Appendix 9-2

Peat and Spoil Management Plan Assessment

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Shronowen Wind Farm

Peat and Spoil Management Plan (PSMP)

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ISSUE FORM	
Project number	19876
Document number	6011
Document revision	A
Document title	Peat and Spoil Management Plan
Document status	**For Planning**
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Document checked by	Ken Fitzgerald

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1 Introduction

Malachy Walsh and Partners (MWP) was engaged in by EMP to compile a Peat and Spoil Management Plan (PSMP) for Shronowen Wind Farm in County Kerry. This PSMP relates only to the wind farm site which is included in the proposed development and part of the overall project.

The Site of the proposed Shronowen Wind Farm is situated within the rural locale between Listowel and Ballylongford in North Co. Kerry. The Site is located in an area of open low peatland east of the R552 Regional Road, approximately 4km southeast of Ballylongford village and 6km north of Listowel town.

Existing land cover at the site is primarily peatlands with extensive areas of active peat cutting along with areas of worked out bog. There are some areas of intact blanket bog and open field pastures which abuts the peatland habitat. There are some areas of conifer plantation within the footprint of the proposed site layout.

The proposed development for which permission under Section 37E is being sought constitutes the following:

- Twelve (12) No. Wind Turbines (maximum turbine tip height 150m) with associated foundations and crane hardstand areas.
- One (1) No. Permanent Meteorological Mast (90m height) and associated foundation and hardstand area.
- New and upgraded internal site service roads (4.43km of existing tracks to be upgraded and 6.85km of new internal access tracks to be constructed).
- Underground 33kV electric cabling systems between turbines within the wind farm site and wind farm substation.
- Six (6) No. peat deposition areas located across the wind farm site
- Two (2) No. site entrances – one permanent and one temporary.
- 225m underground cable connection from the 110kV wind farm substation to the existing 110kV transmission line due east of the wind farm site.
- One (1) No. proposed 110kV substation including: an outdoor electrical yard, two single storey buildings (one for the system operator and one for the wind farm operator) containing associated facilities (control, switchgear and metering rooms, welfare facilities, workshop and office). Security fencing and all associated works.
- New junction off the L-6021 at the north east of the site to facilitate construction and access.
- New junction off the L-1009 on the west of the site to facilitate construction and access.
- Two (2) No. Temporary construction site compounds (95m x 50m and 55m x 25m in size).
- Associated surface water management systems.
- Tree felling of 3.15ha of conifer trees to facilitate site development.

- Temporary works on sections of the public road network along the turbine delivery route (including hedge or tree cutting, relocation of powerlines/poles, lampposts, signage and local road widening).

2 Purpose of the Peat and Spoil Management Plan

The purpose of this Peat and Spoil Management Plan is to describe how it is planned to construct Shronowen Wind Farm in a manner that ensures the landscape is not adversely impacted as a result of the proposed development and that site management practices are carried out to complete the development safely and in the interest of orderly development.

The plan also sets out a methodology to prevent:

1. Peat slippage and bog burst,
2. Soil, peat and rock (if encountered) excavated during the construction phase from being stock-piled on site following the completion of construction works,
3. Peat excavated from the site from being dumped onto adjacent bogland,
4. Adverse local effects on sensitive habitats.

The ultimate aim is to construct the wind farm project in a manner that facilitates regeneration of all-natural habitats at all locations affected by construction works and will minimise the damage incurred on sensitive habitats. The stages of the spoil management process comprise:

1. Appropriate handling of excavated soil, peat or rock (if encountered),
2. Management of existing habitats,
3. Rehabilitation of excavated areas

3 Ground Stability

Site investigations were carried out along the proposed internal access road routes, at each turbine location and at the sites of other infrastructural elements. This consisted of peat probing using a gouge corer. This information allowed a location specific assessment of the peat stability risk to be carried out. Based on this information, turbine positions were adjusted or relocated to avoided traversing locations identified as areas of peat instability. The outcome of identifying all of the environmental, technical and engineering constraints for the site was that an infrastructural layout could be situated in areas characterised by relatively low surface gradients and lower peat instability risk. Comprehensive information on the peat characteristics throughout the site is included in the Peat Stability Risk Assessment Report **in Volume 3, Appendix 9-1** of the EIAR.

4 Peat and Spoil Management Basis Statement

4.1 Prevention of Peat Slide and Bog Burst

In order to address any potential concerns with peat stability, a detailed assessment of peat stability has been undertaken on the proposed wind farm site. The Peat Stability Risk Assessment (PSRA) Report is included in **Appendix 9-1 Volume 3** of the EIAR. The peat stability assessment, presented in the Peat Stability Risk Assessment Report, identified areas of higher risk of instability within the site (such as the area to the east of T9 where evidence of peat movement was noted). The higher risk areas were used as a constraint when designing the layout of the wind farm and were actively avoided when designing the wind farm layout. This process has ensured that infrastructure was only placed in lower risk areas and hence it can be concluded that the risk of instability is low for the proposed infrastructure when appropriate mitigation measures are implemented by the appointed contractor.

Any construction upon the peat depths and topography encountered at the proposed infrastructure locations within this site generally presents a negligible to low level of risk for a peat environment. Localised areas of medium risk (in the unmitigated situation) have been identified to the north of T6, east of T9, south of T8 and near T11. When mitigation measures are applied, medium level risk reduces to low. A localised area of significant risk (in an unmitigated situation) has been identified to the west of T11. When mitigation measures are applied, significant level risk reduces to medium. Full details of the assessment and mitigations is given in the PSRA Report included in **Appendix 9-1 Volume 3** of the EIAR.

In order to manage construction risk within this site, the following shall be taken into account;

1. All site excavations and construction should be supervised by a suitably experienced engineer. The Contractor's method statements for each element of work should be reviewed and approved by the engineer prior to site operations. Specific method statements should be developed for each turbine and hardstanding location within the site.

2. Particular emphasis should be placed in the Contract that only operators of proven experience in working in peatlands are employed for any work element involving excavation, handling or placement of peat.

3. Prior to excavation, drains should be established to effectively intercept overland flow prior to earthworks.

4. The existing network of drainage within the site should be utilised whenever possible.

5. Due to peats potential to have fluid-like properties once excavated, all peat excavated should be immediately removed from work areas. If peat is required for reinstatement, then acrotelm peat (<0.5m shallow, living layer) should be stripped off the surface of the excavated area and placed carefully at the margins of the work area along the access road and hardstand margins that are characterised by near-horizontal slopes (<3^{o}).

6. From evidence of previous landslides (Derrybrien Landslide in Co. Galway (2003) and Pollatomish Landslide Co. Mayo (2003)) and historic occurrences, it is strongly recommended that construction activities should be assessed for impact after prolonged periods of heavy rainfall. Reference: Landslides in Ireland, GSI Landslide Working Group, 2006.

7. From examination of factual evidence to date, the majority of peat slides occur after an intense period of rainfall (Landslides in Ireland, GSI Landslide Working Group, 2006). It is recommended that an emergency response system be developed for the construction phase of the project, particularly during the early excavation phase. This, as a minimum, should involve 24 hour advance meteorological forecasting (Met Eireann download) linked to a trigger-response system. When a pre-determined rainfall trigger level is exceeded (e.g. 1 in 100-year storm event or very heavy rainfall at >25mm/hr), planned responses are undertaken. These responses should include cessation of construction until the storm event, including storm runoff, has passed over. This requirement is also included in the CEMP.

Construction methodologies for excavations in deep peat will need to consider that depths of over 7m are present in places. Turbines and crane hardstands cannot be constructed directly onto the peat due to its low strength. Loads from these structures will need to be on a firmer strata below the peat. This leads to large scale excavations being required. Temporary stabilisation measures at the sides of excavation will be required to prevent peat movements into the excavation. The risk of instability of peat during excavation work is a construction health and safety risk to those working on the construction of the scheme. Temporary works such as sheet pile cofferdams or granular berms will be required around the perimeter of the excavations to prevent movement of peat into the excavation. Alternatively, piled crane hardstands could be considered to remove the need for large scale excavations at the hardstands. Drainage works will need to be installed such that water is directed away from areas where there are steep banks of cut peat to avoid saturating the peat. This is a particularly important consideration in the area to the west of T9 where evidence of previous peat movement and tension crack was noted during the desk study and site walkover. Stockpiling of materials shall not be permitted on peat. Excavated material shall be removed to the designated deposition areas immediately following excavation.

At the area of significant risk to the east of T11, more stringent mitigation measures shall be applied. These are to include the following:

- No stockpiling of material in this area
- More frequent monitoring and inspection of the floated road
- The used of a log road construction
- Consider the use of logs to pile the section of road through this area to transfer loads to a firm strata below the peat.
- No excavation or removal of peat to be carried out in this area

The Construction Manager for the project should impart the philosophy that everyone on the site is aware of peat stability and report any sign of misalignment in monitoring posts. Vigilance is a

fundamental requirement when working on peat where inappropriate construction methodology can cause instability in otherwise benign conditions.

A Geotechnical Engineer experienced in working in peat environments should be employed full-time to ensure the implementation of best practice in this environment. The methodology of all civil works should be reviewed by the Geotechnical Engineer and the monitoring posts should be the subject of a dedicated inspection on a weekly basis by the Geotechnical Engineer.

The following general measures incorporated into the construction phase of the project will assist in the management of the risks for this site:

- Appointment of experienced and competent contractors and detailed designers;
- The construction works on site will be supervised by experienced and qualified personnel;
- Ensure construction method statements are followed or, where agreed, modified/ developed;
- Allocate sufficient time for the project to be constructed safely with all peat stability mitigation measures included in the programme;
- Set up, maintain and report findings from monitoring systems, including sightline monitoring;
- Maintain vigilance and awareness through Tool-Box-Talks (TBTs) on peat stability;
- Prevent undercutting of slopes and unsupported excavations;
- No sidecasting of excavated material other than in areas selected for such activities by a suitably qualified environmental professional or site geotechnical engineer;
- Prevent placement of loads/overburden on marginal ground; and,
- Manage and maintain a robust drainage system.

4.2 Excavated Soil Management

Spoil will invariably be generated during excavations for roads, hardstands, wind turbine foundations and trenching for ducting as well as developing silt controls. Minimisation of the production of this spoil is to be treated as a high priority, but it is nevertheless accepted that there will be generation of excess spoil in the form of a mixture of topsoil, mineral soil, peat and glacial till.

Two types of soil are generated during excavation in upland areas; glacial soils and peat soils. These spoil types need to be treated separately. Glacial soils and peat are to be separated during excavation and these two types of spoil will be disposed of generally as follows:-

- Glacial soils will be deposited directly on top of other glacial soils. This will require the removal of peat where present to facilitate the process.
- Peat can be disposed either on top of glacial soils, on top of inactive peat or on top of the *acrotelm* where the "top mat" has been removed.
- No peat will be stockpiled (either temporarily or permanently) along the roadway to the west of T11.
- No peat will be stockpiled near the area of historical peat movement to the east of T9.

It is proposed that only material required for landscaping and reinstatement around each turbine will be stockpiled adjacent to the turbine excavations. The remainder of the excavated spoil should be transported directly from the excavation for disposal within the proposed deposition areas.

The majority of the site has been cut over for small scale peat harvesting and the bog is severely degraded in terms of its value for habitat restoration. The upper layer of scraw of the bog still has some benefit for landscaping and is considered a preferential material for re-use around turbines.

The following good practice applies to such peat excavation:

- Peat turves will be excavated as intact blocks of upper peat comprising the surface vegetation layer (*acrotelm*) and adjoining upper *catotelm*;
- Underlying turves will be extracted as intact as feasible, with remoulding by the excavator kept to a minimum;
- Excavation of contaminated peat turves (those incorporating substrate) will be avoided if possible, and where unavoidable will be stored separately to non-contaminated peat turves to avoid further contamination on reinstatement (or during transport).

Where possible, a technique known as macroturfing (large scale cutting and re-laying of turf blocks) should be employed to extract intact full depth *acrotelm* layers from the top surface of the peat deposit. This technique will maintain connectivity between the surface vegetation and the partially decomposed upper layers of the *catotelm*.

4.3 Peat and Spoil Storage

4.3.1 Excavated Peat and Spoil Storage

The Peat and Spoil Management Plan for this development is discussed in the following section.

In the first instance, excavated peat and spoil will be reused for the backfilling, landscaping and restoration around wind farm infrastructure such as turbines and hardstands.

Berms will be formed along sections of access roads in order to store an additional volume of excavated peat. These berms will also act as a physical edge protection measure to prevent vehicles falling off the raised floated road edge. This form of storage will be provided on both sides of the internal floated roads where the overall dimensions of the berms will generally be 1m high by 2.5m wide.

The remainder of the surplus excavated peat and spoil material will be stored within the peat deposition areas. The proposed locations for the peat deposition area are shown on **Planning Drawings 19876-MWP-00-00-DR-C-5005 to 5010.**

Retention berms founded on a solid formation layer below peat shall be constructed around the peat depositions areas. The retention berms shall be constructed from free drain granular material or cohesive material with drainage outlets to prevent water build up within the deposition area. The deposition areas shall also be split into cells using internal berms so that they are more manageable in size and to reduce risk of peat movement within the deposition area during construction. A drainage system shall be put in place around the perimeter of the deposition area to prevent siltation of any drains or water courses. See a typical berm detail in Figure 4-1.

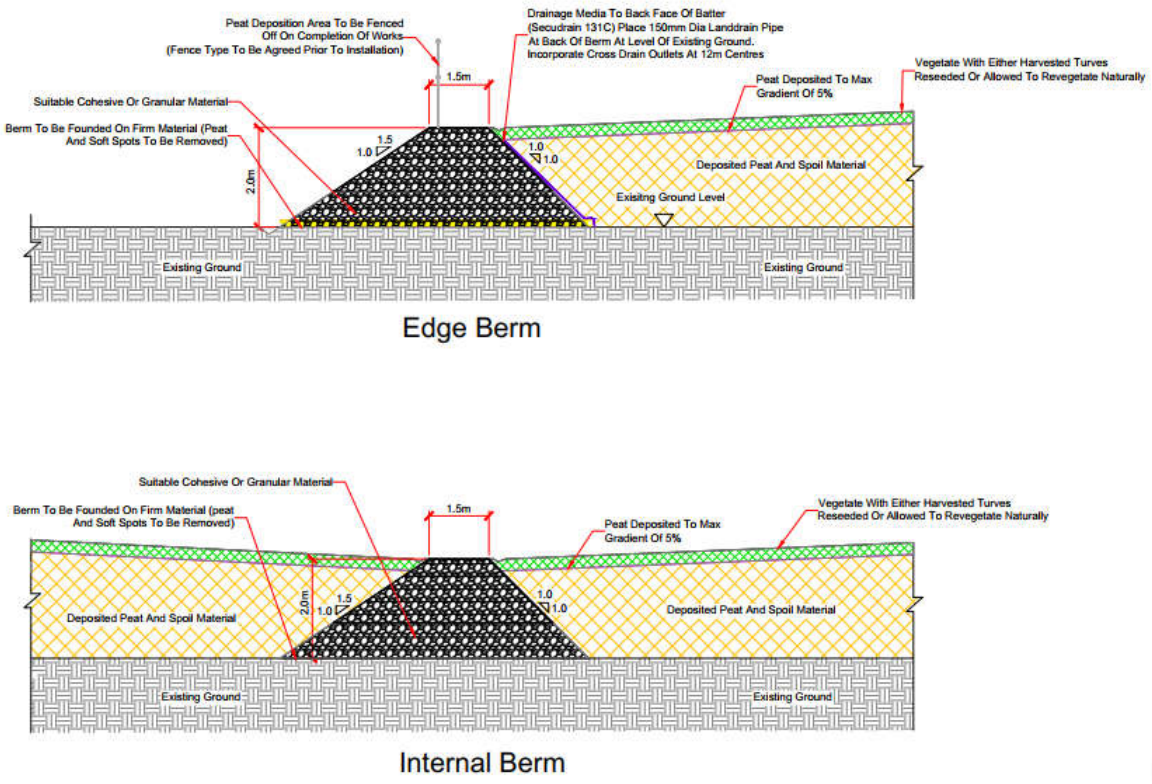

Figure 4-1 Typical Detail of Retention Berms at Peat Deposition Areas

Drainage and siltation control measures will be put in place in all peat deposition areas. This will include a dedicated drainage network, temporary silt fences and settlement ponds designed to cater for the size of each storage area. Peat deposition areas will have a 50m buffer from any OSI mapped watercourses to mitigate against any risk of siltation. This buffer provides a natural filter to reduce the sediment that may be generated by the deposition area from reaching the watercourse.

4.3.2 Restoration of Peat Deposition Areas

Peat is characterised by two distinct layers, the lower *catotelm* layer of highly humified peat and the upper *acrotelm* layer of fibrous peat which contains the live seed bank. The *acrotelm* layer should be regarded as an ecological resource that can be used for habitat restoration rather than simply as surplus excavated material.

As peat is excavated the *acrotelm* layer will be stripped first and set aside temporarily for re-use. As the peat deposition areas are filled they will be covered over with the *acrotelm* layer. This includes the outer faces of the containing berm(s). The peat deposition areas need to be completed and restored in a continuous cycle so as to minimise the length of time the *acrotelm* is stored and to allow the vegetation to be re-established as quickly as possible. It is important that the *acrotelm* is handled carefully and that it is not allowed to dry out while it is being stored. Regular watering may be necessary during dry weather periods. This will be carried out by the appointed Contractor.

4.4 Temporary Storage of Excavated Material

No permanent stockpiles will be left on site after the completion of the construction phase works. After completion of the turbine base reinstatement works all remaining stockpiles are to be removed for permanent disposal at the proposed deposition areas within the site.

Any materials excavated during the construction phase which are to be used in the site reinstatement and landscaping process shall, in the first instance, be stored on site in an environmentally safe manner that will not result in the pollution of waters or the smothering of ecologically sensitive habitats.

The following principles will be adhered to when considering the temporary storage of excavated materials;

- Spoil disposal will take place within a 30m radius of each structure.
- Preparation of the spoil disposal site will involve the removal of the "top mat" which will be transplanted to an area of inactive bog and maintained for re-use during restoration operations.
- Spoil will be deposited, in layers of 0.50m and will not exceed a total thickness of 1.0m.
- Peat can be stored on top of existing, undisturbed peat, adjacent to the access roads and turbine locations where the peat instability risk is low as described in the Peat Stability Risk Assessment Report.
- Where glacial spoil is to be temporarily stored adjacent to the turbine excavations the existing peat layer will first be harvested and stored separately. Upon removal of glacial spoil the peat will be reinstated and the top mat of vegetation replaced.
- Spoil will only be deposited on slopes of less than 5 degrees to the horizontal and greater than 10m from the top of a cutting. The exact location of such areas will be confirmed on consultation with the geotechnical engineer.
- Temporary storage of excavated soils will only occur where peat thickness is minimal (<0.5m).
- Excavated material will not be stored adjacent to turbine bases, on or adjacent to slopes (>15 degrees gradient), or in areas where peat thickness exceeds 0.5m.
- Once reinstatement is complete the disposal sites will be re-vegetated with the "top mat" removed at the commencement of disposal operations.
- Upon commencement of the restoration phase, guidance from a suitably qualified environmental professional will be sought to confirm the methodology and programme.

It is proposed that any temporary onsite stockpiles of soil, rock and other excavated material shall be removed and utilised in the site reinstatement programme to infill any excavated areas which will then be mounded and capped with sod prior to the completion of works.

4.5 Reinstatement

Reinstatement works will commence at an early stage of construction. Such reinstatement will occur following the completion of individual sections of work, such as the completion of a turbine foundation or hardstand. Ongoing restorative programming facilitates the immediate relocation of material from one turbine base excavation to another completed area and in doing so can limit the requirement for temporary storage of material on site.

Areas which could benefit from reinstatement of peat include any exposed areas surrounding turbine bases and crane hardstand areas, borrow pits, obsolete drainage channels and any other areas left exposed by the construction works.

Excess stone and spoil which is unsuitable as a vegetation layer shall be placed in the deposition areas. These areas will be covered with active soil to allow vegetative growth post construction.

4.6 Control Measures

The following generalised control measures will be enforced during construction:

- No storage of excavated material other than in areas selected for such activities; temporary storage within the development footprint and deposition at proposed areas..
- No stockpiling of materials or parking of plant on peat.
- Minimise tracking machinery on peat.
- Exclusion zones delineating the working corridor will be installed around all working areas using post and rope fences. No activity will be permitted past this fence.
- The environmental manager or other designated person will conduct toolbox talks with all personnel working in peat areas to explain the risks associated with such works and to explain the location of exclusion zones.
- Minimise length of unsupported excavations in peat.
- Water build up in excavations will be avoided.
- Peat excavations will not be left unsupported for extended periods.
- The use of vibrating rollers on peat surfaces will not be permitted (dead weight permitted).
- Upslope cut-off drains will be installed in advance of construction.
- Existing drainage patterns in the peat will be maintained as far as is practicable.
- There will be no uncontrolled discharges of water onto peat.
- Deviation from the agreed work methodology must be approved by a suitably qualified environmental professional or site geotechnical engineer.
- The site supervisor will suspend work if work practices or weather conditions are unsafe.
- Where suitable material is available, it will be used for the immediate backfilling of any excavations.

4.7 Monitoring Procedure

Peat monitoring by sightline monitoring method shall be carried out by the appointed contractor for this development. Monitoring will be carried out at areas of deep excavations (e.g. turbine bases), material deposition areas and any area of works where peat is present. Early discovery of stress in the peat will give the developer an opportunity to implement emergency procedures to prevent the onset of a bog burst or localised peat slide. While the risk of such occurrence is low in this instance, the precautionary principle dictates that monitoring posts should be installed in work areas where there are areas with a risk rating higher than "low" or peat depths are greater than 2m. The following monitoring procedure has been adopted from plans for wind farms in similar soil conditions.

To monitor possible peat movements it is proposed to install sighting posts upslope and downslope of the access roads at staggered intervals at locations where the peat depth is greater than 2m for excavated access roads and 3m for floated access roads. Additional monitoring locations will be required at infrastructure locations with deeper peat deposits. The sightlines are to consist of the following:

- A line of wooden stakes (typically 1 to 1.5m long) placed vertically into the peat to form a straight line.
- Each set of sighting line shall comprise 6 no. posts at 5m centres that is a line 25m long.
- A string line shall be attached to the first and last posts and all intervening posts shall be adjusted so they are just touching the string line.
- Lines of sighting posts shall be placed across the existing slope about 5m away from the area to be worked. The posts will be located along the road at 10m intervals in areas of deep peat (say greater than 1m). Where there are relatively steeper slopes or softer ground a sighting line shall be placed down the slope, or at any location where monitoring would be deemed useful.
- Each line of sighting posts shall be uniquely referenced with each post in the line given a reference. The post reference shall be marked on each post (e.g. reference 1-1, 1-2, 1-3, 1-4, 1-5, and 1-6 for posts in line 1).
- The sighting lines shall be monitored at the beginning of each working day, and during the day where considered appropriate (e.g. when working activity is concentrated at a specific location or after each critical step in the construction process).
- Monitoring of the posts shall comprise sighting along the line and recording any relative movement of posts from the string line.
- Where increased movements are recorded the frequency of monitoring shall be increased.

A monitoring record shall be kept of the date, time and relative movement of each post, if any.

4.8 Contingency Plan

The following contingency plan has been adopted from plans for wind farms with similar soil conditions.

4.8.1 Excessive Movement

Where there is excessive movement or continuing peat movement recorded at a monitoring location or identified at any location within the site but no apparent signs of distress to the peat (e.g. cracking, surface rippling etc.) then the following shall be carried out:

I. All activities (if any) shall cease within the affected area.
II. Increased monitoring at the location shall be carried out. The area will be monitored, as appropriate, until such time as movements have ceased.
III. Re-commencement of activities shall only start following a cessation of movement and agreement with all parties (geotechnical engineer, contractor and client).

4.8.2 Onset of Peat Slide

Where there is the onset or actual detachment of peat (e.g. cracking, surface rippling etc.) then the following shall be carried out:

I. On alert of a peat slide incident, all activities (if any) in the area should cease and all available resources will be diverted to assist in the required mitigation procedures.
II. Where considered possible, action will be taken to prevent a peat slide reaching any watercourse. This will take the form of the construction of check barrages on land. Due to the terrain and the inability to predict locations it may not be possible to implement any on-land prevention measures, in this case a watercourse check barrage will be implemented.
III. For localised peat slides that do not represent a risk to a watercourse and have essentially come to rest the area will be stabilised initially by rock infill, if required. The failed area and surrounding area will then be assessed by the engineering staff and stabilisation procedures implemented. The area will be monitored, as appropriate, until such time as movements have ceased.

4.8.3 Check Barrage

Whilst it is not anticipated that a significant peat slide will occur on site as a contingency a check barrage procedure is included below.

The check barrage procedure deals with preventing a peat slide from moving downstream within a watercourse. The most effective method of preventing excessive peat slide debris from travelling downstream in a watercourse is the use of a check barrage. Generally, a check barrage comprises the placement of rock fill across a watercourse. The check barrage is a highly permeable construction that will allow the passage of water but will prevent peat debris from passing through. Rock fill should comprise well-graded coarse rock pieces from about 300mm up to typically 1000mm.

The rock fill for the check barrage should be sourced as close as possible to the site. A stockpile of material will be available as a contingency measure prior to construction work commencing. The size of the barrage will vary depending on the scale of the peat debris to be contained and the geometry of the watercourse at the barrage location. In general due to the low speed of a peat slide there is

generally little impact force and most of the lateral load is due to fluid pressure on the upslope face of the barrage.
Typically the check barrage should fill the entire channel width of the watercourse up to a height of 3 to 4m with a crest width of typically 2m and side slopes of about 45 degrees depending on the geometry of the barrage location.

The check barrage procedure is as follows:

I. Access to the check barrage location shall be along the existing access roads on the wind farm site and/or along public roads, where possible. When it is necessary to form the barrage then rock fill will be placed across the watercourse to effectively block the passage of peat debris.
II. Operatives employed to carry out the construction of the check barrage will need to be inducted by means of a briefing by on-site supervisors as to the proposed location of the check barrage.
III. The check barrage provides containment for peat debris in the unlikely event of a major peat slide. Further remedial measures may be required and will be assessed by all parties and carried out as soon as physically possible when the location and extent of the failure is established.
IV. Where a barrage was constructed as a precaution and no peat debris reached the watercourse then the barrage will be removed as soon as any measures to prevent further peat sliding is agreed with all parties.

4.9 Role of Environmental Manager

An environmental manager will be appointed for the construction phase of the development. As part of this role the environmental manager will conduct the following works in relation to surplus spoil management:

- Mark ecological constraints on the working areas and route corridors, in consultation with the Geotechnical/Civil Designer as necessary,
- Agree proposals for temporarily side casting and temporary storage areas as development proceeds,
- Agree methodology for stripping existing vegetation and locations where material is to be deposited,
- Agree timing of restoration and reinstatement of access track sides,
- Monitor excess peat receptor areas along existing face banks once peat is placed in-situ,
- Monitor the condition of stored turves and determining watering requirements,
- Issue instruction to cease work if unexpected risks arise, until an agreed alternative solution is identified, and risks are avoided or minimised.