WINDFARM DEVELOPMENTS ON BLANKET BOG

A cautionary tale from Derrybrien, Co Galway,
and
pointers for safeguards needed when similar developments are proposed for the United Kingdom

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Plate 1, above: Peat from the bogslide, by now a thixotropic slurry, pressing on the Flaggy Bridge just east of Derrybrien. The bridge was closed for several days amid fears that it would collapse. The watercourse is normally three to four metres below the road level.

Plate 2, right: a road sign just by the bridge.

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Cover Picture

An aerial view, taken the day after the main bogslide, showing it pouring down a watercourse which flows into the Owendalulleegh river. From there, it flowed 15km into Lough Cutra, an SAC for anadromous and other fish species.

Abstract

A SUBSTANTIAL BOGSLIDE took place at Hibernian Wind Power's 71-tower wind farm at Derrybrien, Co Galway on 16 October 2003 when nearly half a million tonnes of peat, boulder clay and vegetation slumped from an area of felled plantation forest. Two weeks later, following heavy rainfall, a stream in spate churned the peat into a mobile slurry and cascaded it into the nearby Owendalulleegh river. This carried it a further 15km into Lough Cutra, a Special Area of Conservation (SAC) and a Special Protection Area (SPA).

There were no casualties or damage to private property but roads were closed and bridges put at risk. The local Fisheries Board estimated that 50,000 fish in the SAC were killed by the slide.

Reports commissioned by the local authority and the developer both highlighted construction activity as the main cause of the bogslide and the site's developer and contractor were fined for pollution offences.

Following intervention by local environmentalists, the European Union's Environment Commissioner is now prosecuting the Irish government for breaches of Directives explicitly related to the case.

The author endorses the findings of a little-publicised but seminal paper by Lindsay and Bragg which investigated the incident.[1] In the light of proposals for a comparable project on the Braes of Doune, close to Stirling, he examines the suitability of the construction techniques used by the developer and the appropriateness of remedial measures it has employed *post hoc*.

The sites have common features – Braes of Doune also consists of deep peat resting on a slope, is linked by proximate watercourses to a recently-designated SAC, lies in the catchment of important amenity fishing and is a foraging range for protected raptors. Mitigation measures used at Derrybrien are proposed for the Scottish site. The author reports that:

- Peat excavated to construct turbine bases at Derrybrien was side-cast over undamaged bog and left to dry. The contractor was unaware that this releases CO_2 to atmosphere;
- Excavations around turbine bases are already eroding, resulting in further peat oxidation and CO_2 emission as well as the discharge downstream of increased levels of humic acids;
- Floating roads on the site are sinking into the bog and destroying its acrotelm, creating potential rupture points and a risk of future land slips.[2] The cutting of roadside drains has compounded the problem;
- Remedial measures include a causeway and a bund built on a part of the site where there is no longer any peat left to slide. These may ameliorate public opinion but they are otherwise all but ineffective;
- Drainage essential for the site's operation is increasing the turbidity and silt load of streams;
- Straw-lined silt beds designed to filter run-off in a containment strategy reportedly approved by SEPA are demonstrably failing at Derrybrien. Their use at the Braes of Doune would put at risk the River Teith SAC and significant private and publicly-owned fishing beats;[3]
- The intense precipitation incidents that characterise the SW Grampians would exacerbate the problem and render the proposed filtration technique totally ineffective;
- Derrybrien demonstrates that there is a significant risk of bogslide wherever attempts are made to industrialise comparable sites. The consequences of a slide at the Braes of Doune, given its link with the River Teith SAC, could be severe.

Finally, the author argues that it is not possible to construct an environmentally valid case for any industrial development, whether for electricity generation or other purposes, on blanket bogs. He calls for improved standards of Environmental Impact Assessment and a greater appreciation of the ecological value of peatlands and the inherent hazards of construction projects thereon.

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[1] Lindsay and Bragg, University of East London, *Wind Farms and Blanket Peat – The Bog Slide of 16th October 2003 at Derrybrien, Co Galway, Ireland,* 2004.

[2] *Acrotelm* – the top layer of a peat bog. Made up of living plants and leaf litter, it is spongy and fibrous in texture, highly porous and absorbent; *Catotelm* – the decayed and humified material underneath the acrotelm. It has built up over many years to form peat.

[3] SAC UK0030263.

Plate 3: An aerial view of the source of the slide of 16 October 2003, taken in April 2005. The base of T68 is clearly visible. It came to rest about a kilometre down the slope but, following torrential rain, slid further into a local watercourse on October 29 and, from there, down the Owendalulleegh River into Lough Cutra.

Plate 4, right: The source of a much smaller slide that occurred on 2 October 2003 (see text). It originated by a floating road near T17, some 250 metres west of T68.

Introduction

In October 2003, a substantial bogslide took place on Cashlaundrumlahan, at 368 metres the highest hill in the Slieve Aughty range in Co Galway, Republic of Ireland. The site was being developed as a 71-tower (58.5MW) wind farm by Hibernian Wind Power Ltd (HWP), a wholly-owned subsidiary of the state-owned Electricity Supply Board (ESB).

It took place in two stages. On October 16, an estimated 450,000 tonnes of peat and boulder clay and the vegetation growing on it slumped from an area of felled plantation forest situated on deep peat just below turbine no 68 (see map, page 18). It slid down a slope of some 7^0 but only progressed about a kilometre.

However, on the night of October 29, after three days and nights of continuous heavy rain, a stream in the catchment ran at spate level into the collapsed and jumbled-up peat, converting it into a highly mobile slurry which became more liquified and lacking in structure as it progressed down the slope. The drag at base-rock level would have created a tumbling effect which resulted in the intimate mixing of peat with storm water so that otherwise solid and structured material became thixotropic.

It slid a further kilometre, cascaded into a watercourse and, from there, into the Owendalulleegh river. Although there was no damage to domestic property, one house was saved only by some old hardwood trees which diverted the flow. Further downstream, two public roads were over-flowed and bridges put at risk. Fear and alarm were engendered among the local population, many of whom are elderly. The river carried the slurry a further 15km into the Special Area of Conservation and Special Protection Area of Lough Cutra with the Shannon Regional Fisheries Board reporting widespread damage to fish stocks.[1]

There had already been a small slump measuring some 40m x 20m on October 2. This occurred on a ca 4^0 slope by the edge of a newly-constructed floating road built for servicing the site (plate 4).

The media focussed sharply on the catastrophe, robustly questioning the local authority, Galway County Council (GCC) and HWP. The Environmental Impact Assessments came in for severe criticism. The National Parks and Wildlife Service joined the Fisheries Board in cleaning-up operations and discussions on how to avoid similar happenings in the future. Geotechnical reports commissioned by GCC and HWP both cited construction activity as the main cause of the slide leading to HWP and main contractor Ascon being fined for pollution offences.

Local community and environmental campaigners, frustrated by perceived indifference on the part of the authorities, had taken their complaint to the European Commission. It has now issued proceedings against the Irish government for breaches of environmental directives.

Some months later, Drs Lindsay and Bragg of the University of East London were commissioned by a private group, the Derrybrien Development Society Ltd, to examine in detail the discussions and processes leading up to the incidents and to comment on the steps which were taken afterwards. This short paper should be considered in the light of their report.[2]

The Derrybrien site

General layout

The site was purchased from Coillte Teoranta, the equivalent of the UK Forestry Commission, by Saorgus Energy Ltd, which obtained planning consent from Galway County Council for two projects, each of 23 towers. By ‘salami slicing’ the application, a further consent was granted without serious debate and the current level of 71 towers, regarded as the maximum number that the site can hold, was achieved. After nearly three years and shortly before the initial consents expired, Saorgus sold the project to HWP.

Extending to some 1,400 hectares of blanket bog capping the hill-top, it is an exposed and highly visible site. The author’s host and guide pointed out that ‘You have wonderful views from up here. To the north, you

[1] The Board reported on 14 November 2003 that, ‘Based on work in similar waters we estimate that over 100,000 fish could have been in the affected waters and the results of our survey in early November confirm that over 50 per cent of these fish died. The dead fish included Trout, Perch, Gudgeon, Stone Loach and Brook Lamprey, which are a special protected species under EU law. Spawning gravels have been heavily silted which means that trout will be unable to spawn effectively. Water quality is also degraded. The affected tributary will remain heavily silted for some time to come and during heavy rain large volumes are still coming down the Owendalulleegh River’.

[2] Lindsay and Bragg, *Op Cit*.

Plate 5: An aerial view of the site looking north towards Loughrea. A nine-turbine wind power site at Sonnagh Old is just visible on the skyline on the top left of the picture.

Plate 6: An aerial view of the site showing floating roads used for access tracks and a near-complete turbine base awaiting final mineral back-fill. Note the excavated peat side-cast and left exposed. The light green/grey areas are trees cut by a 20-tonne tree harvesting machine and laid in rows to support the weight of the machine as it progresses on the blanket bog. The trees have been left to decay.

look out over Galway Bay and see three counties and to the south, over the River Shannon and Lough Dearg, four counties. That chimney is forty miles away, one of our Bord na Mona power stations'. On a clear day such as the author was blessed with for his visit, the view was indeed superb but he chose not to point out that, since the site was a closed one, neither locals nor tourists will be able to go up the mountain and that, if one can overlook so many thousands of hectares of rural Ireland, then it is also visible from the same area.

About 20 years ago (1985), after ploughing, the site was planted with Lodgepole pine *Pinus contorta* and some Sitka spruce *Picea stichensis* with a few small clumps of self-sown *Salix spp* making up the tree species spectrum. Ground rock phosphate had been applied after initial establishment but the trees showed no signs of growing at a commercial rate: none of the roundwood inspected exceeded 15cm dia at the butt. Coillte was happy to abandon the site and write off its losses.

To prepare for the erection of wind turbines, the trees had to be felled and, as a fire precaution, windrowed. This is now all but complete with contractors expected to fell the rest any day. The ameliorating effects of the trees in local landscape terms have been sacrificed to turbine efficiency: trees create turbulence and they have to go. The resulting roundwood was mostly not worth taking off site although doing so was a condition of the deal between Coillte and HWP. A tiny proportion of the cut trees was used for the construction of floating roads *vide infra*. On a wider scale, the presence or absence of the trees makes no difference to the visual impact of the construction.

The site's on-going assessment, rehabilitation and safeguarding is in the hands of environmental consultant and full-time ESB employee Mary Nolan while HWP's peat expert is Henry Bouchier. Both are based in Dublin and the author has had no contact with them.

Wildlife interest

In the Environmental Impact Assessment, play was made of the hilltop being an important site for nesting hen harriers, *Circus cyaneus*: it was claimed that a fifth of Ireland's hen harriers bred on the site. During the visit, when a male merlin *Falco columbarius* flew across the road and alighted on the top of a fallen tree, a bystander remarked, 'Ah, there's one of our hen harriers'. Two kestrels *Falco tinnunculus* were also seen circling and over-flying a piece of cut-over forest. Later, a wide-ranging discussion in the site office produced the comment that 'only this week a harrier had been seen flying just off the ground before pouncing on a mouse'. The level of on-site ornithological knowledge and observation may not be of a high order generally and it is unlikely that harriers are as numerous as stated because the prey base throughout the area is poor.

It was also claimed that there are 'many' Sika deer *Cervus nippon* on the site and a figure of 1,500 was mentioned. When asked, 'How often do you see deer?' the answer was 'Very seldom; I've never seen a stag' although, when the author's party was scouting the day before the official visit, two young stags were seen on the turbary road in mid-morning and broad daylight. A short walk on the edge of the site yielded slots of a Sika hind and, nearby, a fairly fresh fox *Vulpes vulpes* scat made up mostly of beetles but containing no microtin or avian bones. There appears to be no surface damage to the vegetation by Sika using tracks systematically and thus no weakening of the acrotelm caused by hoof damage.[3]

This suggests that the numbers for both species might have been over-estimated although it could also be that hen harrier and Sika populations have declined as a result of deforestation and construction activities.

During the two days that the author was on site, only three meadow pipits *Anthus pratensis* were observed and no skylarks *Alauda arvensis* or larger prey species. No skylarks were seen on the grass heath and no corvids on the upland area, probably indicating a poor prey base although magpies *Pica pica* were common in the lower forest.

Farm animals

There are no farm animals using the turbary area but a wedge of unplanted land which juts into the north-west end of the site is in community ownership and could be used as grazing for hill sheep. None were visible on the day of the visit and it is a matter of speculation whether it is used at all.

Blanket bog

The vegetation association is a poor one, dominated by purple moor grass *Molinia caerulea* associated with

[3] See note 2, page 3.

Plate 7: A supposedly 'floating' road actually sinking rapidly and likely to flood when heavy rain falls.

Plate 8: An aerial view taken in April 2005 of the largest 'borrow' pit on the site, excavated from stratified limestone and originally over-burdened with two metres of peat and three of boulder clay, seen here cast to the side. The excavators suggest the scale. Its volume is estimated at 150,000 m^3.

some cross-leaved heath *Erica tetralix* and occasional ling heather *Calluna vulgaris*. A common constituent is bog asphodel *Narthecium ossifragum* which is regarded in the UK as an indicator of poor conditions for grazing. Consumption leads to photo-sensitivity and is associated with the development of brittle bone disease in sheep. As the area is essentially a deep peat bog where plants have little or no contact with the underlying mineral soil, it is not surprising that the area is floristically impoverished and a poor subject for grazing.

The construction process

Quarrying

In the beginning, a road network was built and a large borrow pit excavated from within stratified limestone bedrock with well-marked vertical and horizontal bedding planes (plate 8). This was therefore easy to work once an over-burden of two metres of peat and three metres of boulder clay had been stripped off. Its size (estimated by eye) was 25 metres deep by 60 by 100 – around 150,000 cubic metres. It was the biggest, but not the only, 'borrow' pit on the site. On completion of construction work, the quarry (for that is what it is) will be abandoned and not back-filled. A suggestion that it could be used for the disposal of unwanted peat rather than side-casting it onto undamaged blanket bog alongside each turbine base *vide infra* was met with a blank stare and 'Why would we want to do that? We'll just leave it the way it is'. A small quantity of peat had been deposited in the quarry.

Floating roads

Floating roads have been constructed throughout the site. The ancient turbary road entering from the east is of similar construction but it has been faced with mineral material on a regular basis over many decades and it is now robust, settled and capable of carrying heavy traffic. It traverses an area which is almost flat.

On the line of the floating roads built within the site, a layer of felled trees was laid in an interlocking mat on top of the acrotelm and 150mm of broken stone placed on top, theoretically to allow water to seep between the acrotelm and the road layers above. A layer of geogrid/terram synthetic material was then laid on top of the broken stone, followed by 400 to 500mm of crushed stone. This was faced with fines to create a smooth surface. The overall depth of imported material was thus about 800mm.

Lengths of road constructed in this way in the early days of the project now lie a full metre below the level of the surrounding bog (plate 7) and are waterlogged in places. The contractor's solution was to pile on more mineral material to raise the road surface above the water-table. This further increased the loading. Elsewhere, where the pressure of the road on the acrotelm had caused it to sink, sticks which protruded from beneath the road were by now pointing priapically skywards.

As the roads are about four metres wide, the surface loading on the acrotelm is in excess of three tonnes per running metre, equivalent to a ground pressure of over 0.8kg/cm^2. The regular passage of vehicles with a loading as low as 0.3kg/cm^2 can cause acrotelm to fail as will repeated foot traffic (*viz* the Pennine Way – an average human being walking on blanket bog exerts around 1.5 to 1.8 kg/cm^2). In contrast, the high-capacity cranes required for turbine construction weigh around 80 tonnes unladen and load the roads by anything up to 4kg/cm^2 over a wide area.

The first (and warning) landslip on October 2, 2003 occurred alongside a floating road where the acrotelm had failed. The mechanics of this are straightforward. Loading the acrotelm results initially in compression and sinking and thus the deformation of the catotelm underneath. After a while, the acrotelm is stretched beyond its tensile strength and elastic limit to the point where it tears. If the road is running along a contour, this weakness will predispose the peat to slip because the cohesion of the cover over the catotelm provided by the overlying acrotelm against gravitational forces has been compromised.

Attempts have been made at Derrybrien to dig side-drains beside the floating roads with the intention of removing the waterlogging. Inevitably, these slice through the acrotelm, removing its control over the catotelm and laying up possible trouble for the future.

The turbine bases

The area is superficially uniform but its underlying variability was revealed by the depths of peat and boulder clay encountered when construction work commenced. Somewhere in the T17-T25 area, a preliminary

Plate 9: A panoramic view of the quarry taken August 2005.

Plate 10, above left: The surround for a turbine base showing boulder clay under the peat.

Plate 11, left: In several places on the site, the boulder clay exposed in this manner is already eroding, leaving the peat high and dry.

Plate 12, above: the drainage arrangement for turbine bases. The silt in the stagnant pools is meant to be trapped in silt beds of the type illustrated on page 12 a method which, although endorsed by SEPA, is proving ineffective.

foundation dig encountered highly unsuitable conditions: the place was abandoned (but not back-filled) and the tower re-sited. One turbine location had an overlay of five metres of peat and seven metres of unstable boulder clay over the bed-rock, necessitating the digging of a hole 12 metres deep to get the turbine base keyed into a solid base. During construction, the continuous pumping-out of turbid seepage water was necessary. The average depth of the boulder clay lying on the limestone bedrock is five metres and, on one site, boulder clay nine metres deep was encountered. It had all to be excavated and disposed of.

This is, of course, only half the problem: as a matter of course, sound mineral material had to be imported from 'borrow' pits to back-fill each hole, secure the turbine and bring the base-ring up to approximately ground level.

The tower bases gave the appearance of the construction work being only half-finished. Each was a mass of crushed limestone piled on top of the concrete plinth and dished into the foot of the steel work. The angle of repose of much of this broken stone was inadequate and, in some instances, the material was actively moving (plates 10-12, 23). The same could be said for the peat banks surrounding each turbine base. Although they had been battered to an angle of around 45 degrees, they were crumbling into the base drain. This was often drawn in the soft boulder clay, had no sound foundation and so had eroded considerably, leaving the peat bank undercut. The implications of the extent of the lack of finishing are serious. Unless the tower bases are back-filled and sealed up with peat and the surfaces re-vegetated, the surrounding peat will dry out, break away from the parent mass and oxidise. Carbon dioxide will be released in large amounts, undermining the *raison d'être* of the wind farm.

At almost every tower, peat and boulder clay had been dug out and either side-cast onto adjacent undamaged blanket bog or stacked on cut-over forest and left rough. The contractor later levelled the spoil, chamfering the edges to smooth out the landform (plate 18). When it was pointed out that peat treated in this way would oxidise over the next decade, as would the battered sides in the pits at the tower sites, jaws dropped with astonishment. No-one had heard of aerated peat oxidising naturally. This is an extraordinary situation.

The aftermath of the bogslide

The reaction of HWP to what was a public relations disaster in the full glare of national publicity can be summed up as 'Be seen to do something', a thought-process that continues today with cosmetic work still being carried out 22 months after the incident.

Beside the Black Road, two tracked diggers were taking peat sludge and mineral sediment out of the bed of the stream above the road bridge and laying it on top of the native vegetation in the form of a large compacted plateau of structureless material 1.5 metres deep (plate 13).[4] When the foreman was asked what was going on, he said 'We're stabilising the bog'. Asked 'What with?', his comment was that, 'When it dries out a bit, we'll just throw some hayseed on it and it'll grow and hold the peat'.

It won't.

Directly below the bridge, the stream had small barley-straw bales size 1m x 0.5m x 0.5m laid into the stream bed with stones on top to hold them in place. They were intended to catch silt. It was, and always will be, totally ineffectual (plate 14). The water at the low current flow prevailing on the day was running through the stones in the stream-bed: little, if any, was running through the straw and none of the considerable amounts of suspended matter being carried downstream even at this low flow was being trapped. When flow levels are significantly higher, the bales will simply be pushed out of the way by the weight of water and the increased load of suspended matter from upstream will again go straight down the watercourse. The issue is examined further on page 15.

A causeway forming a dam designed to hold back some of the collapsing bog was inspected. When asked how much rock had been used (out of a 'borrow' pit opened specially for the purpose), the host said '20,000 tonnes' (plates 16-18). The author forebore to point out that, although 450,000 tonnes of material had passed the spot two years previously, the causeway with its through-pipes was holding up probably no more than 100 tonnes of peat slurry on its up-side.

During the past months, a side-trench had been dug alongside the landslip to catch water seeping into the main watercourse. This water was now coming down alongside the access road to the causeway and

[4] The Black Road is the local name for an unclassified road running from the east end of Derrybrien to Loughrea. It is the main site access route.

Plate 13: Spooning displaced peat with a digger into specially-constructed lagoons where, it is planned, the scattering of hayseeds will stabilise the slurry and prevent further pollution of the watercourses and the Lough Cutra SAC/SPA. See page 11.

Plate 14: A 'silt trap', sited adjacent to the above lagoon, made from barley-straw bales. At low flow levels, the water runs through the stones in the stream bed and little, if any, of the suspended matter is trapped. When the flow is high, it pushes the bales aside and the increased load of suspended matter again goes straight down the watercourse. Two displaced bales can be seen on the top left of the picture. Unless these bales are replaced on an eight-week cycle, their decomposition is itself pollutant.

undermining it. It will take only a winter storm of medium intensity to render it impassable to wheeled vehicles.

HWP's efforts have been not only reactive but pointless as anyone who walked a kilometre upstream from this causeway could appreciate. There was almost no peat left to come down out of the mini-catchment: all that remained were a few tumbled trees with root-plates holding limited quantities of peat and boulder clay. Everything else had gone (plate 16). The entire effort was cosmetic, carried out only because the contractor needed to be seen to be doing something.

Another bund has been built about 300 metres downstream at a point where the gorge narrowed and where the slurry had cascaded through at a depth of 10 metres (plates 19,20). It was five to seven metres high and the peat lagoon behind it was some 50 metres long. Against the bund, the slurry was up to four metres deep and about 15 wide. Two one-metre diameter pipes pass through the bund above the bed of the stream.

An excavator with a 20 metre reach was baling out the lagoon with a 60cm bucket and placing the slurry into a 15 by 25 metre lagoon which had been constructed just alongside. This had high peat sides laid on top of deep blanket bog. The excavator operator had already been working for a day and a half and said he needed another nine hours to empty the gorge. His manager pointed out that the forecast was for heavy rain that evening, that the cofferdam holding back surface water in the stream would not contain storm run-off and that he had to finish the digging-out that day. There was little or no likelihood of it being achieved.

Looking at these activities, it was impossible to avoid the analogy of emptying a bath with a teaspoon.

Recovery of vegetation

It came as a surprise to see that, on every part of the site where bare peat had not been disturbed for eight weeks or so, the surface was revegetating naturally. Species were chiefly soft rush, *Juncus effusus* and Yorkshire fog *Holcus lanatus*. Side-castings from the turbine towers had been thrown in a series of jumbled heaps on top of the blanket bog and, two years on, most were vegetated to a level of at least 60 per cent plant cover. Even patches of slurry in eddies against the bunds were colonising with assorted monocoteledons although they were unstable and would not carry the weight of a small dog.

A note

Before leaving the topic of Derrybrien, it is worth noting that Ireland's national energy policy appears to lack a cohesive anti-CO_2 strategy. Within the last two years, two new peat-fired power stations have been commissioned, one with a capacity of 100MW at Lanesborough, burning three-quarters of a million tonnes of peat per year (mty), and another at Shannon Bridge which consumes 1.25mty of peat. If the CO_2 which will be released by natural oxidation over the life of the Derrybrien wind farm is taken together with the aggregated discharges from these two new stations, the Republic is making an active contribution to increasing CO_2 emission within the British Isles.

Plate 15: Cashlaundrumlahan, highest of the Slieve Aughty mountains, viewed here from the south. Derrybrien is a scattered community whose dwellings straddle the Gort-Potrumna road. This runs through the middle of the cultivation at the foot of the mountain (left to right in this picture). The slide occurred to the east of the village.

Plate 16, above: Looking up from a causeway built across the path of the slide to stop peat that is no longer there from sliding again. Note the drop in ground level compared to the surrounding afforestation.

Plate 17, left: Looking across the causeway which took 20,000 tonnes of rock to build. For scale, note the person (circled) standing half-way across. The reasoning behind its construction is hard to fathom if it is anything other than a political palliative.

Plate 18, right: Displaced peat one metre thick side-cast on top of pristine bog. The work was completed only 14 days before this picture was taken but the surface is already cracking.

The relevance of Derrybrien to the Braes of Doune project

The River Teith SAC

PLANNING CONSENT for Airtricity's Braes of Doune proposal was granted on 5 October 2004, subject to SNH and others being satisfied on around 100 conditions. Two and a half months later, on 18 January 2005, SNH's application for candidate SAC status for the River Teith was confirmed.

Protecting the burn with straw

The Scottish Environment Protection Agency (SEPA) has reportedly advised SNH that the proposal to trap silt emanating from the development using straw beds is satisfactory. A copy of the advice was requested but SNH is unable to supply it. *Pro tem,* it is concluded that SEPA has given misleading advice on which SNH appears to be acting without question.

Notwithstanding assurances given to the author by Dr Angus Laing on maintaining the integrity of the SAC, the experience of Derrybrien confirms that, even at a distance from the bogslide, drainage works essential for the site's operation increase the turbidity and silt load of streams and that the disturbance of the peat results in increased oxidation and the release of a greatly increased level of humic acids.[5]

There are no practical techniques available to mitigate damage further downstream from deposits of suspended matter. The SAC – defined and created for the conservation of anadromous species including lampreys and juvenile salmonids – will be seriously compromised if construction goes ahead.

Two important points about using straw in these circumstances are a) that regard must be paid to eutrophication caused by decomposition of the straw used in the filter beds and b) for the beds to maintain effectiveness they need to be renewed at least every eight weeks even under normal rainfall patterns, a regime that would have to be maintained more or less indefinitely and certainly long after the site was decommissioned.

It is also self-evident that straw beds, however large or numerous within the catchment, would not cope with run-off generated by storm rainfall such as fell in August 2004. Here, separate incidents saw the blockage of the A9 north of Dunkeld and the Glenogle landslide. In the same month, fields in the catchment of the Ardoch Burn were flooded twice, a phenomenon not seen by local residents for at least 40 years.[6]

This year has seen 3.8cm of rain fall in the Lochearnhead area in around two hours on the morning of June 19 (stranding a family in Glen Almond) and 2.5cm in three hours at Inverlochlarig on August 25.

The south-western part of the Grampian Mountains is subject to frequent flash floods and a precipitation incident of similar intensity could cause major damage were it to occur at a construction site on the Braes of Doune. There is, quite simply, no way that straw-filled lagoons and filtration beds will cope with the quantity of suspended matter carried downstream off disturbed ground under storm conditions such as these.

- *Controlling run-off from the development to the degree necessary to safeguard conservation and rod-fishing objectives will not be possible.*

The risk to fish from a bogslide

Based on the Derrybrien experience, where tens of thousands of fish were wiped out considerable distances from the original event, it is likely that, in the event of a bogslide on any significant scale on the Braes of Doune site, salmon and sea trout parr would be all but wiped out in the Ardoch Burn.

Rod-fishing on the four miles of prime beats on the Teith below the Ardoch Burn junction would also be affected and, further downstream, Stirling Council's water on the Forth at the Old Mills of Kildean – a productive stretch fished largely by the residents of Stirling – would be compromised.

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5 Angus Laing, *Pers comm,* 8 April 2005.

6 D McLaren, *Pers comm*, 20 September 2005. On June 14, 2005, *The Scotsman* reported that: 'Experts are drawing up a list of 'high hazard' roads, which include a 14-mile stretch of the A9 between Dunkeld and Drumochter in Perthshire and an 18-mile section of the A82 north of Fort Augustus. Others include the A87 in Glenshiel, the A84 south of Strathyre and the A835 south of Ullapool. The research was ordered by Nicol Stephen, the transport minister, after three main routes were blocked when they were engulfed by landslides within a week of each other last August. Three times as much rain as normal fell that month in parts of Scotland. A family had a narrow escape from their car when a landslide blocked the A9 near Dunkeld. Days later, 50 people had to be airlifted to safety after huge mudslides trapped their vehicles on the A85 in Glen Ogle, near Lochearnhead . . . A further landslip closed the A83, the main Glasgow-Campbeltown route, in Argyll.'

Plate 19: One of the peat lagoons discussed on page 13. The watercourse polluted by the bogslide runs right to left behind the mechanical digger in the left foreground. Peat still in the watercourse, now restrained by a bund, was being lifted into the peat-walled lagoon visible in the foreground. (The power line is the site's 110kV link to the grid.)

Plate 20: The view upstream from the bund, a few hundred metres downstream from the causeway shown on page 14. Twenty-two months after the slide, residual peat was being spooned out with an excavator and dumped into a prepared lagoon, see above. Here, it will dry out and decay, releasing CO_2 to atmosphere.

Deposition of peat slurry on the mudflats of the Firth of Forth SPA Ramsar site could upset the ecology of these sensitive areas and affect the birds living there.

The need for re-evaluation

One must be careful not to make superficial comparisons between the two sites, not least because they are over 300 miles apart and overlie different rock types. While enforcement of environmental best practice is not a high priority in Ireland and, if it were, it is possible that the likelihood of a disaster might have been reduced, it remains open to doubt as to whether the bogslide could have been prevented whatever those working on the site had done.

That is the principal lesson for all those involved at whatever level with the Braes of Doune proposal. Lindsay and Bragg highlighted a frightening lack of appreciation on the part of planners, contractors and others of the dynamics of moorland, the vulnerability of peatlands and the manner in which peat differs from mineral soils. This ignorance created a situation where a bogslide became a distinct possibility rather than the isolated Act of God suggested by participants in the immediate aftermath of the catastrophe. Lindsay and Bragg stress what all connected with this kind of work should know – that peat is a particularly unstable material largely because it is made up mostly of water (>97 per cent being commonplace) and, when it is disturbed, its colloidal nature makes the control of a soliflux event very difficult.

It is also reasonable to ask 'Are the constraints which are applied by law to developers in the UK any more rigorous?' and the answer has to be 'No'. Contractors are frequently ignorant of the problems presented by soil conditions on sites of this type and lack the ability to react to a catastrophe in the virtually certain event of one taking place at one site or another, given the large number proposed for peat terrain. Few people appreciate that, when disturbed, peat may become thixotrophic (which happened at Derrybrien after the ensuing deluge and run-off got into the primary land slip) and that the options for minimising damage once material in this state starts to move are very limited.

The outline plans for the road network and turbine bases at Braes of Doune pay only superficial attention to problems encountered at Derrybrien even though there is every likelihood that, given a similar set of weather circumstances, a bogslide could take place. These circumstances need not occur only during construction: if peat dries out and cracks during a warm summer (and we are experiencing these more frequently), rains during the following autumn would loosen its attachment to the underlying boulder clay and bedrock. In these conditions, a weakness in the acrotelm caused by a floating road, an upset in hydrology due to site drainage or natural fissuring caused by animal tracking is enough to set off a slide. There is then nothing thereafter that man can do to prevent it.

Three questions must be asked with respect to the Natura 2000 sites downstream of the Braes: 'How likely is a catastrophic bogslide event?', 'Should one occur, what would be its effect on these sites?' and 'Would the mitigation measures as currently proposed be effective?'

Neither the Environmental Statement nor Mott MacDonald's supplementary report addresses the issue of bogslide or its potential effects.[7] In particular, there is no information on the return period for extreme precipitation events or the moisture content and in-situ shear strength of peat on the site. Not only is it therefore not possible to assess the likelihood of catastrophic failure at the Braes of Doune but it has also not been established that there would be no impact on the downstream Natura 2000 sites following such a failure.

On the contrary, it is absolutely certain that the proposed mitigation of protecting the Ardoch Burn with straw would be ineffective and that substantial damage to the designated sites would follow.

Although SNH initally objected to the application for the Braes of Doune site, it held discussions with the planning authority and, subject to certain contractual undertakings, withdrew its objections. Particularly in the light of the Derrybrien incident, this was perhaps premature.

- *The recent designation of the area below the Braes of Doune as an SAC means that the proposal must be re-examined as a matter of urgency. It will be very difficult, if not impossible, to guarantee the integrity of the downstream Natura 2000 sites if the development proceeds.*

7 Mott MacDonald, June 2004, *Braes of Doune Windfarm Peat Stability Issues, Summary Report*.

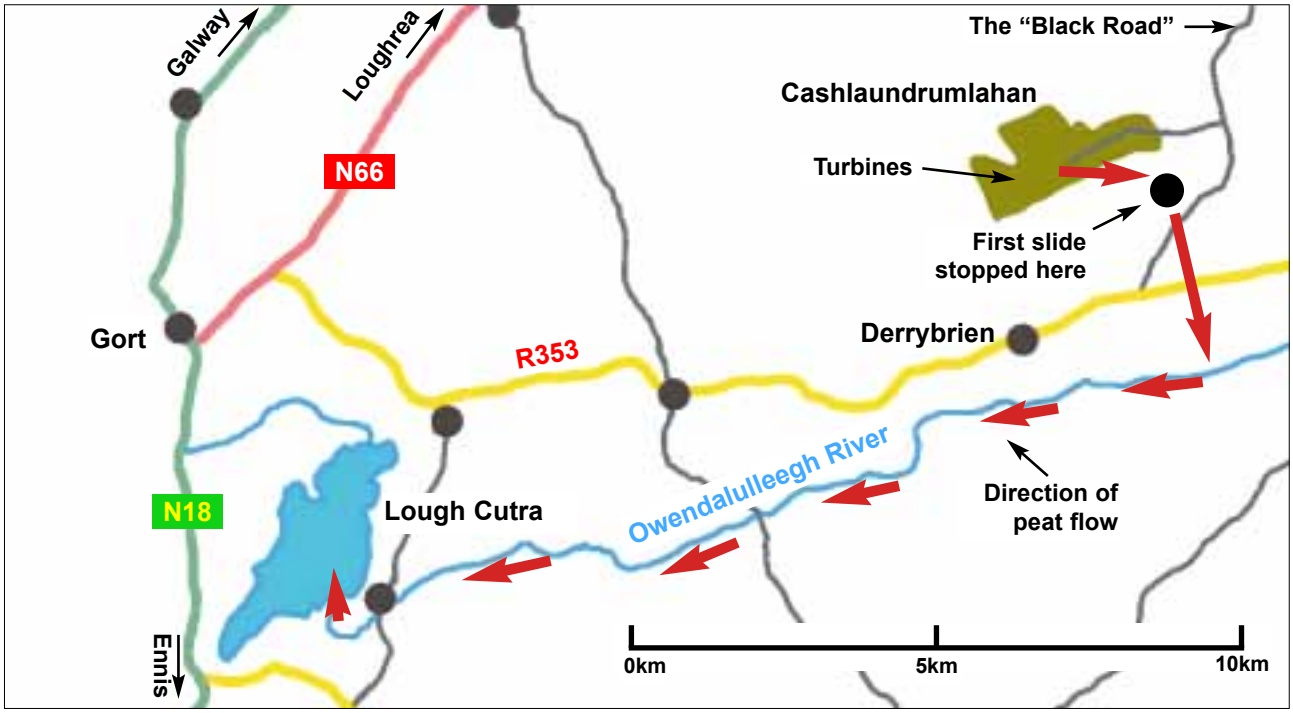

Plate 21: The approximate path taken by the bogslide from the base of Turbine 68 on top of Cashlaundrumlahan into a local watercourse, over the Derrybrien-Loughrea 'Black Road', across the R353 Portumna road and into the Owendalulleegh river. It then flowed downriver into Lough Cutra.

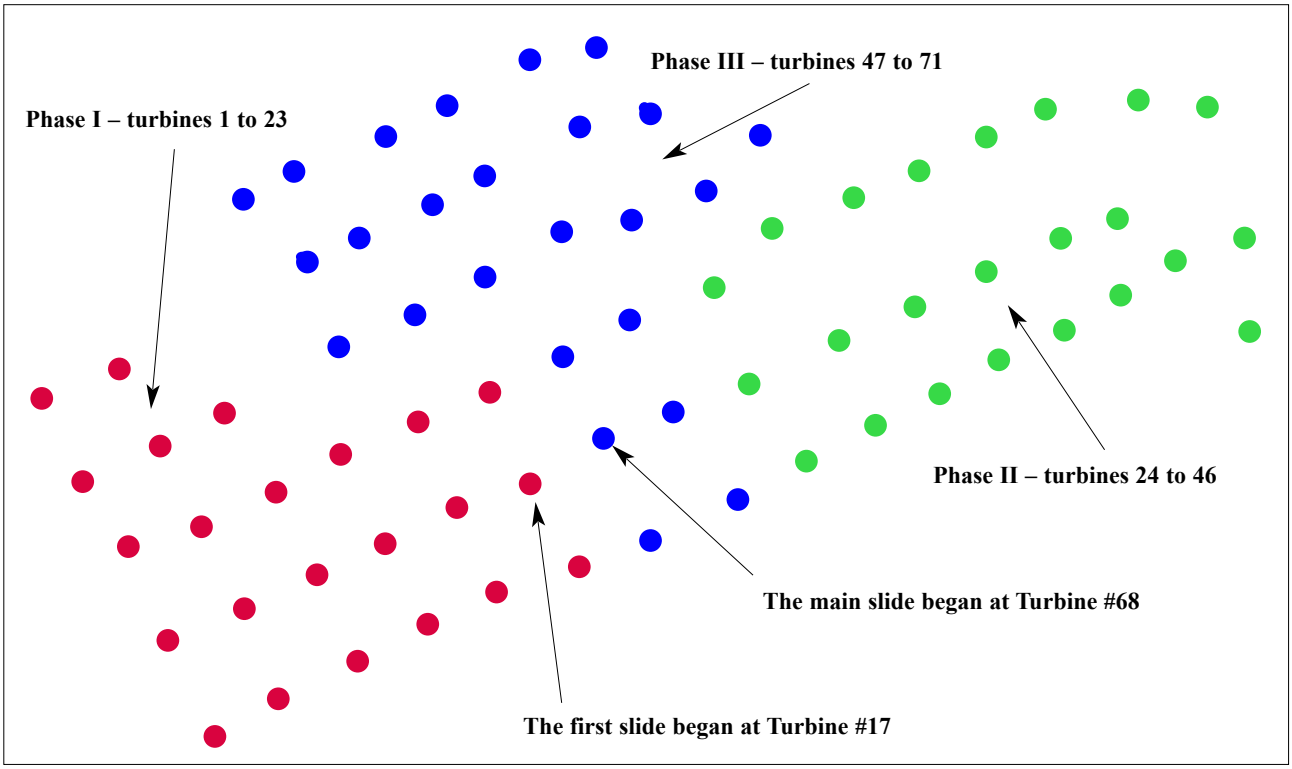

Plate 22: The layout of the turbines on the Derrybrien site. The small slide of October 2 occurred at T17, approx 230 metres west of the point of origin of the main slide of October 16, which was at the base of T68. It is apparent that the EU Environment Commissioner's concerns over 'salami slicing' and other assessment issues have some substance.

The broader picture

- In general terms, Environmental Impact Assessments must be far more rigorous than at present with full weighting given to the considerable problems posed by construction on this scale on deep peat. EIAs which specify rehabilitation of the disturbed sites must set out in minute detail every step which is to be taken to ensure correct rehabilitation. This issue is being neither addressed nor implemented at present;
- No wind farms should ever be proposed for sites where it is necessary to disturb substantive or continuous deposits of peat in excess of 0.5 metres deep. The risks of an environmental catastrophe are too great for development to be allowed on such sites. During the nominal life of a wind farm (20 years), exceptional weather events and precipitation incidents are statistically certain. If they co-incide, a slide will almost inevitably occur;
- It is, in any case, probably unrealistic to expect a wind farm to be scrapped after the nominal 20 years and upgrading by generators could well be the order of the day. The threat of a pollution catastrophe to the general environment lasts for the full life of the project and persists after de-commissioning unless great care is taken;
- This report does not deal with economic or legal issues associated with wind farms as the topic is beyond its remit. However, peat bogs are important carbon sinks worldwide and the vegetation covering them has a significant role to play in sequestering and storing atmospheric carbon. It is particularly foolhardy to disturb and damage these sinks and stores because that will result in the rapid release of stored CO_2 as the bogs dry out and the peat oxidises;
- In the current climate of global opinion on CO_2 emissions, it is impossible to construct an environmentally valid, watertight case for any industrial development, whether for the generation of electricity or for another purpose, on blanket bogs;
- Currently, the Environment Agency and English Nature are strongly advocating changes in moorland management, as is SNH in Scotland. Their joint intention is to reduce carbon emissions by encouraging the improvement of peat bogs and achieving an active increase in the proportion of these in good condition. This policy is incompatible with the development of wind farms on blanket bog nationwide.

Plate 23: A completed turbine base on Derrybrien showing exposed peat which will oxidise and erode over time. While other peatland projects propose different construction techniques, the risk of pollution and landslip remains whenever such terrain is industrialised, whatever the perceived political acceptability of its purpose.

About the Author

JOHN PHILLIPS became interested in the Derrybrien incident on account of proposals to erect a 49-turbine wind farm on the Braes of Doune in west Perthshire on a hill face dominated by deep peat and with many superficial similarities to the Irish site. He had already corresponded with the local office of Scottish Natural Heritage about this intensive industrial development of an area of high scenic worth adjoining the Loch Lomond National Park.

He decided, in the light of Lindsay and Bragg's 2004 report on Derrybrien, that a visit was necessary but the site's owners declined to receive him when he made contact as a private consultant.

As he had already been asked by SNH to assist in commenting on method statements supplied by the developer at Braes of Doune (purification of which were a condition of planning consent), he enlisted the help of SNH's area manager, Dr Angus Laing, who provided a letter of intoduction to Hibernian Wind Power's management. This received a positive reponse from Derrybrien project manager Harry Harbison. Phillips therefore offered Dr Laing sight of the report on his visit. The offer was accepted with alacrity.

The author prepared his report using privately-sourced funds – SNH was not asked to contribute either to the expenses of the trip or to pay any fees to the parties involved. However, it is submitted to SNH and others and is designed:

- to increase awareness of the need for a higher level of specialist knowledge when dealing with peat. (As recently as the summer of 2005, SNH staff dealing with Braes of Doune matters were unaware of the Derrybrien bogslide.)
- to endorse the findings of Lindsay & Bragg and to look at the site two years on, particularly in terms of recovery;
- to ensure that every application for planning consent for wind turbines includes a section which takes full note of the dynamics of peat bog, particularly when it is disturbed. If any deep peat (defined as >0.5m) has to be disturbed as part of a construction proposal, then the application should be refused as a matter of course The predisposition must be that no peat-dominated sites for wind farms will receive planning consent;
- to encourage as a matter of urgency an SNH delegation to Derrybrien for people to see for themselves a) just how not to carry out such a development and b) to take stock of the advisability of undertaking any such developments on deep peat.

Curriculum Vitae

John Phillips, MA (Agric), CBiol, MIBiol.

1959-1964	Owned and ran a small farm in Fife;
1965-1971	Game Adviser, Eley Game Advisory Service, Fordingbridge, Hampshire;
1971-1974	Game Adviser, Economic Forestry Group;
1974-1984	Self-employed wildlife manager and game consultant. Conducted a definitive research programme on the epidemiology of sheep ticks *Ixodes ricinus* and louping ill;
1984-2003	Founded and then directed The Heather Trust which specialises in the management and rehabilitation of heather moor and peatland;
1996-present	Owns and runs a small arable farm in west Perthshire;
2003-present	Consultant in all aspects of moorland and upland wildlife management and hill-farming.