RES/Peat and Peat Hydrology/POE/John Ferry/SSA-B

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IMPACT OF LLANBRYNMAIR WIND FARM DEVELOPMENT UPON PEAT AND PEAT HYDROLOGY

1. Introduction

1.1. Author

1.1.1. My name is John Ferry and I am employed as a Technical Director by SKM Enviros Consulting Ltd based at 160 Dundee Street, Edinburgh.

1.1.2. I hold a B.Sc. (Hons) degree from Glasgow University in Geology and a M.Sc. in Hydrogeology from University College London. I became a Chartered Geologist in 1994 and served as the Secretary to the Hydrogeology Group of the Geological Society for 5 years in which time I was an ex-officio member of the Editorial Board of the Quarterly Journal of Engineering Geology and Hydrogeology.

1.1.3. I have 30 years experience in environmental hydrogeology. In that time, I have been employed as an officer of a water & sewerage utility, with the British Geological Survey and in several civil engineering and environmental consultancies.

1.1.4. I have occupied regulatory and advisory roles on water supply, sewage, waste, contaminated land and environmental issues in the UK and overseas. I work closely with a wide range of organisations and sectors including Government Departments, Regulatory Bodies such as the Environment Agency and SEPA, Industry and Developers.

1.1.5. I have worked extensively on the characterisation, development, protection, restoration and remediation of water resources, private and public water supplies, wetland ecosystems and designated habitat sites in UK and internationally. I have extensive experience of carrying out qualitative and quantitative environmental risk assessments for water resources and impact assessments of developments on groundwater dependent ecosystems and peat habitats.

1.1.6. Increasingly over the last 6 years I have worked on peatland impacts from renewable energy developments, in both Scotland, England and Wales as the profile of peat as a carbon store and a priority habitat has been raised. This work has spanned project lifecycles from scoping through planning to advising on construction impact and monitoring through to operational wind farm review with respect to hydrology and aquatic ecosystems.

1.1.7. My specialist fields in relation to this proof are hydrogeology and hydrology in relation to wetland ecosystems and peat in particular.

1.1.8. I have given evidence in a number of prosecutions and Public Inquiries. Recently this has focused on issues associated with hydrology, hydrogeology, operational and construction environment management especially in relation to:

- peat
- sensitive watercourses
- private water supplies
- wetland ecosystems and Groundwater Dependent Terrestrial Ecosystems (GWDTE)
- drainage and trade effluent
- water pollution prevention
- designated environmental sites.

These roles have related mainly to wind farms but also include waste landfill sites, road, and hydropower schemes and prevention of waterborne infection by animal diseases.

1.1.9. I have been involved with the project since pre-application, via review of the original 2009 ES chapter on geology, hydrology and hydrogeology by Enviros Consulting (CD/RES/BAC/002).

1.1.10. The evidence which I have prepared and provide for this Inquiry in this proof of evidence is true and has been prepared and is given in accordance with the guidance of my professional institution and I confirm that the opinions expressed are my true and professional opinions.

1.2. Scope

1.2.1. The scope of my evidence is to assess and give an opinion on the potential for impact of a wind farm at Llanbrynmair upon peat hydrology and peat as a geological deposit, and mitigation measures related to the topic. It contains a section commenting upon the specific calculation of carbon balance due to effects on peat.

1.2.2. This proof is essentially a sister proof to the ecology proof by Mick Green of Ecology Matters which explores and quantifies impacts on peat habitat and habitat management and enhancement plans.

1.2.3. NRW now accept (CD/RES/BAC/008 letter) that there are no effects from the infrastructure around Turbines 7 and 8 and the soligenous Fen, despite their earlier comments. The topic does not explicitly figure in their Statement of Case. Therefore although addressed in the consolidated supplementary environmental information (CES) (CD/RES/BAC/009) it is not included in the proof.

1.2.4. The structure of this proof is as follows:

- Peat Policy, Terminology and Characteristics
- Planning Application and Statements of Case;
- Peat on Site
- Peat Avoidance and Minimisation
- Mitigation of impact on Peat
- Carbon Calculator re Peatlands
- Conclusions

2. PEAT POLICY, TERMINOLOGY AND CHARACTERISTICS

2.1. Natural Resources Wales Policy on Peat

2.1.1. NRW has been in place since April 2013 when it was formed from the amalgamation of CCW, Environment Agency Wales and Forestry Commission Wales. In this proof, CCW and NRW are identified contemporaneous with their documents but are essentially the same body. When no documents are referenced, NRW is used to describe the organisation.

2.1.2. NRW concerns over peat increased, along with development of policy and guidance across the UK, during the life of the project. Their policy on peat is laid out in two documents both dated 2010. These are CCW Guidance Note Assessing the impact of wind farm developments on peatlands in Wales 14 January 2010 (CPL-ECO-005), and CCW, A Position Statement on Peat Conservation in Wales 6 January 2010 (CD/COM/HYD/01).

"CCW recognise peatlands as a critical environmental resource. They store 30% of the soil carbon resource, despite occupying an estimated 3% of the Welsh land surface, and provide the essential physical template for an important component of our biodiversity, the peat-forming mires. They also deliver a wider range of ecosystem services relating to water quality and flood regulation, and carbon sequestration."

"Degraded peat is a potent source of dissolved organic carbon and there is good evidence for improvements in water quality and reductions in DOC release following restoration, particularly gulley and ditch."

"Peat is under significant threat in Wales through piecemeal development through renewable energy provision. These pressures bear most acutely on the significant resource of peat which remains un-protected by designation." In this respect I note that Llanbrynmair peatlands are undesignated."

'"Proposed and existing wind farm developments through overlap of wind farm infrastructure affect many upland sites in Wales and pose a significant threat to peatland habitats in Wales. CCW supports the development of appropriate renewable energy provision at the right locations and also accepts the likelihood of localised environmental impacts."

'"TAN 8 has served to focus this pressure on the non-statutory resource. Impacts on the peat resource should still be subject to formal EIA because of its significance for carbon (both as an existing store and for its sequestration potential) and habitat restoration. The potential for the latter is very significant in Wales, even on ostensibly highly modified peat surfaces, and its significance is likely to increase given the finite nature of peat, the very limited scope which exists for the expansion of peat onto surfaces which do not currently support it, and the growing importance attached to peat as a carbon storage and sequestration resource."

2.1.3. CCWs internal draft guidance on assessing wind farm impacts on peat (CPL-ECO-005) establishes the following three key principles which will also apply to all forms of development, namely;

(i) That peat should be avoided wherever possible,

(ii) that impacts on peat will require detailed assessment as part of an EIA, including assessment of the whole peatland resource within the application site, and

(iii) compensation for loss or degradation of peat should demonstrate equivalence by taking the form of peat restoration elsewhere within the development site, or as close to it as possible.

Therefore there is no absolute prohibition on peat and the guidance specifically allows for development on peat provided that there is demonstrated mitigation by equivalent peat restoration.

2.1.4. CCW note in their guidance (CPL-ECO-005) that calculations of carbon losses caused by peat loss and degradation have a part to play in this process. Based on thorough impact assessment, careful planning of wind farm siting and design coupled with effective mitigation and compensation actually has the potential to deliver positive gains for biodiversity and soil (peat) carbon whilst also contributing to renewable energy targets.

2.2. Peat Terminology and Characteristics

2.2.1. Peat is composed of the partially decomposed remains of plants and develops under waterlogged anoxic soil conditions which result in the inhibition of decomposer organisms. It is generally separated into two layers based on its physical properties. An upper fibrous layer often only a few 10s of cms thick known as the Acrotelm; and the underlying more decomposed layer that can be many metres thick known as the Catotelm.

2.2.2. Acrotelmic peat is generally found within the top layer of peat depending on the degree of decomposition and fibrous nature of the peat. The water table fluctuates in this layer and conditions vary from aerobic to anaerobic. Material may be fibrous or pseudofibrous (plant remains recognisable), spongy, and when excavated strength is lost but retains integral structure and can stand unsupported when stockpiled >1m. There can be substantial water movement in this layer although generally horizontally due to the low permeability of the underlying layer.

2.2.3. Catotelmic peat is found deeper than acrotelmic peat and has organic matter which decomposes anaerobically. Material has high water content and is permanently below the water table, although there is little water movement. Material is amorphous (recognisable plant remains absent), plastic, and low tensile strength and is unable to stand unsupported >1m when stockpiled.

2.2.4. NRW consider deep peat to be 50 cm, a more rigorous definition than elsewhere in the UK. The Carbon landscape and Drainage (CLAD) guidelines (CD/COM/HYD/08) note that ‘The Soil Survey of Scotland (1984) defines peat as ‘the organic layer or layers exceeding 50 cm depth from the soil surface and with an organic matter content of greater than 60 %. The UK Forestry Commission used 45 cm as the critical depth for peat to occur. The soil classification for England and Wales defines peat soils as an organic soil layer more than 40 cm deep, or if overlying bedrock more than 30 cm deep, with a minimum organic carbon content of 12–18 % (CD/RES/HYD/10). The Macaulay Land Use Research Institute for peat classification define shallow peat as having “a prescribed depth of organic matter of 50 - 100cm and deep peat ‘a prescribed depth of organic matter of >1 metre” (http://www.macaulay.ac.uk/explorescotland/organic_soils.html) (CD/COM/HYD/03). Similarly, Scottish Natural Heritage define deep peat as having a prescribed depth of organic matter of >1 metre. http://www.snh.gov.uk/about-scotlands-nature/rocks-soils-and-landforms/scotlands-soils/soil-types/) (CD/COM/HYD/02).

2.2.5. The classification of deep peat as 50cm by NRW is therefore a very high standard and the infrastructure layout of Llanbrynmair has incorporated this depth classification into the design.

2.2.6. Depth of penetration probing is a simple method that involves inserting a small diameter (1cm) pole into the ground to the depth where resistance is encountered. This depth is assumed to be the maximum depth of peat, however if other sediments including soft clays underlie the peat then a deeper reading than that of the true peat depth could be recorded.

2.3. Wind farm activities with the potential to effect peat

2.3.1. Potential impacts of wind farm developments on peatland habitats include direct habitat loss through construction of wind farm infrastructure, and habitat modification or even loss primarily due to adverse changes to hydrology. Direct immediate habitat loss can be due to access tracks, turbine bases, permanent crane pads Damage can also be caused by altered hydrological regimes which may lead to more widespread habitat deterioration

3. Application and Statements of Case

3.1. Application

3.1.1. RES UK & Ireland Limited made an application, BERR/2009/0004, dated 27 March 2009 (CD/RES/BAC/001), for consent under section 36 of the Electricity Act 1989 to construct and operate a 100 MW wind turbine generating station 'Llanbrynmair' in Powys, Mid Wales.

3.2. Powys Council Objection and Statements of Case

3.2.1. Powys Council (PC) resolved to object (CD/RES/BAC/006). Their reasons for objection are wholly based on objections by Natural Resources Wales (NRW) and its predecessor body, the Countryside Commission for Wales (CCW).

3.2.2. In their Outline Statement of Case dated 21 January 2013 Powys Council (CD/RES/BAC/007) confirmed the reasons for objection relevant to this proof and stated that:

> "The Council currently objects on the grounds of hydrological impacts. The Council is securing further advice and will seek to confirm its position within the formal statement of case."

3.2.3. In this context, I assume that the hydrology referred to by PC is solely the hydrology of peat, which as identified below, is the essence of the relevant NRW case.

3.2.4. The Powys Council updated Statement of Case of September 2013 (CD/RES/BAC/006) notes in 5.3.2 that

> "In respect of peat matters as recommended at the pre-inquiry meeting, PCC are working closely with NRW in relation to the presentation of evidence. PCC will not

themself lead evidence in relation to this matter as NRW will be providing evidence on it and PCC is anxious to comply with the Inspector's request to avoid duplication of evidence.'

They also note that:

"This statement of case should be read alongside Powys County Council's ("PCC") outline updated statement of case (Document OBJ 002 OSOC 2)".

This stated that:

"in respect of the reasons for objection, the Council is aware that NRW are in discussions with RES to explore whether objections in relation to hydrology and peat resources can be overcome and that should NRW be satisfied on this point then the Council would no longer pursue this reason for objection. "

3.3. NRW Objection and Statements of Case

3.3.1. NRW concerns have been addressed by additional extra work which is described in the CES (CD/RES/BAC/009). RES and its advisors have also been regularly in contact with NRW by letters and site visits over the last several years.

3.3.2. CCW initially objected to the application on 11 November 2010 (CD/RES/BAC/003) requesting additional information and modifications to the scheme.

" The key issue is that this is a highly sensitive site in environmental terms with many constraints (including)… peat (and) peatland habitats. CCW objects to the development in its current form due to impacts on peatland habitats. In CCW's view the ES does not demonstrate the likely significant effects on peatlands. There are deficiencies in the ES which make the evaluation of impacts and determination of mitigation difficult. "

"CCW will be in a position to give further advice on this application and the requirement for further modifications when we are in receipt of the following additional information:

- Additional peat depth data for the site to inform the re-siting of infrastructure and to demonstrate that impacts on peat and its associated habitats have been avoided and minimised (and) to demonstrate that the overlap between infrastructure and deep peat (>0.5m) has been minimised.

- Further hydrological assessment of the impact of infrastructure on habitats."

3.3.3. RES responded with a series of SEI which have been consolidated into the CES (CD/RES/BAC/009).

3.3.4. On 12 October 2012, CCW responded to DECC with their formal advice and position (CD/RES/BAC/006), following the submission of the series of SEI. Their position then was that having taken into account the additional information and modifications to the scheme, including the deletion of 13 turbines and 2 substations, a number of outstanding concerns remained and CCW therefore continued to object to the proposed Llanbrynmair wind farm in its current form. The summary reason for objection concerning peat was "Lack of mitigation to avoid impacts on peat and peatland habitats". Specific areas identified were:

> "Lack of definition of the extent of peatland habitats and therefore whether the scheme is optimal in terms of peat avoidance."
>
> "The ES and SEI did not consider the area of peatland habitat to be affected as a result of drainage around infrastructure".

3.3.5. CCW preliminary Statement of Case dated 21 January 2013 (CD/RES/BAC/007) stated that their case will cover the effect of the proposed development on peatlands including peatland habitats and areas of peat soils and noted their intent to present evidence on the following:

- "That impacts on peatlands have not been satisfactorily minimised;
- insufficient information on the overlap between infrastructure and peatland habitat; and
- Insufficient baseline information on peat distribution and depth which limits the identification of mitigation."

3.3.6. CCW were explicit in their preliminary Statement of Case that, in addition to biodiversity, they will argue that the reason wind farm developments should seek to avoid impacts to peatlands is because:

> "peatlands function as an important carbon sink and losses of peat, through for example inappropriate siting of infrastructure, will negate some of the carbon gains to be achieved from wind farms."

And also noted:

"That the carbon calculator has a number of deficiencies and does not give an accurate assessment of pay back periods and carbon losses from disturbance to peat."

3.3.7. The NRW Opening Submission CON/003/024 further noted that:

"Given the large amount of additional work still being carried out in preparing Supplementary Environmental Information it is hoped that a number of concerns that NRW has raised can be reduced or even removed so that objections to the schemes can be resolved. "

NRW go on to say that:

"In the case of Llanbrynmair, NRW consider that the baseline information on peat distribution and depth across the site is inadequate so that it cannot be assessed whether infrastructure could be resited to reduce impact. Approximately 24 of the 30 turbines appear to be located in deep peat, and impacts on peatlands as a result of hydrological changes are not considered. The applicant has made some modifications to the scheme to reduce impacts, and these are welcomed, but NRW believes that there are further examples of turbines or tracks being located on deep peat where resiting would be beneficial. Further information on these issues, and any improvement to the proposed Habitat Management Plan will be considered and NRW's position reviewed before the SSA B Inquiry session."

3.3.8. Following submission of the CES by RES, NRW submitted an amended Statement of Case in September 2013 (CON-003-SSA-B-2) which stated that

"Natural Resources Wales welcomes the additional work presented in the SEI 2013. Nevertheless, we have remaining concerns about the overlap between infrastructure and deep peat and peatland habitats."

"We consider that the scheme does not currently demonstrate that impacts on peat and peatland habitat have been minimised and mitigated."

"Natural Resources Wales considers that the drainage assessment underestimates the potential impacts on deep peat and peatland habitats. "

"Further, we consider that the assessment using the carbon calculator of peat carbon gains resulting from habitat restoration does not represent adequate mitigation/compensation for losses due to disturbance to peat. Further discussion/clarification is required from the applicant to understand how the assessment has been completed."

"It is Natural Resource Wales's view that residual impacts on peat should be commensurately mitigated by means of a Habitat Management Plan which includes peatland restoration. We have reviewed the further information in the SEI 2013 and we will be seeking further information from the applicant to demonstrate that the proposed HMP would provide sufficient mitigation".

"Although discussions between the applicant and Natural Resources Wales are continuing, Natural Resources Wales considers that it has not been demonstrated that the development has minimised disruption to peat and peatland habitats, and that the carbon balance savings of the scheme have not been maximised. Should further discussions with the applicant not resolve our concerns, we will provide evidence to support the need for sufficient mitigation to address the impact of the proposals on deep peat and peatland habitats.

3.3.9. On the 30th August 2013, RES submitted a first draft Statement of Common Ground for Peat and Peat Hydrology to NRW. This crossed over with the NRW amended statement of Case. A meeting was subsequently held on 17 September between RES and NRW and their respective advisors which discussed in detail NRW outstanding concerns on peat habitat, peat depth, peat hydrology, peat carbon and the habitat management plan (HMP). A second draft containing comments by NRW has now been received and we are hopeful of arriving at an agreed Statement of Common Ground.

3.4. Other Objectors

3.4.1. The only specific mention of peat that I have found is contained in the initial Alliance Statement of Case which states that:

" none of the developments should be allowed on the ground of… Impact on peat and organic-rich soils transforming Carbon Dioxide sinks into Carbon Dioxide sources." The amended alliance statement of Case dated 10 September 2013 does not make any further substantive points on the topic."

3.4.2. It is considered therefore that dealing with the CCW objections will cover any other objections related to peat

4. PEAT ON SITE

4.1. Documentation

4.1.1. The 2009 application was accompanied by an Environmental Statement (ES) (CD/RES/BAC/002). This included a Phase 1 habitat survey, depth penetration probing undertaken to identify the maximum depth of peat and, where habitats of conservation interest were found, National Vegetation Classification (NVC).

4.1.2. Subsequent to the application and in response to consultee comments, there have been several further SEI reports reporting on further depth of penetration probing, coring (using an auger to obtain intact samples of the peat and mineral soil profile), habitat assessments, changes to the description of the project, additional ecology, a Habitat Management Plan (HMP), a Peat Management Plan (PMP) and further analysis of the impact of hydrological changes on peat.

4.1.3. The CES (CD/RES/BAC/009) consolidates all previous environmental submissions and incorporating work carried out in 2013 since the Council recommendation is now prepared and includes all of the previous peat related SEI. The final proof will rely upon this consolidated document rather than the individual earlier ES and SEI.

4.2. Additional Work

4.2.1. Additional work on peat and hydrology since the 2009 submission includes:

- Further peat ecology and habitat distribution surveys and relocation of infrastructure
- Additional depth penetration probing to determine the maximum potential peat depth and coring to establish peat and mineral soil profile
- Development of a maximum potential depth of peat contour map to indicate the deepest areas of peat with respect to site infrastructure in areas where other constraints do not preclude development. This has been based on the depth penetration probing results and also on coring in areas where sufficient coring has been completed
- Subsequent layout adjustment based on both good habitat avoidance and peat depth avoidance, assuming other constraints do not preclude development

- Calculation of dewatering volumes associated with the drainage induced by the various infrastructure excavations based on the depth penetration probing results and estimation of the hydrogeological properties of the acrotelm and the catotelm
- Further development of Habitat Management Plan (HMP) (CD/RES/BAC/009 Appendix 5.2)
- Further development of the Peat Management Plan (PMP) (CD/RES/BAC/009 Appendix 8.9)
- Further assessment of potential link between Turbines 7 and 8 and soligenous fen
- Supply of hydrological data to Arup for carbon calculator and review and iteration of the inputs and outputs
- Site meetings and discussions with NRW
- Development of the consolidated CES hydrology and peat chapter and input to the ecology chapter.

4.3. Peat Habitat

4.3.1. Although strictly the domain of the Ecology proof a brief discussion of peat habitat is considered necessary here due to the integrated nature of peat management and preservation. Further details are available in the CES Ecology Chapter.

4.3.2. Situated at the southern end of Llanbrynmair moors, a large proportion of the wind farm site is underlain by a relatively thin and discontinuous layer of peat, with areas of blanket bog.

4.3.3. Active blanket bog where it is still actively accumulating peat has been identified as a priority habitat by the European Union in the Habitats Directive (EU 1992) (CD/COM/HYD/05) requiring special conservation measures. There are no local or international statutory ecological designations within the Site.

4.3.4. Afforestation and grazing has resulted in both modification and damage to some of the peat habitats on the site. Afforestation in the 1980's has covered large areas of the site itself, and is particularly widespread on areas of peat which are therefore much modified and damaged by afforestation. Most of the blanket bog which is within the study area but outside the afforested areas is currently grazed by sheep and cattle. This has a very visible effect on the peat habitat and species composition is consequently affected.

4.3.5. Also, much of the blanket bog has artificial drainage. However there are still areas that are wet and boggy and that support good quality blanket bog vegetation.

4.3.6. The key habitats of conservation importance are areas of peat mire, often modified and degraded with heath and marshy grassland. Many areas were found to be a complex mosaic of habitats and were mapped as such.

4.4. Peat Depths

4.4.1. Appendix to the NRW letter of 11 Nov 2010 states:

> “No rationale for the choice of probing locations is given in the ES with no available data for large areas of the site including some areas of infrastructure. Without this data it cannot be determined if infrastructure can be resited to areas of no or less peat into order to avoid and minimise impacts on peat.”

4.4.2. RES have now carried out additional and extensive depth penetration surveys which now include almost 5000 depth of penetration probes, covering the areas of interest identified by NRW and where there are no other absolute constraints. Other constraints include steep gradients, noise, ornithology, watercourse buffers and landscape and visual. These ruled out large blocks of the site that were therefore not probed.

4.4.3. A full rationale for the probing locations and philosophy is given in the CES Hydrology Chapter. Simply it comprised probing in the areas of interest in the following grid:

- 100m grid across the site where there are no other constraints
- Probe at the centre and 10m either side of track
- 9 probes per turbine location – at centre and in a radius of 25 and 50m.

4.4.4. Depth of penetration probe readings across the area of infrastructure range from a zero where there is a complete absence of peat, where topsoil over mineral soil is present, to over 3 metres. Based on an assumption that a probe penetration depth of 0.1m signifies an absence of peat then 244,150 m^2 or 65%of the infrastructure is estimated to be located on peat. The total area of the infrastructure footprint is 377,850 m^2.

4.4.5. The peat depth is less than one metre across the majority (95%) of the area of infrastructure. This includes the 35% that is not located on peat. Areas of deeper peat (>1.5m) were found in small pockets rather than large areas of blanket bog. The peat depths tend to be greatest under mire vegetation or within forestry (where it was planted on peat), with shallower areas of peat found on the steeper slopes of the site.

4.4.6. Recent coring work comprising 117 cores, carried out in response to the NRW concerns identified that many of the penetration probe depths often overestimated peat depth. This is because the probe penetrated both the overlying peat and underlying glacial clay which has very similar penetration characteristics as the peat. An overestimate of depth was recorded on 104 of the 117, or 89% of cores. This is more common where probes penetrate <1m. NRW accept that the use of probing for the estimation of the actual depth of peat is conservative.

4.4.7. Based on the additional coring data there is clear evidence of both shallower peat depths at many locations across the site than those indicated by depth of penetration probing. Additionally the presence of low permeability clay across much of the site will have positive hydrological implications as there will effectively be no increased drainage of the peat from the underlying layers.

4.4.8. The coring also allowed estimates of acrotlem and catotlem profiles and wetness across the site to be estimated with an average acrotelm thickness of approximately 0.2m observed.

4.4.9. Due to the sample size and a nonlinear relationship, estimating a reduction in peat volume due to coring results is very difficult. The key data however are that:

- A total of 25% of the area of infrastructure is located on peat of depth >0.5m based on depth of penetration probing
- A comparison of 69 depth of penetration probes between >0.5m and 1.0m were undertaken with coring which indicated that only 13 cores (19%) actually encountered peat >0.5m, whereas 56 cores (81%) identified peat <0.5m
- These results suggest that only 9% of the area of infrastructure is located on peat of depth >0.5m
- The distribution of peat depth across the area of infrastructure is therefore estimated at: 91% of the area <0.5m, 4% >0.5m – 1m, 3% >1 – 1.5, 1% >1.5 – 2 and 0.3% >2m.

4.4.10. It is also important to note that the depth of peat is not always related to the quality of the habitat. Deeper peat does not mean good habitat and vice versa, due to modification and degradation of the peat habitats. Some of the deeper probes were within afforested areas, or in the southern area that was very heavily grazed and the habitat strongly modified.

4.4.11. NRW have not suggested any specific additional data requirements in respect of peat depth. It is considered that the existing data as discussed above is sufficient and it is therefore considered that the final extent of depth of penetration probing and the coring undertaken together with the peat contour map fully answers the NRW objection on insufficient peat probing and characterisation of the peat.

5. Peat Avoidance and Minimisation

5.1. Interaction of project infrastructure with peat

5.1.1. The construction and operation of the project will have two principal effects on the peat environment. These are:

- The excavation of 120,900m^3 of peat for creation of site access tracks, turbine bases, compounds and other infrastructure
- The draining (dewatering) of groundwater from the peat to excavated areas. In some cases this will be a permanent effect equivalent to 34,700 m^3 of peat as access tracks will remain throughout the operation period, and in others the effect will be temporary and equivalent to 18,900 m^3 as turbine bases and borrow pits are backfilled.

5.1.2. These volumes (for excavated peat and for dewatered peat) are reliant on an accurate understanding of the peat depth in areas where infrastructure is proposed as the depth provides the basis for the volume excavated and the depth of peat where drainage can originate from.

5.1.3. These effects and the estimated volumes of peat removed and peat drained are discussed below and have been minimised through the detailed understanding of the spatial variability of the peat described above in Section 4, thereby allowing appropriate infrastructure design to avoid deeper peat or more valuable habitats.

5.2. Peat Minimisation and Avoidance in Infrastructure Layout

5.2.1. Full development of the layout is described in CES Chapter 2.

5.2.2. All areas of peat land, both with respect to peat habitats and peat depth, have been considered as valued natural resources and sensitive, both from direct loss from construction and, especially in the wetter habitats, to changes in hydrology caused by construction and operation, to the development. As well as the existing habitats and deep peat, the restoration potential with respect to carbon losses by drainage and re-use of peat were taken into account in informing layout revisions.

5.2.3. A series of recommendations were made to RES following site surveys for peat depths and habitat to alter the proposed site layout, to avoid the most sensitive habitats and to minimise the infrastructure overlap with peat. The alignment of tracks and location of turbine bases and crane hardstanding sought to minimise where reasonably practical any negative effect on peat habitats and deep peat (>0.5 m) peat while taking into account other constraints. This resulted in the deletion of a number of turbines and relocation of tracks to avoid peat habitats and deep peat.

5.2.4. In identifying those areas where it was necessary for further peat depth surveys, other constraints on layout and infrastructure development were taken into account in an iterative process. Some of the more critical are discussed below.

- Areas where no infrastructure could be laid for ownership reasons and due to slopes over 14% were not probed
- Areas with identified visual and landscape constraints, insufficient wind speed precluding turbine location were similarly not probed
- Areas where no infrastructure would be laid for reasons of habitat management and ecological and ornithological constraints were not probed
- Areas within watercourse buffers and steep slopes close to sensitive watercourses where again no infrastructure would be laid were not probed.

5.2.5. Many of these constraints, especially those non ecological, informed the locations of depth of penetration probing as well as projected infrastructure. Where development was possible outside buffer zones and non-ecologically constrained areas, then ornithological, habitat restoration, peat depth and peat habitat considerations were considered. Often, moving from one constraint made it more likely to encounter another. A good example of this is when locating turbines 35 and 36 away from good quality peat habitats into poor quality peat habitat in the afforested areas, the forest peat areas were found to be significantly deeper. The history of these mitigations can be seen in Figure 8.1c of the CES Annex III (Appendiced to this proof for convenience).

5.2.6. From the original scheme of 43 turbines and 30km of on-site roads, there are now 30 turbines and 25.2km of track (21.1km of which are new). The 13 turbines which were removed for a mixture of landscape, ornithological and peat habitat reasons and the change has had a significant effect on avoidance and minimisation of peat habitat. In particular turbines 7, 17, 26 and 27 have specifically been re located to avoid the nearby deep peat pockets as have significant stretches of track sections.

5.2.7. NRW in their Opening Submission refer to 24 of the 30 remaining turbines being located on peat > 0.5m. However, it is demonstrated in the CES Hydrology Chapter that, in fact only 14 turbines have one or more reading (of the 5 readings within, or just outside the limits of, the footprint of the turbine base) >0.5m.

5.2.8. Of these 14 turbines, 10 turbines can avoid the possible peat >0.5m by minor micrositing;

- In seven locations – turbines 4, 7, 17, 19, 27, 40 and 42 - there is only one depth >0.5m at a 25m distance from the centre of the turbine base. These were not cored and based on other coring information it is possible that many of these depth readings may be overestimates. It is assumed micrositing can avoid this potentially deep peat.
- Two locations, Turbines 26 and 38, had multiple probes >0.5m prior to coring. However subsequent to coring each had only one location where peat was deeper than 0.5m: 0.6m depth 25m west for turbine 26, and 0.85m depth 25m west for turbine 38. As with the above 7 turbine locations it is considered that these can be microsited to avoid this deep peat
- Turbine 15 has deeper peat readings (verified by coring at the centre of the turbine base and 25m to the north and 25m to the west) but micrositing is possible and recommended to the south east.

5.2.9. Only 4 turbines will therefore be located on possible areas of peat of depth >0.5m. These are the 4 turbines at R18, R31, R35 and R36:

- Turbine 31 is just inside the forestry (some coring was taken where accessible), and has one reading >0.5cm at the centre of the turbine base and micrositing may be possible but cannot be confirmed;

- The remaining three of these locations – turbines 18, 35 and 36 - have deeper peat and are within forestry areas and it was not possible to core. Further coring post felling may allow micrositing of these to avoid deep peat but this cannot be currently confirmed.

5.2.10. Therefore it is considered that at least 10 can be microsited to avoid the single deep probe penetration depth and the remaining 4 can be re-assessed when forest felling takes place and coring is possible as to micrositing potential.

5.2.11. The percentage of the potential development area which is not already blocked by other constraints (CES CD/RES/BAC/009 Figures 8.2 a, b and c, and reproduced in the Appendix to this proof) with peat soils >0.5m depth of peat is 41 %. The percentage of site infrastructure on peat >0.5m is only 9%, which demonstrates significant avoidance of peat.

5.2.12. It is considered that within the limits of the other constraints that there has been a maximum avoidance and minimisation of deep (i.e.>0.5m) peat consistent with the economic development of the wind farm with only an estimated 9% of the infrastructure located on peat >0.5m depth.

5.2.13. It is estimated within the CES (CD/RES/BAC/009 Appendix 1), that a maximum of 120,000m^3 of peat will be excavated due to the development of infrastructure. This comprises 50,000m^3 of acrotlem and 70,000 m^3 of catotelm. This does not take account of the likely overestimate of peat depths nor to micrositing of track and turbines off peat>0.5m. The fate and reuse of this excavated peat is described further in section 6 below.

5.2.14. SSA B is a generally peaty area and a ‘carbon landscape’ (CD/COM/HYD/08) with large parts underlain by a combination of deep and shallow peaty soils and soils with peaty pockets (CD/RES/HYD/09). It is likely that any wind farm development proposal in SSA B will encounter significant areas of peat soils although there is insufficient published peat depth data to confirm this conclusively.

5.3. Dewatering of Peat by Infrastructure

5.3.1. NRW in their letter of 11 Nov 2010 (CD/RES/BAC/003) are concerned that:

> “peatlands, in addition to their high nature conservation value, are particularly sensitive to wind farm development because construction and operation of a wind farm requires or results in drainage of water which alters the hydrology of peat in

terms of the level of the water table, flow through the peat unit, loss of habitat structure and subsidence of the peat surface.”

and considered that :

“The hydrological impacts of the proposal are inadequately considered by the ES. Further consideration is required of losses of sensitive mire habitats as a result of hydrological degradation in the longer term and any necessary mitigation identified to prevent these losses.“

5.3.2. In their amended statement of Case (CON-003-SSA-B-2), NRW:

“considers that the drainage assessment underestimates the potential impacts on deep peat and peatland habitats.”

5.3.3. This statement, which is not supported by any quantification or calculation, came after their receipt of the series of dewatering calculations which were developed in continued consultation with NRW to estimate the volume of peat that will be drained by the excavated areas of the site on a temporary and permanent basis (CES CD/RES/BAC/009 Appendix 8.2). The methodology for the dewatering assessment included analytical calculation involving a range of parameters such as precipitation, recharge rates, current groundwater level conditions, permeability of the different formations and types of peat, the location of the seepage face and the inclusion of two peat layers in the calculations.

5.3.4. NRW also noted in their opening submission that:

“a programme of groundwater level (water table) monitoring to support hydrological characterisation of, and impact assessment for, the site has not been proposed”

It is possible to hand install a series of shallow dip wells on site using an auger and PVC pipe to establish groundwater levels in several locations to support the assumptions of water table depth based on habitats. However, it was deemed that this was not a practical or scientifically valid activity as it would require a prohibitive number of tube wells to be introduced given the large and effectively linear nature of the site which corresponds to numerous habitats, slopes, surface water catchments, different infrastructure, and would require long duration period to ensure sufficiently ‘dry’ years are recorded and in any case would have little additional value in determining impact on peat.

5.3.5. Based on the available data and a series of conservative assumptions developed following discussions with NRW, the guidelines for Hydrogeological Impact Appraisal for Dewatering Abstractions Environment Agency guidance April 2007 (CD/COM/HYD/04) were used for the peat dewatering calculations which predict that:

- The maximum volume of peat calculated to be impacted by dewatering from all wind farm infrastructure is predicted to be a maximum 55,000 m^3
- Some of this loss will be permanent (e.g. tracks) and others only temporary during the construction period (e.g. turbine bases)
- Of this maximum 55,000 m^3 volume, 20,000 m^3 will be temporary and 35,000 m^3 will be permanent

The effect of dewatering of this volume of peat will potentially have implications in those affected areas for continued peat development, carbon stocks and also on peat habitats in those areas.

5.3.6. However this dewatering will at most affect a maximum of 2% of the peat volume and will almost all be within the acrotlem and as the acrotelm is periodically seasonally depleted this will not be linearly related to loss of habitat.

5.3.7. These estimates are very conservative based on the estimation of the various input parameters and to the method of calculation of the volume of dewatered peat.

5.3.8. In the absence of any quantified methodology or calculations from NRW we do not consider that there is any justification for stating that the drainage assessment underestimates the potential impacts on deep peat and peatland habitats.

6. MITIGATION OF IMPACTS ON PEAT

6.1. Reuse of Peat Volume Excavated and Peat and Habitat Management Plans

6.1.1. CCW in their 21 Nov 2010 letter (CD/RES/BAC/04) stated:

> “CCW requires further information regarding the disposal and treatment of peat excavated during construction. A Peat Management Plan would need to be submitted to CCW for review prior to determination. The HMP refers to the spreading of peat across land which raises concerns about the potential for damage to good quality habitats and the drying of peat leading to carbon losses.“

6.1.2. A more detailed Peat Management Plan (PMP) has been developed (CD/RES/BAC/009) Appendix 8.9). Also the Habitat Management Plan (HMP) (CD/RES/BAC/009) Appendix 5.2) has been significantly further developed. These will remain dynamic documents and will acquire more detail as the project proceeds. They should be read in conjunction as they are closely related documents. Together the PMP and HMP plans provide evidence of the mitigation measures that are in place to minimise any impacts, and the long term habitat restoration and management plans for key areas of the site.

6.1.3. The PMP demonstrates that peat has been afforded significant consideration and will be treated with the utmost importance during the construction should consent be granted. It confirms that an overall approach of minimisation of peatland disruption has been and will continue to be adopted. It will ensure all opportunities to minimise peat disturbance and extraction are taken and that acceptable proposals to re-use the surplus peat can be accommodated within the site layout without significant environmental impact, to minimise risk in terms of carbon release and human health.

6.1.4. The PMP addresses relevant peat policy and guidance and classification of excavated peat materials. It reviews peat conditions on site, looks at controls for further minimisation, carries out a peat balance between excavation and reuse, lays down rules for sensitive excavation and temporary storage to maintain the peat in a state suitable for beneficial reuse.

6.1.5. As is demonstrated in the PMP initial peat balance, all of the excavated peat can be reused on site in such a way as to retain a significant proportion of the carbon value of the peat and by minimisation of dissolved carbon run-off and creation of new active peat by ditch, furrow and gully blocking, to add to the carbon stocks. That portion of the excavated peat which cannot be deployed to maintain its carbon stock can be used to minimise other environmental effects of the development such as sediment run off control and screening.

6.1.6. Methods for minimising impact on peat during construction are proposed for the site within the PMP. Losses will be further minimised by an ecological clerk of works walking the site with engineers before construction commences, identifying all areas of sensitive habitat and carrying out further probing and coring to see which areas can be completely avoided by minor movement of infrastructure within the micro-siting limits. The ecological clerk of works will also ensure that any micro-siting does not lead to movements into sensitive habitats or deep peats.

6.1.7. Overall, the PMP identifies that all of the surplus peat can be reused either on site or within the habitat management plan.

6.2. Mitigation for Volume of Peat Dewatered

6.2.1. Account is taken of the impact on peat hydrology in the peat management plan and will be detailed in the drainage plans to minimise this volume and impacts. However this dewatering should be seen in a net positive context as more than balanced by the use of surplus peat in the extensive rewetting of degraded habitats under the HMP by ditch blocking.

6.2.2. The PMP identifies further mitigation regarding maintenance of peat hydrological conditions, and details how the hydrology and drainage will be managed to maintain the peat integrity to prevent drying out and subsequent oxidisation of excavated peat in storage and in situ, and how to manage variations in physical characteristics.

6.2.3. Given the mosaic and relatively fragmented nature of the peat occurrence, it is unlikely that there will be significant disruption of the hydrological regime other than very locally. This will be further ensured by developing drainage plans for peat in the CEMP.

6.3. Habitat Management Plan

6.3.1. The NRW opening submission talks about

> "Further issues include … the inadequacy of the Habitat Management Plan (HMP) in mitigating the schemes impact."
>
> "A need to minimise the loss of peat, due to its importance as a carbon sink, is also a vital part of maximising the carbon gains that can be achieved from wind farm development. The carbon losses associated with peat degradation caused by the development are not, in NRW's view, compensated for by the HMP."

6.3.2. The further development of the HMP linked to the detailed PMP is now very explicit that a key target of the management and site restoration proposed as part of the wind farm scheme is restoration of the blanket bog habitat. Relevant activities will include removal of trees in areas of deep wet mire and extensive drain and furrow blocking. The drain blocking will reduce flow of water off the site and minimise this flux of carbon. Removal of trees will allow water levels to recover. These should lead to increased water tables across many areas which are at the heart of successful blanket bog habitat restoration.

6.3.3. An appropriate monitoring programme to assess the impact is described in the HMP. Details of the monitoring programmes and protocols would be drawn up prior to their commencement and following consultation with CCW, RSPB and MWT.

6.3.4. Many practical and successful restorations of bogs under forestry are now underway. Drain blocking has proved successful in many areas including the LIFE Restoring Active Blanket Bog project being undertaken to the north of this site at Vyrnwy and on the Migneint SAC. Although the project is in its early stages drain blocking has been shown to be successful in restoring water tables and vegetation appears to be recovering (Blanket Bogs Wales, 2009 CD/COM/HYD/05) Ditch blocking for peatland restoration depends on a number of factors including gradient, eroded status of ditch, width and flow and will utilise peat turves and plastic sheeting. The IUCN booklet - Peatland Restoration Demonstrating Success- June 2012 (CD/COM/HYD/07) contains much valuable information demonstrating the realistic success rates which can be achieved with schemes such as the proposed HMP.

6.3.5. The HMP is consistent with Technical Advice Note 5: Nature Conservation and Planning – 2009 (CD/CON/003/PLA/011) which provides advice about how the land use planning system should contribute to protecting and enhancing biodiversity and geological conservation. It also chimes with the Scoping comment by the Environment Agency that opportunities for habitat creation and enhancement should be fully taken. It also complies with the NRW draft guidance on assessing wind farm impacts on peat (CPL-ECO-005) key principles

> "(iii) that compensation for loss or degradation of peat should demonstrate equivalence by taking the form of peat restoration elsewhere within the development site, or as close to it as possible."

6.3.6. I note that without the development proposal, this restoration would not happen.

6.3.7. It is considered that within the limits of the other constraints there has been a maximum avoidance and minimisation of deep (i.e.>0.5m) peat consistent with the economic development of the wind farm. Peat restoration plans are at the very least full and adequate compensation for peat impacts due to the development and consistent with TAN5 and NRW guidance (CPL-ECO-005).

7. CARBON CALCULATOR

7.1.1. CCW in their objection letter (doc no), noted that

> "A revised carbon calculator would help to demonstrate if the carbon benefits from the restoration of peat balanced the expected carbon losses from peat disturbance."

Whilst I understand that a further run of the carbon calculator is in progress with revised hydrological outputs from the hydrological calculations, in our experience, the carbon calculator is unlikely to fully take into account the true benefits of the HMP due to the nature of the programming. As is demonstrated in the PMP, all of this peat can be reused on site in such a way as to retain the carbon value of the peat and indeed by minimisation of run-off and creation of new active peat, to add to the carbon stocks.

7.1.2. In their amended Statement of Case (CON-003-SSA-B-2), NRW considered:

> "that the assessment using the carbon calculator of peat carbon gains resulting from habitat restoration does not represent adequate mitigation/compensation for losses due to disturbance to peat. Further discussion/clarification is required from the applicant to understand how the assessment has been completed."

7.1.3. This discussion has now taken place and clarification has now been provided in the discussions between RES and NRW on the Statement of Common Ground, and at the time of this final proof we are close to agreeing a Statement of Common Ground.

7.1.4. The Scottish Government's Carbon Calculator for Wind Farms on Peat Land (CD/COM/HYD/007) was used to estimate the overall payback time for the proposed development. This excel spread sheet tool also allocates carbon losses and gains to different activities, which enables comparison of potential soil carbon losses through construction and operation with potential soil carbon gains through habitat management and restoration. This section describes that part of the carbon calculator related to peat issues.

7.1.5. The Carbon Calculator estimates the payback period for the proposed wind farm development at Llambrynmair to be 1.1 years, with a minimum of -0.1 years and a maximum of 3.8 years. The range of values for the payback represents the best and worst case scenarios, as the best case is calculated as the payback under the maximum savings from displacement of grid electricity, the minimum carbon losses and the maximum carbon gains and the worst case is vice versa.

7.1.6. The expected value provides the best estimate of the payback as the input parameters have been chosen as most representative of the actual site conditions, with a range of minimum and maximum to cover uncertainty. Under the expected scenario, the total site losses are estimated at around 110,000 tCO_2eq. Of these, nearly 55% come from the lifecycle carbon emissions of the infrastructure and potential losses due to backup required in the electricity grid. The remaining 45% of losses come from on-site ecological carbon stores; this equates to around 49,500 tCO_2eq over the lifetime of the proposed wind farm. It is noted that it is inevitable and indeed implicit in policy that carbon emissions will occur in the development and manufacture of wind farm infrastructure irrespective of whether the development is on peatland.

7.1.7. Within these ecological carbon losses, the majority of the losses come from soil organic matter, in particular peat soils (47.9%) and felling existing forestry (45.6%). The other two sources of ecological carbon losses only account for a small percentage of the losses with the reduction in area with carbon fixing potential contributing 3.7% and losses of Dissolved Organic Carbon and Particulate Organic Carbon leaching just 2.8%.

7.1.8. Looking in more detail at the losses of soil organic matter, of the 23,700 tCO_2eq, the majority is from CO2 losses from excavated peat (just over 20,800 tCO_2eq), with only a small amount of losses due to drained peat (2,800 tCO_2eq). However, it is likely that the excavated peat losses are overestimated by the carbon calculator for the following reasons.

- There is evidence that the peat depths across the site have been systematically overestimated. Lower average peat depths would reduce the total volume of extracted peat.

- The carbon calculator assumes that 100% of the excavated peat will be lost as atmospheric CO2 emissions. However, all the excavated peat is planned for onsite reuse and therefore it is reasonable to expect that a significant proportion of this excavated peat will be re-established and therefore will not be oxidised and thus the carbon store will not be lost. It is not possible to change this assumption in the protected version of the carbon calculator (v2.7.0).

- The land take envelopes for the turbine bases and hardstanding are larger than might actually be required for construction purposes to cover the worst case scenario.

7.1.9. The carbon losses in drained peat are also likely to be overestimated as the carbon calculator uses a simple diagonal representation of the drainage pattern in soils, whereas this is more likely to be a cone of drawdown.

7.1.10. The losses due to felling forestry are due to the carbon calculator assuming an average rate of carbon sequestration in forestry for the total felled area. A default value of 3.6 tC ha-1 yr-1 is available in the spread sheet for this rate, however this is likely to be an overestimate as the stand age is already around 30 years old and the environmental conditions for growth are unlikely to be optimal. There is evidence in the literature that forestry on peat bogs can be a net emitter of carbon (CD/RES/HYD/11) and therefore the expected value has been taken as the average between this literature value and the default carbon calculator value.

7.1.11. Furthermore, the estimate of the felling forestry losses assumes that, in the absence of the wind farm, the forestry would continue on site. However, it is more likely that the forestry area would be felled at some point during the planning consent period and therefore the losses due to the wind farm will be overestimated.

7.1.12. The Carbon Calculator also provides an estimate of carbon gains from site restoration activities. Under the expected scenario, the spread sheet predicts gains of around 38,500 tCO_2eq, the majority of which (79.4%) come from improvement of felled forestry area. A smaller proportion come from improvement of degraded bogs (20.5%) and an insignificant amount (<1%) from borrow pit restoration and removal of drainage from foundations and hardstanding.

7.1.13. The gains from both the felled forestry and restoration of degraded bog are calculated as the difference in quantity and balance of CO_2 and CH_4 emissions unimproved land. The calculator assumes that improvement will increase the number of saturated days from 0 to 178 annually and therefore reduce aerobic breakdown of the peat and consequently CO_2 emissions. Conversely, as a consequence of increasing anaerobic conditions, CH4 emissions are estimated to increase from the re-wetted soil. In the case of the felled forestry area, where the average water table is currently estimated to be around 0.5m due to the trees, this calculation estimates this balance to result in a gain of around

30,600 tCO_2eq from the restoration compared to the estimated loss from felling the forestry of 22,600 tCO_2eq.

7.1.14. The gain is significantly smaller for the restored bog, although it is a larger area, as the average water table in this area is estimated to be already closer to the surface and therefore there is less reduction in CO_2 emissions. However, there is evidence in the literature which suggests that the increased rate of methane emissions in re-wetted peat is a temporary effect and is unlikely to continue at this rate throughout the lifetime of the wind farm (CD/RES/HYD/12). Therefore the carbon calculator could be significantly underestimating the soil carbon gains from restoration.

7.1.15. The gains estimated from site restoration do not include any additional carbon that might be sequestered as a result of restoring the degraded bog and afforested area, a clear NRW policy. Based on the average carbon accumulation due to C fixation in bog plants in undrained peat which is used to calculate losses in the carbon calculator (0.25 tC ha-1 yr-1) and a 10 year restoration period, the additional carbon sequestered could be in the region of 4,800 tCO_2eq over the lifetime of the wind farm.

7.1.16. A summary of the above is given in the following table:

Source of Wind Farm lifetime Carbon loss	**tCO_2eq**	**Years to payback**	**Comment**
Total Site Carbon loss	-110,000	1.1	
Lifecycle and grid back up	-60,500	0.65	Independent of peat
On site ecological carbon stores	-49,500	0.45	
Excavated peat	-20,800	0.17	
Forest Felling	-22,600	0.18	
Dewatering	-2,800	0.02	
Carbon fixing potential	-1,900	0.05	
DOC/POC losses	-1,400	0.03	
Site Peat Restoration	+38,600		Underestimated by CC
Felled forestry	+30,569		
Bog restoration	+7,890		

7.1.17. Overall, the ecological carbon balance for this proposed wind farm development is close to neutral – the estimated 49,500 tCO_2eq in losses against gains of 38,600 tCO_2eq. It has been demonstrated that there is evidence that the ecological carbon losses are likely to be overestimated within the Carbon Calculator, while the gains are likely to be underestimated. It is considered probable that at this site, the development is likely to have an overall net soil carbon benefit due to the existing degraded nature of the habitat and soils and the large area of proposed restoration of felled forestry and degraded bog.

7.1.18. Additional benefit in minimising carbon flux will accrue from the 200 ha area of degraded bog restoration.

7.1.19. I am therefore confident that the HMP in its current state and supplemented by the calculations regarding reuse of surplus peat for habitat enhancement ditch and furrow blocking in the PMP very adequately demonstrates the positive carbon benefits of this activity, notwithstanding the habitat benefits discussed elsewhere and in my opinion compensate fully and more for the peat degradation caused by the development. I would like to make the point that the above does not take into account any benefits from restoration of the windfarm beyond the 25 years life span.

8. CONCLUSIONS

8.1.1. The CES demonstrates that there is full compliance with the CCW Guidance Note of January 2010 on assessing the impact of wind farm developments on peatlands in Wales.

8.1.2. There is sufficient baseline information on peat distribution and depth to demonstrate avoidance and minimisation of overlap between infrastructure and deep peat, i.e. peat>0.5m, and to allow identification of mitigation.

8.1.3. There is sufficient information to determine, manage and more than adequately mitigate the effect of the infrastructure development on the hydrology of peat.

8.1.4. The project infrastructure development has satisfactorily minimised loss of peat and peat impact consistent with other constraints and the economic viability of the scheme.

8.1.5. Whilst there are negative impacts on peat depth and peat hydrology, there will be continued minimisation of damage to peatland during construction and implementation of mitigation for peat, including reuse of disturbed and surplus peat and enhanced habitat management for peat bog restoration will be rigorously implemented.

8.1.6. Extracted peat can be accommodated wholly within the proposed restoration both within the construction site and as part of the HMP and only a small proportion of the peat carbon would actually be lost.

8.1.7. The mitigation and enhancement proposals are in line with NRW policy on peatland development and present a positive benefit.

8.1.8. There is clear strong evidence that there is a net positive benefit gain with respect to carbon and peat hydrological conditions when habitat enhancement and peat reuse are taken into account.

John Ferry

2 October 2013