2	0	0	0	0	I(2)
Polygala serpyllifolia	0	2	0	0	0	I(2)
Juncus effusus	0	0	0	2	0	I(2)
Juncus bulbosus	0	1	0	0	0	I(1)
Empetrum nigrum	0	0	1	0	0	I(1)
Festuca ovina	0	0	0	1	0	I(1)

MATCH based on aggregate data from 5 (2m x 2m) quadrats

1.	M15	coefficient = 66.2	4 sub-communities
2.	M17	coefficient = 63.7	3 sub-communities
3.	M19	coefficient = 56.6	3 sub-communities
4.	M18	coefficient = 51.9	2 sub-communities
5.	H12	coefficient = 49.4	3 sub-communities
6.	M6	coefficient = 47.8	4 sub-communities
7.	M16	coefficient = 47.0	4 sub-communities
8.	M21	coefficient = 46.3	2 sub-communities
9.	U5	coefficient = 45.5	5 sub-communities
10.	H10	coefficient = 42.0	4 sub-communities

NVC Communities most closely matching test data for blanket bog in wider search area

Sub-community	Coefficient
M17c	66.3
M15	66.2
M15d	65.6

Matches against sub-communities

APPENDIX 4

NVC of soakways within M19a blanket bog below realignment area.

SPECIES	Q1	Q2	Q3	Q4	Q5	TOTAL
Potamogeton polygonifolius	8	9	7	7	6	V(6-9)
Hydrocotyle vulgaris	5	4	5	0	5	IV(4-5)
Menyanthes trifoliata	0	3	4	0	5	III(3-5)
Carex echinata	3	4	0	0	4	III(3-4)
Ranunculus flammula	3	4	0	3	0	III(3-4)
Eriophorum vaginatum	1	0	2	3	0	III(1-3)
Sphagnum inundatum	5	4	0	0	0	II(4-5)
Sphagnum denticulatum	3	3	0	0	0	II(3)
Saxifraga stellaris	2	0	2	0	0	II(2)
Erica tetralix	0	0	0	2	3	II(2-3)
Drosera rotundifolia	0	0	1	1	0	II(1)
Carex panicea	0	0	3	2	0	II(2-3)
Warnstorfia exannulata	1	2	0	0	0	II(1-2)
Philonotis fontana	4	5	0	0	0	II(4-5)
Anthoxanthum odoratum	0	0	0	0	1	I(1)
Myosotis secunda	0	0	0	0	2	I(2)
Eriophorum angustifolium	0	0	0	0	2	I(2)
Carex nigra	0	0	0	0	2	I(2)
Caltha palustris	0	0	0	0	4	I(4)

Soakways within Gwaen Gynfi

(MATCH based on aggregate data from 5 (2m x 2m) quadrats)

1.	M29	coefficient = 40.9	0 sub-communities
2.	M35	coefficient = 29.7	0 sub-communities
3.	M6	coefficient = 29.5	4 sub-communities
4.	M1	coefficient = 24.1	0 sub-communities
5.	M4	coefficient = 24.0	0 sub-communities
6.	M25	coefficient = 24.0	3 sub-communities
7.	M15	coefficient = 23.8	4 sub-communities
8.	S9	coefficient = 23.7	2 sub-communities
9.	M32	coefficient = 23.7	2 sub-communities
10.	M2	coefficient = 23.5	2 sub-communities

NVC Communities most closely matching test data.

Sub-community	Coefficient
M29	40.9
M35	29.7
M6	29.5

MATCHES against sub-communities.

APPENDIX 5

NVC of M15 wet heath around Llyn Owen-y-ddol.

Waymark: NGR	Q1	Q2	Q3	Q4	Q5	Total
	61101 64556	61139 64564	61054 64553	61042 64563	61017 64591	
SPECIES						
<i>Erica tetralix</i>	7	9	7	7	7	V(7-9)
<i>Potentilla erecta</i>	4	4	4	4	3	V(3-4)
<i>Hylocomium splendens</i>	4	3	2	4	2	V(2-4)
<i>Sphagnum fallax</i>	4	2	4	3	4	V(2-4)
<i>Eriophorum vaginatum</i>	1	2	2	5	3	V(1-5)
<i>Molinia caerulea</i>	4	0	7	2	4	IV(2-7)
<i>Vaccinium myrtillus</i>	4	4	0	5	2	IV(2-5)
<i>Polytrichum commune</i>	3	4	2	5	0	IV(2-5)
<i>Festuca ovina</i>	5	4	1	1	0	IV(1-5)
<i>Sphagnum papillosum</i>	1	4	3	0	2	IV(1-4)
<i>Rhytidiadelphus loreus</i>	3	3	1	0	2	IV(1-3)
<i>Carex panicea</i>	3	0	2	1	3	IV(1-3)
<i>Pleurozium schreberi</i>	2	3	0	2	1	IV(1-3)
<i>Calluna vulgaris</i>	0	0	3	4	5	III(3-5)
<i>Trichophorum</i>						
<i>cespitosum</i>	2	2	0	0	5	III(2-5)
<i>Sphagnum capillifolium</i>	0	2	0	4	4	III(2-4)
<i>Hypnum jutlandicum</i>	2	3	0	0	3	III(2-3)
<i>Eriophorum</i>						
<i>angustifolium</i>	3	3	2	0	0	III(2-3)
<i>Deschampsia flexuosa</i>	2	3	0	2	0	III(2-3)
<i>Nardus stricta</i>	2	2	2	0	0	III(2)
<i>Carex echinata</i>	0	0	4	2	0	II(2-4)
<i>Galium saxatile</i>	3	0	0	2	0	II(2-3)
<i>Juncus acutiflorus</i>	4	0	0	0	0	I(4)
<i>Sphagnum palustre</i>	0	0	4	0	0	I(4)
<i>Anthoxanthum</i>						
<i>odoratum</i>	2	0	0	0	0	I(2)
<i>Juncus effusus</i>	2	0	0	0	0	I(2)
<i>Juncus squarrosus</i>	0	0	2	0	0	I(2)
<i>Narthecium ossifragum</i>	0	0	2	0	0	I(2)
<i>Agrostis canina</i>	0	0	0	1	0	I(1)

Wet heath around Llyn Owen-y-ddol

(MATCH based on aggregate data from 5 (2m x 2m) quadrats)

1.	M15	coefficient = 62.0	4 sub-communities
2.	M17	coefficient = 59.4	3 sub-communities
3.	M19	coefficient = 51.2	3 sub-communities
4.	M6	coefficient = 50.4	4 sub-communities
5.	U5	coefficient = 49.8	5 sub-communities
6.	H12	coefficient = 47.4	3 sub-communities
7.	M18	coefficient = 46.5	2 sub-communities
8.	H10	coefficient = 46.1	4 sub-communities
9.	M21	coefficient = 44.5	2 sub-communities
10.	M16	coefficient = 44.3	4 sub-communities

NVC Communities most closely matching test data.

Sub-community	Coefficient
M15d	67.0
M17c	64.5
M15	62.0

MATCHES against sub-communities.

APPENDIX 6

NVC of M23a Rush Pasture to west of realignment area.

Waymark: NGR	Q1	Q2	Q3	Q4	Q5	Total
SPECIES	60795 63625	60784 63615	60772 63605	60691 63527	60661 63575	
Juncus effusus	8	7	5	5	2	V(2-8)
Galium palustre	3	4	3	4	3	V(3-4)
Sphagnum fallax	3	5	7	1	4	V(1-7)
Holcus lanatus	4	3	3	4	2	V(2-4)
Rhytidiadelphus squarrosus	3	0	3	5	2	IV(2-5)
Anthoxanthum odoratum	0	4	2	3	4	IV(2-4)
Potentilla erecta	0	3	1	4	2	IV(1-4)
Cirsium palustre	0	2	1	2	1	IV(1-2)
Agrostis stolonifera	3	1	2	0	0	III(1-3)
Carex echinata	0	3	0	2	2	III(2-3)
Juncus acutiflorus	0	0	9	9	9	III(9)
Epilobium palustre	0	1	3	0	3	III(1-3)
Polytrichum commune	4	6	3	0	0	III(3-6)
Festuca ovina	5	4	0	0	0	II(4-5)
Sphagnum palustre	4	0	0	4	0	II(4)
Eriophorum vaginatum	1	4	0	0	0	II(1-4)
Carex panicea	0	3	0	1	0	II(1-3)
Rumex acetosa	0	0	0	3	4	II(3-4)
Ranunculus acris	0	0	0	2	3	II(2-3)
Taraxacum officinale agg.	0	0	0	2	2	II(2)
Agrostis capillaris	4	0	0	0	0	I(4)
Cardamine pratensis	0	2	0	0	0	I(2)
Myosotis secunda	0	0	0	0	1	I(1)
Hylocomium splendens	2	0	0	0	0	I(2)
Nardus stricta	3	0	0	0	0	I(3)
Pleurozium schreberi	0	0	0	0	2	I(2)
Aulacomnium palustre	0	0	0	0	2	I(2)
Leontodon autumnalis	0	0	0	0	1	I(1)

Juncus effusus dominated rush pasture to west of realignment area.

(MATCH based on aggregate data from 5 (2m x 2m) quadrats)

1.	M23	coefficient = 52.1	2 sub-communities
2.	M25	coefficient = 51.7	3 sub-communities
3.	M6	coefficient = 50.9	4 sub-communities
4.	M4	coefficient = 39.1	0 sub-communities
5.	W4	coefficient = 35.9	3 sub-communities
6.	U5	coefficient = 35.3	5 sub-communities
7.	MG10	coefficient = 34.7	3 sub-communities
8.	U4	coefficient = 33.8	5 sub-communities
9.	M8	coefficient = 33.8	0 sub-communities
10.	M28	coefficient = 33.5	3 sub-communities

NVC Communities most closely matching test data.

Sub-community	Coefficient
M23	52.1
M25	51.7
M23a	51.6

MATCHED against sub-communities.

APPENDIX 7

Bryophytes found within and beside streams (with DAFOR scale).

Aneura pinguis (O)
Brachythecium rivulare (D)
Bryum pseudotriquetrum (F)
Calliergonella cuspidata (R)
Dichodontium palustre (O)*
Diplophyllum albicans ((F)
Fontinalis antipyretica (O)
F. squamosa (F)
Hygroamblystegium fluviatile (D)
Hygrohypnum eugyrium (O)*
Hyocomium amoricum
Jungermannia exsertifolia subsp. cordifolia (O)*
Marsupella emarginata (F)
Mnium hornum (F)
Pellia epiphylla ((F)
Philonotis fontana (O)
Plagiomnium undulatum (O)
Platyhypnidium riparioides (O)
Pogonatum urnigerum (R)
Racomitrium aciculare (O)
Scapania undulata (F)
Sphagnum fallax (A)
S. girgensohnii (O)

* ID confirmed by Peter Benoit

APPENDIX 8
Species list of all plants found within the study area

Agrostis canina
A. capillaris
A. stolonifera
Andreaea rothii ssp rothii
Aneura pinguis
Anthoxanthum odoratum
Aulacomnium palustre
Barbilophozia floerkii
Blechnum spicant
Brachythecium rivulare
Bryum capillare
B. pseudotriquetrum
Calliergonella cuspidata
Callitriche hammulata
Calluna vulgaris
Caltha palustris
Campylopus flexuosus
Cardamine pratensis
Carex binervis
C. dioica
C. echinata
C. nigra
C. ovalis
C. panicea
C. pilulifera
C. pulicaris
C. rostrata
C. viridula subsp. oedocarpa
Chrysosplenium oppositifolium
Cirsium palustre
Cryptogramma crispa
Danthonia decumbens
Deschampsia flexuosa
Dichodontium palustre
Dicranum scoparium
Diplophyllum albicans
Douinia ovata
Drosera rotundifolia
Dryopteris carthusiana
D. dilatata
D. oreades
Eleocharis palustris
Eleogiton fluitans
Empetrum nigrum
Erica tetralix
Eriophorum angustifolium
E. vaginatum
Euphrasia nemorosa
Festuca ovina
F. vivipara
Fontinalis antipyretica
F. squamosa
Galium palustre
G. saxatile
Glyceria fluitans
Holcus lanatus
Hyocomium amoricum
Hydrocotyle vulgaris
Hygroamblystegium fluviatile
Hygrohypnum eugyrium
Hylocomium splendens
Hypnum andoi
H. jutlandicum
Juncus acutiflorus
J. articulatus
J. bulbosus
J. effusus
J. squarrosus
J. tenuis
Jungermannia exsertifolia subsp. cordifolia
Kindbergia praelonga
Leontodon autumnalis
Lepidozia reptans
Listera ovata
Lophozia ventricosa
Luzula campestris
L. multiflora
Marsupella emarginata
Menyanthes trifoliata
Mnium hornum
Molinia caerulea
Montia fontana
Mylia taylorii
Myosotis secunda
Nardus stricta
Narthecium ossifragum
Odontoschisma sphagni
Oreopteris limbosperma

Oxalis acetosella
Pellia epiphylla
Phegopteris connectilis
Philonotis fontana
Plagiomnium undulatum
Plagiothecium undulatum
Platyhypnidium riparioides
Pleurozium schreberi
Pogonatum aloides
P. urnigerum
Polygala serpyllifolia
Polypodium vulgare
Polytrichastrum formosum
Polytrichum commune
P. juniperinum
P. piliferum
P. strictum
Potamogeton natans
P. polygonifolius
Potentilla erecta
Pseudotaxiphyllum elegans
Pteridium aquilinum
Ptychomitrium polyphyllum
Racomitrium aciculare
R. fasciculare
R. lanuginosum
Ranunculus acris
R. flammula
R. omiophyllus
Rhytidiadelphus loreus
R. squarrosus
Rumex acetosa
R. acetosella
Saccogyna viticulosa
Sagina procumbens
Saxifraga stellaris
Scapania gracilis
S. undulata
Scutellaria minor
Sedum anglicum
Sphagnum capillifolium
S. compactum
S. cuspidatum
S. denticulatum
S. fallax
S. girgensohnii
S. inundatum
S. palustre
S. papillosum

S. squarrosus
S. subnitens
S. tenellum
Taraxacum officinale agg.
Thuidium tamariscinum
Trichophorum cespitosum
Ulex gallii
Vaccinium myrtillus
Viola palustris
Warnstorfia exannulata

Appendix 12

Compensation Area – SAC

**Realignment of Penrhyn Quarry
Environmental Impact Assessment**

Ecological Survey Report : Compensation Area

October 2011

Dr Rod Gritten PhD, PGCE, CBiol, MSB

Cynefin Consultants Ltd
1 New York Cottages • Bangor Road •
Penmaenmawr • Conwy • LL34 6NP
(01492) 622272
info@cynefin.co.uk

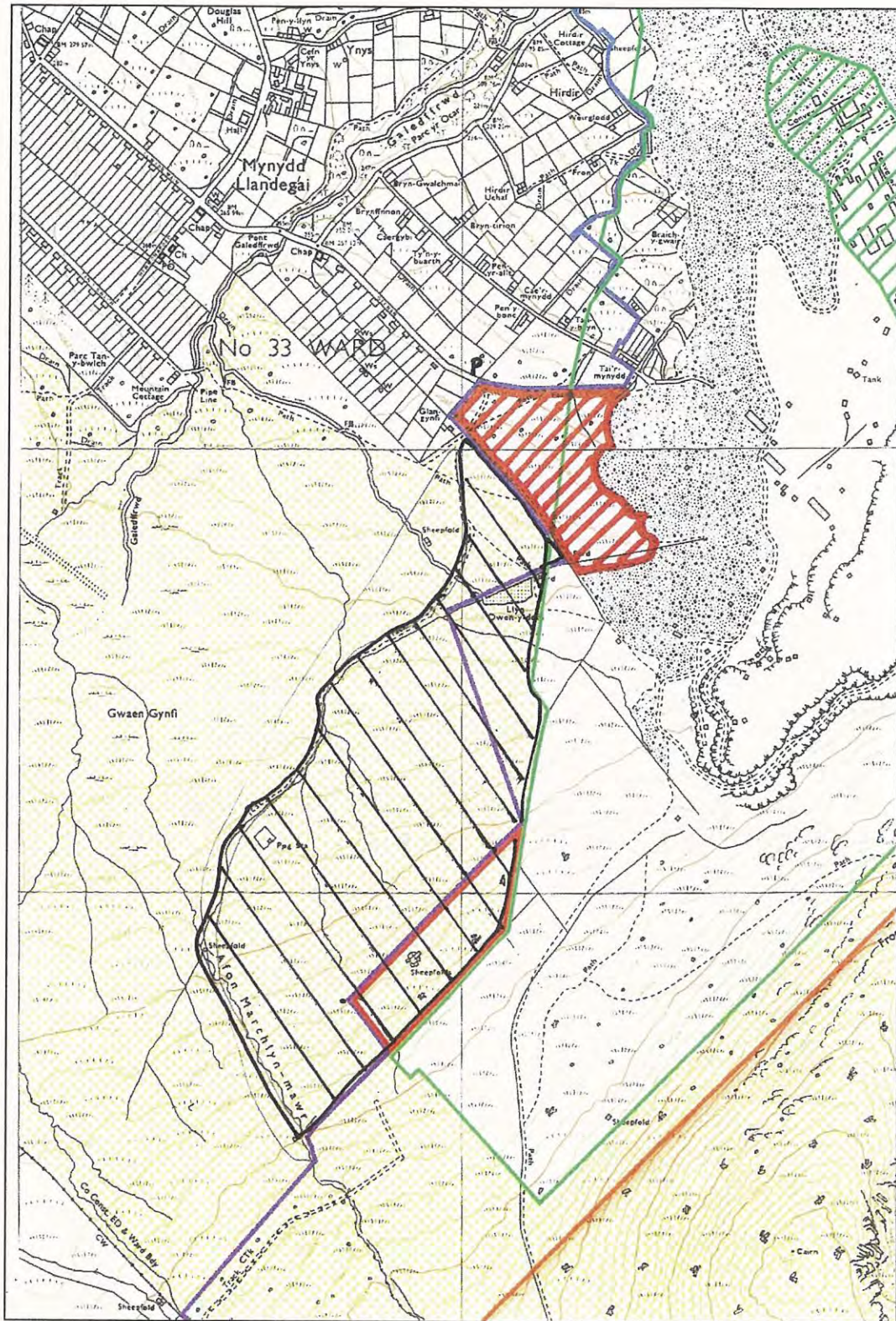
*Cynefin
Consultants*

INTRODUCTION

The European Commission Directive of 21st May 1992 on the Conservation of Natural Habitats and of Wild Fauna and Flora (92/43/EEC) states in Article 6(4) that in the case of a Special Area of Conservation (SAC) "...the Member State shall take all compensatory measures necessary to ensure that the overall coherence of Natura 2000 is protected". In other words, a "compensatory measure" must "...aim to offset the negative impact of a project and to provide compensation corresponding precisely to the negative effects on the species or habitat concerned" (from EC Managing Natura 2000 Sites. The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC).

Accordingly, a suitable site reasonably close to the proposed Realignment Area was selected to serve as a Compensation Area. It was felt that a suitable site had to be a) integral with the large wetland area known as Gwaen Gynfi, b) within the ownership and control of Welsh Slate Ltd, c) outwith Common Land 106, which includes the majority of Gwaen Gynfi, d) is not currently within the boundary of the Eryri SAC and e) will be unaffected in any way by the proposal.

It is appropriate to mention here that the proposed Realignment Area will only have a direct impact on rather uninteresting acid grassland (see botanical report elsewhere in this EIA). However, there must clearly be some concern that the Realignment Area itself and the excavation which is proposed may have an impact on the hydrological integrity of an area of Gwaen Gynfi downhill of the site. For Gwaen Gynfi to remain in Favourable Conservation Status, the flow of water into the mire must either not be interrupted or water flow into it must be compensated for by some mitigative process. It is proposed that a compensation leat will be constructed which will mitigate for the loss of water flow onto Gwaen Gynfi below the Realignment Area. This mitigation will be dealt with elsewhere in this EIA but should be considered separately from the Compensation Area to be described below. Indeed, guidance from the EEC on this issue is very clear in that mitigation and compensation must be treated as two quite distinct issues.



Map 1: The Compensation Area is hatched in red.

SURVEY METHODOLOGY

A suitable site which fulfils all the conditions (a-e above) was located at the extreme north eastern corner of Gwaen Gynfi (see **Map 1**). This was surveyed during very wet weather on 11th October 2011 and a species list of plants was noted. A brief habitat description was also made. No faunal surveys were conducted.

RESULTS

The site proposed as the Compensation Area is 12 hectares in size and is broadly composed of an **NVC M15 *Scirpus cespitosus-Erica tetralix*** wet heath in the eastern two-thirds of the site (approximately eight hectares) and a drier area of **NVC U5 *Nardus stricta-Galium saxatile*** grassland to the west (approximately four hectares). This drier area, which is slightly elevated above the wet heath to the east, is better described as a mosaic since there are also elements of **NVC U4 *Festuca ovina-Agrostis capillaris-Galium saxatile*** grassland and **NVC H8 *Calluna vulgaris-Ulex gallii*** heath present. The dry heath area is dominated by a stand of *Ulex gallii*. A number of mature *Sorbus aucuparia* are dotted throughout this drier area.

Of considerably more interest in relation to this 12 hectares being treated as a Compensatory Area is the wet heath itself. This extends eastwards as far as the toe of the huge slate tips of the main quarry itself where a row of Goat Willow (*Salix caprea*) disguises the toe of the tip. The wet heath, while primarily corresponding to the **M15** community, also contains an area dominated by *Juncus acutiflorus* which corresponds more closely to the **NVC M23 *Juncus effusus-Galium palustre*** rush pasture. Roughly at the centre of the main wet heath area is a small **NVC: M29 *Hypericum elodes-Potamogeton polygonifolius*** soakway, though *H. elodes* appeared to be absent. In this respect, the wet heath/mire has very similar affinities to the main mire of Gwaen Gynfi and certainly to the **M15** area to the south of Llyn Owen-y-ddôl (see NVC survey report elsewhere in this EIA).

The wet heath is quite species-rich and includes such species as *Narthecium ossifragum*, *Viola palustris*, *Pedicularis sylvatica*, *Holcus lanatus*, *Erica tetralix*, *Vaccinium myrtillus*, *Calluna vulgaris*, *Lotus pedunculatus*, *Ranunculus flammula*, *R. acris*, *Cirsium palustre*, *Trichophorum cespitosum*, *Angelica sylvestris*, *Potentilla erecta*, *Molinia caerulea*, *Scutellaria minor*, *Eriophorum angustifolium*, *E. vaginatum*, *Festuca vivipara*, *Hydrocotyle vulgaris*, *Empetrum nigrum*, *Drosera rotundifolia*, *Polygala serpyllifolia*, *Carex echinata*, *C. panicea* and the mosses *Sphagnum capillifolium*, *S. palustre*, *S. fallax* and *Breutelia chrysocoma*. Of particular interest is the abundance of *Succisa pratensis*. This is the food plant for the Marsh Fritillary (*Euphydryas aurinia*) butterfly and it would be well worth undertaking a survey for this species at a more appropriate time of year. It is quite possible that additional plant species of interest might be present but the time of year and weather conditions during which this survey was conducted was a limiting factor.

The site is informally grazed by cattle and is generally in good condition, neither under- nor over- grazed. There is a boundary all round the site though this needs some attention.

It is the view of the author that this site would make a very satisfactory Compensation Area. The proposed Realignment Area covers an area of 8.1 Hectares with only 3.7 Hectares being proposed for excavation. This lies entirely within acid grassland of limited floristic interest. In contrast, the Compensation Area is 12 Hectares in extent, some 8 Hectares of which is already rich (wet heath) habitat.

Preliminary discussions with the North Wales Wildlife Trust (NWWT) have indicated that they would be interested in managing the Compensation Area on behalf of Welsh Slate Ltd. Some improvements to the site could include the establishment of a broadleaved oak woodland on the drier third of the site but additional survey work would help to inform possible future nature conservation enhancement management. It would not be inappropriate, for example, to create a pond on the site.

It is useful to put this proposed Compensation Area into context with CCW's Upland Framework document. The objectives of the Upland Framework can be summarised as improving the quality and biodiversity of upland habitats in Wales by allowing the development and re-establishment of some of the diversity which has been lost through man's activities. Analysis of the maps which accompany this document, essentially CCW's „wish list“, indicate that their aim is to re-establish the area within and around the proposed Compensation Area as wet sub-montane heath. As such, the selection of this piece of land as the proposed Compensation Area fits in very well with CCW's aims as proposed within their Upland Framework.