



Good practice during windfarm construction

A joint publication by

Scottish Renewables

Scottish Natural Heritage

Scottish Environment Protection Agency

Forestry Commission Scotland

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1 Introduction

1.1 Background

Windfarm development in Scotland is accelerating rapidly. The Scottish Government, Scottish Environment Protection Agency (SEPA) and Scottish Natural Heritage (SNH) all support the development of renewable energy, including windfarms, as a key means of tackling climate change.

Considerable experience has been gained during the construction and operation of more than sixty windfarms already operating in Scotland. The purpose of this guidance is to share that experience amongst the industry, planning authorities and those more broadly involved in the planning and development of windfarms. It is focused on pollution prevention, nature conservation, landscape, hydrological and related issues. It does not offer guidance on the detailed design or erection of turbines, their components or related infrastructure. It is aimed at the post consent, pre-construction planning phase of development.

This guidance seeks to identify Good Practice, not necessarily Best Practice, which is evolving constantly. For example, our knowledge on the management of peat on windfarm sites has increased rapidly during the production of this guidance. It is therefore difficult to offer definitive guidance at this stage. As a result this guidance aims to 'raise the bar'. It aims to ensure that all windfarm sites are constructed in a way which respects the surrounding environment and minimises environmental risks beyond ensuring compliance with environmental legislation whilst retaining the need to remain cognisant of the practicalities of construction and constraints on developers and contractors from legislative and commercial sources.

The guidance will be updated as more experience is gained. In particular, our understanding of issues relating to carbon emissions from windfarm sites is evolving quickly and as a result this guidance will be updated regularly. The guidance box on page 4 outlines current good practice in relation to peat management on site and minimising carbon loss.

This guidance is aimed at:

- Windfarm developers
- Construction companies and contractors working on windfarm sites
- Consultants and advisers supporting the windfarm industry
- Planning officers working on windfarm applications
- Statutory consultees such as SNH, SEPA and others with an interest in windfarm construction, and those responsible for the regulation of wind farms under relevant Environmental Protection and Pollution Prevention legislation
- Environmental and Ecological Clerks of Works

1.2 How to use this guidance

The information contained in this guidance has been prepared by a joint working group involving Scottish Renewables, SNH, SEPA, FCS and several representatives from companies with extensive windfarm development experience. It is intended to share good practice across the industry and to demonstrate what can be achieved on windfarm sites in Scotland. It is not a 'how to' guide – the case studies and examples used are illustrative only and they do not prescribe a specific method, technique or approach. Better techniques and practices are evolving quickly.

When designing a windfarm and planning the construction process, the various issues highlighted within this guidance will require careful consideration in relation to the site, it's location, topography, ground conditions and other factors. It is impossible to offer generic guidance which is relevant to all windfarms. Every site is different and will require a tailored approach.



SNH staff on a site visit to a recently completed windfarm development

Within each of the topics included in the guidance key considerations are identified; examples of good practice are provided and the key issues to consider in the Construction Method Statement are highlighted.

1.3 How this guidance was produced

Recognising the examples of good practice on a number of existing windfarm sites SNH approached Scottish Renewables in summer 2008 to establish a joint project to promote good practice during windfarm construction. As a result a working group was established comprising representatives from SNH, SEPA, Scottish Renewables, FCS and several member companies with extensive windfarm development experience. The members of the group included:

Jenny Hogan, Scottish Renewables
 Rosie Vetter, Scottish Renewables
 Brendan Turvey, SNH
 Kenny Taylor, SNH
 Lorna Harris, SEPA
 John Burns, SEPA
 Ian Johnson, Morrison Construction
 David MacArthur, ScottishPower Renewables
 Steve Pears, Natural Power Consultants
 James Milner-Smith, SSE Renewables
 Hugh Clayden, Forestry Commission Scotland

Further staff within these organisations have also contributed to the development of the guidance and the working group are grateful for both their time and the considerable contribution from the working group.

Some of the examples provided are deliberately ‘disguised’ and not attributed to a particular company or windfarm. The purpose of this guidance is to show what is achievable (and what can go wrong) – not to endorse or criticise a particular windfarm, developer or contractor.

The contents of the guidance were also discussed in detail at a Sharing Good Practice event hosted by SNH on the 7th of May 2009 enabling wider stakeholders and industry representatives to contribute towards the process. It is intended that the guidance will be updated over time as our experience and understanding of windfarm construction improves. Comments and feedback on the guidance are welcome and should be sent to the contacts identified in section 1.7 below.

1.4 Contents

The aim of this guidance is to demonstrate good practice across all aspects of windfarm construction, including related infrastructure. Sections are therefore included on:

- Pre construction planning
- The use of Environmental Management Plans and Construction Method Statements (incorporating a Site Waste Management Plan)
- Using an Ecological Clerk of Works (or Environmental Clerk of Works and other specialist advisors)
- Access tracks
- Site drainage
- Managing Recreational Access
- Traffic management
- Site infrastructure
- Habitat management and restoration
- Seasonal considerations

Waste issues are not specifically covered within this guidance document. SEPA should be consulted on all aspects of waste management proposed to ensure that all the relevant legislation is fully complied with. Advice on how to prepare a Site Waste Management Plan (SWMP) is available on SEPA's website at www.sepa.org.uk. Further advice on the reuse of demolition and excavation materials is available from the Waste and Resources Action programme (WRAP) at www.aggregain.org.uk. Advice from SEPA should be sought at an early stage.

1.5 Carbon emissions

One of the key aims of windfarm development is to reduce carbon emissions. Windfarm developments, through the materials used, the construction processes employed and the potential emissions from disturbed soils and habitats, do result in carbon emissions. However, these are generally considerably outweighed by the benefits in terms of the carbon free electricity generated by the windfarm over its lifetime. In many cases the 'payback' will be within the first few years of operation.

The Scottish Government published Calculating carbon savings from wind farms on Scottish peat lands – A New Approach in 2008, which provides more detailed guidance on these issues. However, the recommendations contained within that guidance are very relevant to this guidance on good practice during construction and these are summarised below. The Scottish Government report recognises that in some circumstances the payback of windfarm development could be significantly affected by the construction methods used and the degree of restoration of the site. The recommendations should therefore be considered throughout the guidance that follows.

1.6 Sources of further information

Key sources of further information include:

www.snh.gov.uk

www.sepa.org.uk

www.scottishrenewables.com

www.forestry.gov.uk/scotland

Good Practice approach to development on peat and carbon savings – a summary of recommendations

(from page 55 of the Scottish Government Report)

- When excavating areas of peat, excavated peat turfs should be as intact as possible, often it is easiest to achieve this by excavating in large turfs or clumps. An intact excavated block will be less prone to drying out.
- Excavations should be prevented from drying out or desiccating as far as possible. This can be achieved by minimising disturbance or movement of the excavated peat once excavated. Consideration should also be given to spraying the peat to keep it moist in appropriate circumstances.
- Stockpiling of peat should be in large amounts, taking due regard to potential loading effects for peat slide risk. Piles should be bladed off at the side to minimise the available drying surface area.
- The peat should be restored as soon as possible after disturbance. When constructing tracks, this requires restoration as track construction progresses. However for borrow pits and crane pads it may be more difficult to reinstate before construction is complete.
- Floating roads should be used in areas of deeper peat to avoid cutting into peat and disturbing it leading to drying out.
- Submerged foundations should be employed on deeper areas of peat, to maintain hydrology around the turbine base and avoid draining the peat area. Submerged foundations are designed to be larger than normal drained foundations so they can withstand water pressure lifting up the foundation.
- The design of tracks should be such that they do not act as a conduit or channel for water or a dam or barrier to water flow. This is a highly site specific consideration, and requires the consideration of track design at the construction stage, when all geotechnical investigations are proceeding, rather than deciding on a final track design at the planning stage.
- Good track design should be employed with appropriate cross drains, minimising the collection of water and ensuring overall catchment characteristics are maintained.
- Developers should take ancillary opportunities to improve habitats, by including simple practices such as drain blocking and re wetting of areas. These practices can be included as mitigation

1.7 Contacts

For further information please contact:

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2 Pre construction considerations

Pre-Construction planning is the incorporation of construction due diligence during the Environmental Impact Assessment (EIA) stage of the project development and prior to site mobilisation planning. It is about planning ahead and being proactive in your construction strategy. It involves:

- Thorough risk assessment
- Baseline monitoring
- Appropriate site investigation and appraisal of ground risk
- Identification of pollution prevention measures and mitigation
- Waste arisings and management options
- Early contractor involvement
- Adherence to the Construction (Design and Management) Regulations 2007
- Achieving the balance between environmental constraints and engineering processes.

Getting pre-construction right should prevent pollution of the environment, harm to human health, and unnecessary damage to nature conservation interests. It will also reduce risk, cost and programme delay, and increase stakeholder confidence in the project.

2.1 Key considerations

The key issues to be considered include:

- Thorough site investigation
- Relevant legislation (Construction (Design and Management) Regulations, 2007)
- Other legislation (e.g. water, waste and wildlife legislation)
- Grid connection considerations
- Environmental Protection
- Wildlife and habitat surveys
- Ground risk
- Infrastructure design and integrated thinking
- Waste management and site drainage strategy
- Minimisation of peat arisings
- Justifying the need for, use and location of borrowpits
- Good construction practice
- Community engagement
- Public Roads
- Existing services and other constraints

2.2 Site infrastructure layout, key questions:

- Are key temporary works (e.g. site compound, laydown areas) and permanent works (e.g. sub-station and control building, borrow pits, access tracks and crane hardstandings) situated in areas of suitable gradient, with sufficient design separation from sensitive receptors (i.e. watercourses, lochs or sensitive wetlands)?
- Are access track gradients and radii suitable for the largest loads anticipated to be delivered to the site?

- Are site tracks following design track lines as identified in the EIA? If not, have proposed alternative track lines and other infrastructure amendments been suitably assessed?
- Are critical path items (e.g. sub-station) easy to access at an early stage of the works?
- Are borrow pits proposed? Are they proposed in practical locations (i.e. close to proposed construction routes, to minimise haul distances, and available as early as they shall be needed (not situated remotely at the far-side of the site)? What is the likely impact on the environment (e.g. impact on the water environment including groundwater, and nature conservation interests)?

(Please, note that this guidance does not deal directly with the issue of waste management, particularly linked to restoration. However excavated material, including peat, from windfarm developments may under some circumstances be classified as waste and waste activities – recovery and disposal – may require authorisation from SEPA. Please refer to SEPA’s Regulatory Position Statement ‘Developments on Peat’ for further information.)
- Have appropriate arrangements been made for the storage of fuel and oil? Does this comply with the The Water Environment (Oil Storage) (Scotland) Regulations 2006?
- Can maintenance of vehicles and plant be carried out in impermeable areas where any oil spillage can be contained?
- Has consideration been given to the need to maximise the use of recycled material, promote the use of secondary aggregates (sand, gravel and stones etc.), and ensure sufficient production of primary materials (excavated material suitable for use)?
- Consideration should also be given to the recycling of waste material originating from elsewhere such as demolition waste. It is recommend that a Site Waste Management Plan (SWMP) is developed. All imported materials should be adequately assessed for suitable use on site.

2.3 Site Investigation

Good Site Investigation (SI) is essential. SI includes desk study, site walk-over surveys and more “intrusive” methods which are termed “ground investigation” (GI). SI should begin during the early phases of the EIA design, when other surveys (ornithological, ecological, hydrological, archaeological, hydrogeological) and assessments (e.g. waste management) are being undertaken, such that potential ground risk can be identified and designed for appropriately.

Some ground investigation is likely to be required during the EIA phase (i.e. soil/peat depth surveys, including depth and general characteristics), though the more detailed GI is typically undertaken “post-consent”.

Any Environmental Statement prepared in support of the planning application should demonstrate that the windfarm design has taken into account site hydrology and habitats. It should focus on areas of deep peat and intact hydrological units of mire vegetation. Turbines and other infrastructure should be located on the basis of waste minimisation, ecological (species and habitats), hydrological/hydrogeological survey work and balanced against the other assessments and constraints identified during the EIA.

The level of GI required will depend to some extent on the assumed “difficulty” of a project. A rough-guide for gauging approximate costs of the actual GI is between 1% and 3% (for a low to high risk project, respectively) of your estimated “Balance of Plant” (civil and electrical infrastructure, and likely licence and permit) costs.

The scope of GI should include for all the main infrastructure – access track alignments, watercourse crossings, crane hardstandings and turbine bases, sub-station and construction compounds, laydown areas and borrow pits. A suitably qualified professional engineering geologist/geotechnical engineer can advise

on appropriate methods of GI, which may include (but not be limited to), further peat probing, trial pitting, boreholes, geophysics and appropriate sampling and laboratory testing and reporting. This is for assessing and quantifying ground risk, hydrogeological impact, risk of peat slide, waste management options, impacts on the water environment (especially on peatland) and ecology and to refine construction methodology. Some of this assessment will have been completed during the EIA. If as a result of GI amendments are made to the design it is important that this is carefully assessed to ensure that the above impacts are reconsidered.

Consider mobilisation and site access for GI Plant – in the absence of any windfarm access tracks existing infrastructure may not permit easy access (i.e. too narrow gates, bridge parapets, weak ground). **Always check for environmental sensitivities and risks prior to accessing the site.** Always reinstate the ground after the GI is completed.

2.4 Planning conditions

Where construction activities could have a significant detrimental effect on pollution prevention or nature conservation interests, these will often be carefully controlled by attaching conditions to the planning consent. Legislation has been written to avoid duplication of effort and regulation i.e. if an activity is controlled through a SEPA permit then planning would not apply conditions. Further guidance on the use of planning conditions can be found in Scottish Government Planning Circular 4/1998. While there may be restrictive conditions aimed at control, there may also be a need to apply for, obtain, and comply with any environmental permissions, licenses or consents.

It is the responsibility of the developer of the windfarm to ensure that planning conditions are adhered to. It is also the responsibility of the author of the planning permission and conditions to monitor and ensure compliance. SEPA and SNH will often advise the determining authority (either the Planning Authority or the Scottish Government Energy Consents Unit) if conditions are required to meet pollution prevention or nature conservation objectives. Conditions should be developed in early consultation with the developer, SEPA, SNH and the determining authority. There may also be a requirement to obtain other permissions such as a permit or authorisation from SEPA, which will be monitored and enforced by SEPA.

2.5 CDM Regulations 2007

As part of fulfilling a Client's (the Developer's) responsibilities under the CDM Regulations 2007, a pre-construction information pack (PCIP) should be prepared for tendering contractors. In addition, sufficient time should be allowed for the appointed contractor to complete any detailed design and mobilisation to the site with sufficient welfare facilities in place for site staff.

2.6 Pre-Construction Monitoring

As a responsible Developer, it is appropriate to ensure that surveys are commenced prior (6-12 months typically, depending on monitoring parameter) to the on-set of the Site Works to establish suitable baseline conditions for such factors as: Water Quality; Protected Species and Habitat Surveys (flora and fauna); background landfill soil/gas, noise and dust levels.

Peat surveys

Surveying a windfarm site's peat habitats during EIA is essential to allow the statutory consultees and appropriate planning authorities to make informed and sound decisions on proposed workings in the peat environment. Surveys should be carried out in order to (although not restricted to):

- Remain compliant with current and relevant legislation
- Gain realistic volumes/quantities for peat management on site
- Make more precise carbon budgeting calculations
- Better understand the risk of peat slides and peat habitat dynamics
- Increase knowledge and awareness of the site hydrology

It is recommended that a pre-consent, broad scope survey is carried out, in conjunction with a trained ecologist, across the likely construction envelope using a 50m grid structure. The level of survey effort should be discussed with statutory consultees. Survey at 100m grids across the rest of the site that is suitable for development is recommended. This should identify both peat depth and habitat characteristics. Clear justification for areas which are not going to be assessed should be provided.

Particular focus should be given to areas where known infrastructure is likely to be located. A further more detailed study/survey, post consent and pre construction is then recommended once the location of site infrastructure and turbines are known. This will provide a better understanding of the site and provide adequate information to inform decisions on micro siting and detailed design. The level of survey effort should be tailored to the sensitivities of the site and proposed engineering solutions of the site. Full peat depth should be established unless justification is provided for not doing so. Please note that the Scottish Government is currently producing guidance to add further detail to this process.

2.7 Micro-siting

Micro-siting of wind turbine locations and ancillary infrastructure is commonly undertaken at this stage. A variety of considerations need to be taken into account, such as:

- Results of detailed habitat and vegetation surveys,
- Results of soil/peat surveys (depth and characteristics)
- Geotechnical assessment
- Hydrology
- Archaeology
- Species surveys

Care is required to ensure that the overall effects of micro-siting are taken into account. For example, extensive micro-siting may affect the overall landscape and visual impact of the development. A level of re-assessment may be required at this stage to ensure that any negative impacts are minimised. Further consultation may be required.

2.8 Links/further information/Contacts

SNH Environmental Impact Assessment guidance.

BS 5930 "the code of practice for site investigations".

Scottish Government "Peat Landslide Hazard and Risk Assessments".

Construction (Design and Management) Regulations 2007.



Thorough site investigation, such as detailed peat depth surveys, is essential at the early stages

3 Seasonal considerations

3.1 Introduction

It is important to consider the time of year and scheduling of windfarm construction to minimise impacts on the surrounding environment. The current turbine supply market and the availability of specialist contractors will limit the opportunities for a developer to fundamentally alter a construction schedule to take account of these issues.

Nonetheless, careful scheduling and an awareness of the different issues likely to arise at different times of year will be beneficial, particularly in the context of planning for drainage and the impact of flooding events, or management of borrow pits either during their operational phase or reinstatement phase.

3.2 Key considerations

- Weather – the winter months are generally windier and wetter, making the scheduling of turbine lifts difficult and creating additional challenges in terms of managing run off and storm events; generally increased quantities of water on site (especially during snow melts) mean that very careful consideration will need to be given to drainage and water management on site. Snow and ice cover will restrict access and increase risks on site;
- Site drainage should be designed to take account of the likely Storm Event Intensity for an area and infrastructure appropriately designed for a 1:200 year event. This has implications for the size of culverts, settlement ponds, and any other drainage and pollution mitigation techniques. Failure to adequately plan for flood events can result in considerable damage on site, construction delays and pollution of local watercourses, lochs, sensitive wetlands, and groundwater;¹
- Careful design and maintenance of drainage/silt traps to prevent heavy silt runoff into the water environment during rainfall;
- Flooding on site may inhibit site operations or make some areas of a site difficult to reach. Increased runoff from saturated peat should be considered;
- There is an increased risk of peat slides in very wet weather and from the additional weight of a snow pack. Appropriate mitigation measures should be put in place for areas at risk of peat slide and particularly for areas of sensitive habitat, lochs and watercourses;

1. Further information is highlighted within Planning Advice Note PAN 69: Planning and Building Standards Advice on Flooding. The assessment should take account of the expected impact of climate change. The Flood Estimation Handbook (FEH) published by the Centre for Ecology and Hydrology (CEH) should be used to calculate flood values. CIRIA and SEPA guidance should also be referred to.



Winter conditions pose a significant challenge in all stages of construction.



Storm events can hamper the effectiveness of, and overwhelm, pollution mitigation measures.

- In wet weather some excavated materials (particularly peat) can quickly turn to sludge making it more difficult to excavate, transport and store;
- Low visibility in blizzard conditions or heavy fog can increase the risk of accidents on site;
- Forestry – seasonal timing of tree felling should be considered (see Forests and Water Guidelines). Felling near watercourses or lochs increases the risk of higher sediment loads, metals and nutrients in runoff which can have a negative impact on freshwater ecology. It is important that breeding birds are given consideration when planning felling timings. The impact on any nearby sensitive habitat (e.g. good quality blanket bog or other sensitive wetlands) should be minimised where possible;
- Dust – extended periods of dry weather can make it difficult to manage dust from vehicles and tracks. Vehicle movements may be constrained and suitable mitigation put in place;
- Traffic – patterns of road use change throughout the year and the scheduling of deliveries, particularly of turbine components should take account of this to avoid congestion;
- Snow cover and frost – during the winter months snow cover and frost may inhibit activities such as re-vegetation, restoration work and identification of sensitive flora/habitats on site. Access to some areas may be restricted. Frost may also affect the effectiveness of temporary drainage/silt traps and road structure;
- Seasonal use of watercourses – many sensitive species (such as Atlantic salmon) which could be affected by watercourse pollution are only present during certain seasons (Oct-May). As a general rule in-stream or near stream works/activities should be avoided as much as practicable and both SNH and SEPA should be consulted on these matters. Drainage and silt trap maintenance should be carefully undertaken during the salmonid spawning and incubation period (Oct-May). The presence of other species (such as lamprey) may require consideration at other times of year. Further guidance is provided in the Forests and Water Guidelines (see below) and in the SNH Guidance for Competent Authorities (see below);
- Water crossings – constructing water crossings will be more challenging in winter and will also require particular care if sensitive species such as Atlantic salmon or freshwater pearl mussel are present;
- Breeding bird season – many species of birds will only be present/most at risk during the main part of the breeding bird season (March-August)²; while other species may be present throughout the year. A Bird Protection Plan should consider the specific risks to each species on each site. On most sites, a walkover of track routes and the locations of site infrastructure by a qualified ornithologist is recommended prior to construction and at any key stages during the construction process. Please consult SNH for further information;
- Seasonal bird activity – some birds may only be at risk during particular periods such as during display behaviour or during migration. Site specific advice may be required to address impacts and agree appropriate mitigation;
- Other protected species, such as badger, red squirrel, otter and bats are also more active at different times of year and may require consideration if present on site. If licenses are required as derogation then timing and phasing of construction needs careful planning (e.g. often a year in advance for certain species to record accurate data, discourage, and mitigate for);
- Deer – managing deer may not be possible at certain times of year, for example in closed seasons, and the impact of deer on restoration work should be considered. Known wintering areas for deer require careful consideration. Compensatory culling may be required to avoid creating problems for adjacent land managers;
- Habitat management – the effectiveness of restoration work and habitat management is often highly dependent on the time of year, especially if livestock are present. Consideration should be given to both seasonality and the need to provide temporary fencing in some circumstances;

Note – SNH intend to produce further guidance on this later in 2010.

- Working hours will be restricted at certain times of year and careful consideration of site health and safety will be required. The visual impacts of lighting should be considered.
- Waste management options (which may require authorisation from SEPA) associated with any wind farm development may also involve hazards and nuisances arising from waste movement, use of waste, and waste disposal. Bad weather conditions can increase the risk of pollution and damage to the environment from these activities.

3.3 Key things to address in Construction Method Statement

- Produce a construction timetable and illustrate seasonal considerations
- What measures will be put in place to deal with weather related events (flash floods, peat slide, snow melt, dust)?
- How will construction be scheduled around key site constraints (such as the breeding bird season)? Where scheduling is not practical, what other mitigation can be put in place?

3.4 Links/further information/Contacts

SEPA's CAR practical guide – http://www.sepa.org.uk/water/water_publications.asp

Pollution Prevention Guidelines relevant to construction (published by SEPA)
<http://www.netregs.gov.uk/netregs/links/63901.aspx>

Forests and Water Guidelines – [http://www.forestresearch.gov.uk/PDF/fcgl002.pdf/\\$FILE/fcgl002.pdf](http://www.forestresearch.gov.uk/PDF/fcgl002.pdf/$FILE/fcgl002.pdf)

Salmon and Freshwater Fisheries Act (2005)
<http://www.opsi.gov.uk/legislation/scotland/ssi2005/20050174.htm>

CIRIA Control of water pollution from linear construction projects. Technical guidance (C648) (2006). <http://www.ciria.org/acatalog/C648.html>

SNH Guidance for Competent Authorities
<http://www.snh.org.uk/pdfs/publications/heritagemanagement/guidanceforcompetentauthorities.pdf>



Early nightfall in winter bringing dark, difficult working conditions

4 Construction Method Statements

4.1 Introduction

The use of Construction Method Statements (CMS) to guide a development is common practice across the construction industry. With the ability to cover a wide range of subjects, including environmental, hydrological and ecological considerations, Health and Safety on site, and build procedures, the construction method statement ensures consistency across the site for the duration of a build.

CMS's are often required as a condition of Planning Permission. For procedural consistency and awareness raising, the provision of a useable and clearly laid out document for developers, contractors and statutory consultees to scrutinize makes the development of a CMS with site specific content a necessary and useful tool. Where an environmental management plan is produced the links between this and the CMS should be made explicit.

4.2 Key considerations

- What is required to meet conditions within granted Planning Permission?
- Timely submission and distribution of the Statements will depend on the requirement and level of consultation and the particular stage of the development. For instance, a more generic CMS may be submitted at a pre-construction or pre-planning stage whereas specific build CMS's may require to be written during development as the need arises.
- Is legislation pertaining to environment issues and Health and Safety legislation included in all CMS's where relevant?
- Avoid falling into the trap of inserting unachievable aims, procedures and details within the CMS. Speak to the appropriate stakeholder for guidance.
- Should the method statement take the form of a single document containing headings of individual works or areas of work (even a dynamic document, a ring binder of segments etc) or is it more useful to developers and consultees etc. as individual documents pertaining to a single piece or area of work? Should it be available on-line, usually as a pdf?
- Are all environmental aspects associated with a particular construction topic considered and highlighted, for example; water issues and drainage, waste management, noise and dust generation, ecological aspects and habitat management?
- Identify the readers and users of a specific Construction Method Statement (CMS).
- Site Waste Management Plans and Accident Management Plans should also form part of the CMS.
- The level of detail and the specific content of a CMS will be important to each individual stakeholder depending on their input and involvement with the development i.e. is the suitability of the CMS targeted at specific audience/consultee? This may have an affect on the layout and structure of the CMS and indeed the timing of their submission.
- Time frames considered i.e. do method statement timings match 'work on the ground' timings? Will the content/subject of a particular CMS be affected by seasonality?
- Where will the appropriate CMS be located? Are they available on site, used on a daily basis or at a central office location?
- Has the temporary storage of excavated materials on site been planned for, where relevant/appropriate? SEPA can advise on this matter.

Statutory agencies have limited resources to engage at these stages in the planning process. Developers and consultants can greatly assist by co-ordinating requests for meetings and channelling requests for advice through the appropriate officers. Generally SNH and SEPA will only comment on those aspects of a CMS on which we have specifically requested to be consulted on or which have significant consequences for their statutory responsibilities.

5 Ecological/Environmental Clerk of Works (ECoW)

5.1 Introduction

During wind farm construction the developer and contractor have to comply with a number of obligations under both the conditions of the planning consent and environmental legislation. To ensure effective implementation and monitoring of these obligations, an Environmental (or Ecological) Clerk of Works (ECoW) is commonly requested as a condition of planning consent. **The ECoW role is focused on providing environmental advice and monitoring compliance – not implementing measures.** An ECoW's role is to ensure biodiversity is secured and impacts either avoided or minimised. They will also advise on relevant wildlife legislation and aid in the development of practical solutions. Environmental Clerks of Works is a term often used to describe a multi-disciplinary team of individuals covering a diversity of specialist roles e.g. hydrology, landscape and soils.

This section provides details on:

- The likely scope of works for the ECoW;
- Additional resources required to support the ECoW; and
- Recommendations on how an ECoW should be incorporated within the construction team structure.

5.2 Key considerations

1. The scope of works and level of resource commitment required of the ECoW needs to be commensurate with the scale of the development, and the complexity of the ecological and/or environmental issues at a site. This often requires a variety of skills. For this reason it is often the case the ECoW position represents a broad multidisciplinary resource. The scope of the ECoW position is likely to include the following aspects:
 - a) Construction Activities typically Monitored by the ECoW

Installation of site roads, compounds, hard standings, borrow pits, electrical cable installation, turbine foundations, vehicle movements, micro-siting of infrastructure and fuel and chemical storage. Monitoring should be undertaken both before and during construction on many of the activities listed above.
 - b) Monitoring of Pollution Prevention and Mitigation undertaken by a developer

This may include: monitoring site pollution prevention plan, advising on required pollution prevention measures and monitoring their effectiveness. This will also involve liaison with SEPA.
 - c) Breeding bird protection

This may include: monitoring of buffers around nest sites identified by pre-construction surveys, spot checks for nesting birds (or liaison with site ornithological consultants), and advice on mitigation measures and monitoring their effectiveness.
 - d) Other protected species

This may include: monitoring buffers around protected species structures such as nests and holts identified during pre-construction surveys and spot checks for mammals, reptiles and amphibians as appropriate, and providing advice if protected species are found that were not recorded during previous site investigations.



An ECoW can provide on site advice on protected habitats and species, such as this water vole colony.



The ECoW is likely to be involved in the management of habitat management measures such as drain blocking.

e) Environmental Register

The ECoW should maintain a register of issues, advice given and action taken by contractors.

f) Reporting

A monthly report should be produced providing a summary of issues on site and their status during the relevant month. The report should be issued to the Local Authority and relevant statutory consultees, as agreed at the consenting stage.

g) Environmental Induction and Tool Box Talks to contractors and sub-contractors

The ECoW may contribute towards environmental inductions held by the infrastructure contractor. These should be conducted at the same time as Health and Safety inductions so that all contractors are aware of the environmental sensitivities and procedures on the site. These may cover protected species to be aware of on site, exclusion zones and sensitive habitats.

h) ECoW Skills

As the above scope suggests, the range of skills required by the ECoW is diverse. For this reason, it may be necessary to employ specialists/specialist Clerks of Works for particular tasks that may arise (e.g. hydrologists, hydrogeologists, ecologists (including protected species ecologists), waste management specialists, landfill engineers and technically competent landfill managers).

i) Site Waste Management Plan (SWMP)

It is the developer's responsibility to monitor compliance with the SWMP. Point of contact should be established with SEPA regarding waste issues.

2. Additional resources required by the ECoW

The ECoW role is focused on providing environmental advice and monitoring compliance – not implementing the measures. Generally, for the ECoW's advice to be effective, appropriate capacity needs to be allocated to environmental protection by the infrastructure contractor. This may involve a dedicated 'environmental team' on site whose core responsibility is to maintain and monitor environmental protection measures. This team would require access to the necessary capital equipment at all times. The size of the 'environmental team' required will depend on the size and sensitivity of the site. For example during peak construction activity on a 50 turbine upland site, around 3-4 full time staff may be required in addition to the ECoW.

3. Position of ECoW within Construction Team Structure

- a) Obligations under planning conditions and environmental legislation are the responsibility of the developer. These obligations are largely passed onto the infrastructure contractor, via the infrastructure contract, to implement on site.

As explained above, the ECoW's role is to monitor compliance and provide advice. As a result of this compliance-monitoring role, it is often best (for ease of communication) for the ECoW to be employed directly by the developer. This helps to ensure direct reporting lines between the developer and ECoW.



5.3 Case study: Whitelee Wind Farm, near Eaglesham

Whitelee Wind Farm is located within a mixture of upland habitats and commercial plantation. Construction involved the installation of 86km of site roads, 940km of cable, 140 Turbines and the operation of borrow pits. The Planning Consent required an ECoW to be appointed to monitor compliance with environmental obligations. ECoW duties included repeat surveys of road lines ahead of construction. A process was also established at Whitelee of walking each track section with the contractor prior to construction. This allowed an opportunity to discuss and agree specific pollution prevention measures required during construction.

During this process high quality bog habitat was noted between the spine road and turbine 32. Areas of mire habitat of this quality with no evidence of historical drainage were very rare in the context of the site. However it was considered essential both for the practicalities of construction and for operational reasons to provide a link from this array of turbines to the spine road. An alternative location for the link was proposed across felled forestry, to the west of the original location. This was still a floating road design over relatively deep peat. A similar area of habitat was lost, however severely degraded formerly afforested peatland was developed in order to avoid development in an area of relatively intact bog.

5.4 Benefits

In general, ensuring that the project has an appropriate ECoW resource allows construction to progress more smoothly. Common issues, including those of protected species, habitats and water pollution, can be addressed effectively at an early stage avoiding unnecessary delays to project completion. The key is well-written Conditions to set good foundations for the development process, using a well-qualified and experienced ECoW, and maintaining good lines of communication between all parties.

6 Traffic Management

6.1 Introduction

Good traffic management is vital to a successful windfarm construction project, particularly in light of the intensity of public highway usage at key periods during the construction phase, and the presence of abnormal loads on the roads. This document identifies good construction practice relating to traffic management, and includes identification of key items that should be considered in the preparation of a Traffic Management Plan (TMP).

Good traffic management improves road safety for all users, minimises congestion and “severance”, and promotes positive dialogue with local communities.

6.2 Key considerations

- Relevant legislation/permits
- Key stakeholders
- Transport Route(s)
- Site Access(es)
- Health and Safety
- Signage
- Traffic Management Plan



Careful planning of turbine component delivery is essential

6.3 Examples of good practice

Speed limits

Prevailing speed limits on public highways may not always be suitable for windfarm construction traffic. Alternative, lower, speed limits should sometimes be set for all site traffic on the public highways to increase road safety and minimise nuisance to the general public. Consideration should be given to how this is policed, perhaps introducing a “zero tolerance” policy for all site drivers who exceed the artificially lower limit introduced. The presence of some protected species (e.g. otter) might justify lower speed limits in some locations.

Road cleaning

Although wheel wash facilities are often introduced on-site to clean vehicles as they exit onto the public highway, it is often inevitable that some dirt will make it onto the public roads. Arranging for the regular use of a “street sweeper” vehicle to clean the public highway is a positive demonstration of commitment to a clean project. In addition, employing a local window cleaner to work on properties in close proximity to roads that receive heavy traffic loads can be a simple, yet popular, gesture for those communities that are affected.

Site Access(es)

Consideration should be given to sufficient “sight-lines”, and appropriate modification of existing fabric/roadside vegetation to give clear vision for all road users. Bellmouths at the entrance to sites, or onto minor roads toward site, should be sufficiently wide to permit the largest abnormal loads to turn off the public highway safely. Entrance control points/gates should be sufficiently set back from the road to prevent accessing vehicles having to “wait” on the public road. The use of Banksmen should be considered in some locations.



Use of road signs to inform other road users as well as drivers approaching site

Traffic Management

How best to manage traffic flows on approach to the site is a key consideration. The type of road (trunk road, B-Class, or minor), the typical traffic flows (peak times, local domestic, agricultural or industrial use), and, often most significant, proximity to local schools, should all be considered. The use of traffic lights, stop go signals, road closures and diversions are all possible options, though minimising disruption and inconvenience to the general public, particularly local residents or tourists, is of importance. Consider time of year (holiday periods), time of day (rush-hour, school drop-off/pick-up times), and typical weather (snow and ice) in your traffic management preparations. Plan ahead. Check local dates, such as agricultural/village fairs and avoid these periods.

Information

Keep the local communities informed of your proposed works, key delivery dates and times. Consider door-to-door visits, letter drops, notices in village post office, dissemination via community

councils, and newspaper notices. Provide contact details for your Site Manager/Community Liaison Officer so that concerned individuals may speak with an informed individual.

Dry-runs

Always undertake a “dry-run” before abnormal load deliveries commence. Plan this as far in advance as is practical. Keep communities informed.

Reinstatement

Prior to the on-set of works undertake a pre-condition survey with the local roads departments. Agree areas of existing degradation/damage. Ensure that the public highway is maintained during your works (either through the use of the local Roads Department contractors, or approved sub-contractors), and ensure prompt reinstatement of damaged verges and infrastructure. Go the extra-mile. Consider the need for landscaping/planting.

6.4 Key things to address in a Traffic Management Plan

- Continued dialogue with local communities, including advance notice of abnormal load deliveries
- Avoiding school opening and closing times, peak times, holiday periods
- Road sweepers to clear any residue off public highway
- A pre-condition survey may be necessary
- Include key contacts (Police, Trunk Roads, Local Roads Department, other key stakeholders, including local schools/institutions along the proposed transport route(s))
- Identify any specific environmental risks

7 Outdoor Access and Recreation

7.1 Introduction

Sites which are chosen for windfarm development are often already used for recreational purposes, because of their rural, upland location, their wildlife, and in some cases due to their location near to centres of population where they can provide a valuable outdoor access resource. A windfarm's track network may enhance such use, so careful long-term planning is required.

In Scotland, statutory access rights apply on most land, including operational windfarms and those under construction (with some restrictions). The rights apply to land in general, and are not restricted to paths. Members of the public may use sites for a wide range of purposes such as walking, cycling, horse-riding, wildlife watching, camping, canoeing and other recreational pursuits, as long as they do so responsibly. Local residents may particularly value these places because of convenience, local knowledge, cultural significance and familiarity with the area.

Legislation

Maintaining access and managing access safely are therefore key considerations during the planning and construction of a windfarm, and the site's track network can provide a useful resource for recreation users in the long-term. In many locations the number of visitors will be small, while some sites may attract considerable numbers of users, depending on existing access arrangements, terrain and location.

Regardless of numbers, or statutory requirements most developers and landowners will gain significant benefits from making positive provision for access, including improved relations with neighbouring communities.

Access to the outdoors is largely based on the Land Reform (Scotland) Act 2003, which establishes the statutory right for responsible public access to land in Scotland. These rights are for crossing over land, and for recreational use by non-motorised users, like walkers, cyclists and horse-riders. The Act also places a legal duty on land managers to manage their land and operations in a way that is responsible in respect of access rights. The requirements for those accessing the land, and managing land, to act



Site maps can be produced to aid access and reduce risks to the public



Restrictions on access should be limited as far as practicable. In areas where construction is complete, signs restricting access should be removed.



Good signage will help promote responsible access.

responsibly cannot be overemphasised, and the Scottish Outdoor Access Code provides guidance on responsible behaviour. Construction sites are potentially very dangerous, with large items of plant machinery moving about frequently.

The access rights become suspended on land where building or civil engineering work is being carried out, except for routes which are core paths or rights of way. The suspension applies only where building operations are active (rather than, for instance, to the whole area under the developer's control).

The Scottish Outdoor Access Code clarifies that restrictions should be kept to the minimum area, and the minimum duration, that is reasonable and practicable.

7.2 Key considerations

Planning phase

- Establish and map the existing paths and patterns of access on the site
- Are there particularly heavily-used paths, or any formal core paths or rights of way?
- Consult with local groups, and user-representative bodies, to determine if there are particularly popular routes/paths/patterns or types of use (eg. horse-riders, regular events, access on water etc)
- Are there any particular features of interest (eg. viewpoints, hill summits, lochs)?
- How could access opportunities be enhanced (eg. visitor car parking, by loop and circular track routes, by connections to external paths)?
- How can impacts on access be minimised?
- Co-ordinated signage strategy
- Establish and map any areas which may be excluded from access rights under Section 6 of the Act
- If new tracks or footpaths are proposed to accommodate access these should be carefully designed to minimise habitat disturbance and maximise recreational benefits.

Construction phase

- How will access be managed during the construction process? (eg. route sign-posting, alternative paths, training for vehicle drivers, provision of refuge passing places)
- Use site phasing, to ensure that exemption from access rights due to building and engineering works is kept to a minimum area, only where works are active

- Information provision, including Health and Safety information (eg. signs and way-marks, leaflets, information boards, relevant websites, contacts with representative groups, community newsletter)
- Will particular phases or aspects of the construction be problematic? (e.g. creating temporary cul-de-sacs). If so, can suitable alternative routes be provided, indicated and explained?
- Are there particular risks during construction (eg. blind corners on tracks, unstable ground) that users and construction workers need to be made aware of?

Operational phase

- How will existing and new access routes be maintained, with adequate safety measures and signage?
- Are there any particular risks for users which need assessment before the windfarm is operational (such as maintenance traffic¹, or ice throw?²).
- Can suitable outdoor access be enhanced and promoted, on completion of the windfarm? If so, how? Is there an opportunity to promote access, for example for mountain bikers, or horse-riders, or to make new connections to nearby communities?
- Can information for visitors to the windfarm be provided, such as signs explaining what the windfarm generates? – who owns it? – how much CO₂ it displaces?

7.3 Key things to address in a Construction Method Statement/ Outdoor Access Plan

- Who will be the key point of contact for local residents/members of the public, for access issues? How will this be advertised?
- What is the current baseline of access use, and how will this be affected?
- How will any conflicts over access be resolved, and ideas sought (e.g. in liaison with the local authority access officer)?
- Are there any conditions relating to access in the planning consent which need to be addressed?
- What arrangements will be put in place to maintain access, as far as possible?
- What signage is proposed and where?
- What designs of surfaces/access arrangements (such as gates and water crossings) will be required?
- If existing access routes are to be disturbed during construction, how will these be restored afterwards? What temporary alternative routes will be provided?
- If new access is to be provided, how will this be designed, and promoted?
- Which local residents' and other representative groups should be consulted?



Maintaining access for a wide range of users will increase the benefits of the windfarm to the local community.

1. Maintenance traffic (and most construction traffic) should expect access takers to be using tracks, since this multi-use of tracks is now common practice (for instance with forestry tracks). During particularly intensive periods of heavy traffic, users can be requested to keep off the track and use an alternative path, but such periods should be limited. Signs can remind the public to keep a look-out for site traffic, and to step aside to allow it to pass safely, while drivers should be trained to operate suitably.

2. Modern wind turbines generally have a reduced risk of ice throw. However, on any occasion when icing may present a valid risk, temporary warning signs at access points should alert the public to this issue, with advice not to stand close below towers, and to take care when nearby and in-line with turbine blades. Access to the windfarm site should not, however, be unnecessarily restricted.

7.4 Case study: Whitelee Windfarm

The development of the upland windfarm at Whitelee, south of Eaglesham, provided an opportunity to enhance existing access routes and build a full network of new routes which would increase opportunities to enjoy the whole area. The local planning authorities and the Scottish Government took this opportunity to ensure considerable access benefits were delivered through effective consultation and legal agreements.

The Whitelee Access Planning Group (WAPG) was set up to secure and improve outdoor access during the construction and operation of the windfarm. The WAPG consists of representatives from the relevant local planning authorities and community groups, Scottish Natural Heritage, Forestry Commission Scotland, Scottish Power Renewables and community groups. An Access Project Officer has been appointed, whose salary is paid through East Renfrewshire Council from money provided by the developer under the Section 75 Agreement.

The Access Project Officer is responsible for establishing a constitution for the WAPG, implementing their objectives and visions and delivering the community benefits package.

This work included the publication of a draft Access Action Plan, subject to local consultation, detailing the strategy and deliverables across the three local authorities' administrative areas. Each council will publish its own Core Paths Plan, which will integrate with the Whitelee Access Plan.

SPR also invested in a visitor centre on the site which opened in September 2009. This facility provides an insight into how the windfarm was built, with specific emphasis put on education visits. The centre also acts as a hub for all users of the routes for walking and other outdoor pursuits. Over 30,000 people visited the centre in its first eight months of opening.

7.5 Links/further information/Contacts

Land Reform (Scotland) Act 2003 (The Stationary Office).

Scottish Outdoor Access Code. www.outdooraccess-scotland.com

Managing Access – Guidance for Owners and Managers of Land – Scottish Rural Property and Business Association (2004).

The Construction (Design and Management) Regulations 2007.

Countryside Access Design Guide – SNH (2002 with updates).

Management for People – SNH (2004).

Public Access and Land Management – SNH (2007).

Signs Guidance for Farmers and other Land Managers – SNH (2006).

Outdoor Access Signage Guidance – Paths for All Partnership (2009).

A Brief Guide to Preparing an Outdoor Access Plan – SNH (2010).

8 Woodland removal

8.1 Introduction

Wind farm construction has often involved the removal of significant areas of commercial forestry plantation. This has been carried out for a number of reasons including: improving wind yield; reducing turbulence; or habitat mitigation and enhancement. This section deals only with situations where the need for woodland removal³ has been agreed and the purpose includes the aims of habitat mitigation or enhancement.

This section provides details on:

- The requirement for woodland removal and open-ground habitat restoration
- The aims of open-ground habitat restoration
- Tree removal
- Recommendations for felling contract

Habitat restoration is integral to the minimisation of carbon emissions. Further guidance is being developed by SEPA and SNH on this issue.



On site chipping operations.

8.2 Key Considerations

The requirement for woodland removal and open-ground habitat restoration

- Woodland removal and subsequent open-ground habitat restoration may be suggested to compensate for other actions arising from the development that may have a significant effect(s) identified in the Environmental Statement. This may include (for example) impacts on sensitive heathland or blanket bog habitat or impacts on ornithological interests (such as displacement from foraging habitat).
- Open-ground habitat restoration may, however, also be proposed by the developer even though no significant effect(s) has been identified by the Environmental Statement. This is classed as 'enhancement' as it is over and above the requirements of mitigation. The opportunity to deliver substantial positive enhancement measures may arise even in cases where woodland removal is planned as part of the construction purely for the aim of enhancing wind yield and reducing turbulence effects.
- Statutory guidance on woodland removal is contained within paragraph 94 of Scotland's second National Planning Framework (NPF2). Guidance is also contained in Scotland's consolidated Scottish Planning Policy and policy direction is set out in the Scottish Government's Policy on Control of Woodland Removal (www.forestry.gov.uk/woodlandremoval). One of the key guiding principles is that woodland removal should take place only where it would achieve significant and clearly defined additional public benefits. Where woodland is removed in association with development NPF2 indicates there will be a strong presumption in favour of compensatory planting. However, changes to the type and/or design of woodland, or to the way it is managed, may achieve the required management objectives without the need to resort to woodland removal.

3. Woodland removal, in this context, means the deliberate change of land use from forestry to another type of land management such as that associated with the management of open-ground habitats. Tree felling in itself does not indicate woodland removal, it is the subsequent aftercare of the site that determines whether the site will continue to be woodland or converted to another land use.

The Aims of open-ground restoration

- a) Post-woodland removal habitat restoration can have various ecological aims depending on the site-specific circumstances. However, in upland locations the most common aims include blanket bog and heathland restoration to mitigate significant other development-related effects on these habitats or to compensate for the loss of foraging habitat of sensitive bird species.
- b) A detailed Management Plan should be developed. This plan should explain the specific site aims and objectives and the management prescriptions required to achieve these. When restoring blanket bog, for example, it is essential that measures to raise the water table and improve hydrological conditions are also included.

Tree Removal

Any tree felling carried out without a felling licence or other valid permission is an offence unless it is covered by an exemption. Prior to undertaking tree felling it is therefore essential to check that the area to be felled has either been formally consented through the development management process or through a felling licence issued by Forestry Commission Scotland.



Chipped material may assist with regeneration but care is required to ensure that both the quality and the quantity is suitable.

Prior to undertaking woodland removal it is also important to seek competent advice on whether the resultant timber will be eligible to be sold as 'Certified timber' under the forest certification schemes operating in the UK ⁴. Failure to secure certification can have a significant bearing on the value and saleability of timber.

Forestry biomass is utilised in the form of 'roundwood', chips (for energy use or panel products) branchwood ('brash') or stumps. In utilising such biomass, all forest operations should comply with the requirements of the latest version of the UK Forestry Standard and associated Guidelines.

The harvesting of brash or stumps can pose a number of particular hazards to the forest environment that can threaten sustainable forest management. Accordingly, industry-wide guidance on brash and stump harvesting has been developed to reduce

these risks. On carbon-rich soils such as those commonly associated with wind farm development, such guidance is particularly relevant.

If the utilisation of the biomass is not commercially viable, in-situ 'chipping' of the timber and biomass is sometimes suggested as a way of improving subsequent ground and vegetation management. However, this can also have unwanted environmental and regulatory (waste) consequences which require careful consideration (please refer to Section 14). Whenever such an operation is contemplated it should therefore be discussed at an early stage of the planning process with SEPA and SNH.

All forest operations should comply with the requirements of the latest version of the UK Forestry Standard and associated Guidelines⁵.

- a) Generally, two broad techniques may be used to remove trees: commercial timber harvesting and in-situ chipping. Various machines can be used but the most appropriate technique depends on the size of the crop and site-specific conditions. In all cases it is essential to seek professional advice in the planning and execution of tree harvesting operations so that safety, environmental, economic and logistical factors are fully considered, including subsequent aftercare/use of the site.
- b) Commercial Harvesting: On anything other than the steepest sites this technique generally uses ground-based machines called 'harvesters' to fell and process the timber and forwarders to remove the logs from the site. The branches are used to form brash mats for the machinery to move along safely and minimise soil damage

4. Currently the Forestry Stewardship Council (FSC) and the Programme for the Endorsement of Forest Certification Programmes (PEFC).

5. Link: www.forestry.gov.uk/ukfs. As at September 2009 the current version of the UK Forestry Standard can be found at [www.forestry.gov.uk/pdf/fcfc001.pdf/\\$FILE/fcfc001.pdf](http://www.forestry.gov.uk/pdf/fcfc001.pdf/$FILE/fcfc001.pdf).

and subsequent erosion and diffuse pollution. This method is usually used on mature commercially viable crops. Where the ground is too steep for the safe operation of ground-based machines, aerial extraction systems, known as cable-cranes, are used.

- c) In-situ Chipping: On immature crops that are not commercially viable, a number of techniques can be used which chip the immature timber and branchwood. At the time of writing these include: Slash buster flail; Shin systems flail; Bob Little Flail; and the Gallowtrax. All, except the Gallowtrax, consist of an excavator mounted with a chipping head. The Gallowtrax chipping head is located beneath the machine and is usually better suited to dryer habitats where the ground surface can provide resistance to the chipping head. Refer to section 14 on 'Habitat management' for further detail.

Recommendations for felling Contracts

- a) Commercial Harvesting: Methods for commercial removal of timber are well developed and noted within several guidance notes. Competent specialist advice should always be sought when arranging felling contracts so that safety, environmental and other requirements are fully addressed.
- b) In-situ chipping: Contracts should clearly state the specifications required for end products (chips) and post-operation site conditions as well as habitat management objectives. This will determine the size and rating of the chip produced. Competent, specialist advice should always be sought when arranging in-situ chipping contracts so that safety, environmental and all other requirements are fully addressed.

Disturbance (including spreading of chips or excavator movements) of areas of vegetation within or adjacent to the forest should be avoided unless absolutely necessary. These areas can act as important seed sources for restoration of the surrounding felled areas.

A monitoring programme should be set up during felling operations to ensure that the forestry contractor is meeting the required specifications.

8.3 Case study: Black Law windfarm

At Black Law windfarm 458Ha of commercial forest plantation was removed as part of an extensive Habitat Management Plan covering 1440Ha. The key objective of removing commercial forestry was to restore priority blanket bog habitat within this area – a key UK Biodiversity Action Plan habitat and important carbon sink.

The Sitka spruce plantations were removed using three techniques depending on the size of the timber crop and ground conditions. Commercial harvesting was used in areas where mature crops existed and immature crops were chipped in-situ using either the 'Bob Little Flail' or the 'Gallowtrax' depending on the ground conditions.

A detailed monitoring programme was implemented to determine the rate and type of regeneration post woodland removal. The aim of this monitoring is to ascertain whether the desired blanket bog communities are re-establishing. Since tree removal in 2005, monitoring has indicated that some key blanket bog species are successfully re-colonising the site.

The percentage cover of Heather and bog cotton species increased on the areas where blanket bog might be expected to re-develop (peat depth generally > 0.5m). The cover of bog mosses (*Sphagnum* spp.) currently shows a less clear pattern. At the local scale, monitoring indicates that the old ridge and furrow patterns resulting from the legacy of tree planting determines the distribution of bog mosses within the tree clearance areas. More generally, the water table across particular parts of the deforested areas is probably too low to provide the constant waterlogged conditions required for "active" bog to re-develop and persist.

It is therefore considered that successful restoration to "active" blanket bog could require additional intervention, which was predicted as part of the Habitat Management Plan for the site. Additional hydrological monitoring and drain damming trials are now being implemented as part of ongoing research to inform future management measures.



On site harvesting operations prior to windfarm construction.



Harvesting adjacent to existing good habitat. Measures should be taken to protect areas of good habitat during felling/chipping.

Monitoring

- a) The following monitoring recommendations should be considered:
 - i) Long term monitoring is required to inform site management and aftercare.
 - ii) Monitor felling or in-situ chipping before, during and after operations, to ensure the contractors have achieved the safety and environmental specifications agreed within the contract;
 - iii) Monitor the response of vegetation to tree removal and the response of the water table to actions to improve hydrology. This should ideally be initiated pre-clearance to establish baseline conditions and then continued at an appropriate and pre-agreed frequency and duration post-clearance; and
 - iv) Results from monitoring programmes should inform an adaptive management approach to allow the defined ecological aims and objectives to be met within the specified time-scales.

8.4 Links/Further information/Contacts

Forestry Commission: Forests and Water Guidelines (Fourth edition).

Scottish Government Policy on the Control of Woodland Removal.

National Planning Framework 2.

Scottish Planning Policy.

Restoring afforested peat bogs (Forestry Commission, 2010).

9 Drainage

9.1 Introduction

This section considers the necessity for a site drainage strategy for the windfarm site. It aims to provide detailed methods for the collection and treatment of all surface water runoff from hard standing areas and roads using sustainable drainage principles. The installed drainage system on a windfarm has to be carefully planned and implemented, with regular liaison and consultation with the statutory consultees, For example:

- Construction soils should be re-used in their best condition, and not discarded or re-worked due to saturation. Peat turves require careful storage and wetting to ensure that they remain fit for re-use.
- Engineering activities such as culverts, bridges, watercourse diversions, bank modifications and dams are avoided wherever possible in order to maintain the natural state of the water environment. Where watercourse crossings are required, use bridging solutions or bottomless arched culverts which do not affect the bed and banks of the watercourse.
- No large capacity build ups of surface water should be allowed to occur that would lead to additional loadings being placed on the surrounding ground-form that may, in turn, lead to soil failure. This could particularly be the case in areas with peat stability concerns.
- Minimise any effects on natural flora and fauna, and ensure there are no indirect impacts on any surrounding designated sites.
- Works are allowed to progress efficiently without flash wash-out events affecting partially completed sections.
- The completed windfarm can be suitably operated with the minimum maintenance to the installed systems.
- Both temporary and long term foul drainage provisions and maintenance considered and authorisation sought if applicable.
- Pollution Prevention and Environmental Protection Legislation should be adhered to.



Sediment lagoons should always be situated away from watercourses, unless, as in this case, there are no alternatives. Better pre-construction planning should address this.

9.2 Relevant Legislation

The Water Environment and Water Services (Scotland) Act 2003 (WEWS Act) gave Scottish ministers powers to introduce regulatory controls over water activities, in order to protect, improve and promote sustainable use of Scotland's water environment. This includes wetlands, rivers, lochs, transitional waters (estuaries), coastal waters and groundwater.

The Water Environment (Controlled Activities) (Scotland) Regulations 2005 are more commonly known as the Controlled Activity Regulations (CAR). If you intend to carry out any activity which may affect Scotland's water environment, (this includes wetlands, rivers, lochs, transitional waters (estuaries), coastal waters and groundwater) you must be authorised to do so. Discharges, disposal to land, abstractions, impoundments and engineering works are all regulated by SEPA. Early engagement with SEPA is recommended.

9.3 Key considerations

General Principles

- Do get to know your site, to understand drainage paths, downstream users, and areas where flows would normally collect and discharge.
- Do consider options for habitat enhancement through appropriate drain blocking and other measures.
- Do keep existing natural hydrology and hydrogeology in balance as far as reasonably practical.
- Do not divert natural flows, unless under prior agreement with SEPA/SNH
- Do keep clean water flows clean, by not allowing mixing with "construction" drainage. This means that there are lesser volumes of contaminated/ discoloured water to treat.
- Do allow many small/mid diameter offlets, rather than collecting larger volumes of drainage flows to discharge to a smaller number of larger capacity outlet points.
- Do use the Riparian/Buffer zone to assist with the practical filtering out of silty run-off if appropriate. Please consult with the relevant authority prior to discharge.
- Do not allow direct ditch discharge into watercourses, lochs and sensitive wetlands.

9.4 Access Track Drainage

Pre-earthworks drainage

This is the term generally given to cut-off/ diversion ditches that are installed ahead of the main earthworks activities to minimise the effects of collected water on the stripped/exposed soils once earthworks commence.

These drainage ditches should be installed on the "high-side" boundary of the areas that will be affected by the access track earthworks operations, and should be installed immediately ahead of the main track construction operations commencing. They should generally follow the natural flow of the ground with a generally constant depth to ditch invert. They should have shallow longitudinal gradients. Their purpose is to intercept any stormwater surface run-off, and collect it to the existing low points in the ground, allowing the clean water flows to be transferred independently through the works without mixing with the "construction" drainage.

This can be achieved through dedicated piped culverts and results in a significant reduction of the volumes of potentially discoloured run-off that would otherwise require to receive further treatment prior to passing across the riparian zone, and ultimately filtering into the existing main watercourses.



In some locations substantial constructed 'Step' designed settlement lagoons maybe be required to manage large volumes of contaminated run-off.

Depending on the types of soils that are local to the area the profile of the ditch can vary from a sharp 'V' to a flatter sided 'U' shape. "V" ditches tend to maintain more existing vegetation as their plan footprint is lesser than a flatter wider "U" ditch but are generally successful in harder ground conditions that would not be susceptible to erosion. A flatter "U" ditch has the benefit of allowing easier access, and egress to wildlife. These ditches can be left as permanent installations on completion of the works, or can sometimes be infilled, and reinstated to return the existing area to their natural condition. If at all possible, any stripped turves should be placed back in the invert and sides of the ditches to assist regeneration, and also to reduce potential erosion in softer soils.

Permanent track drainage

Track edge drainage is required to control run-off from the running surface to lower water levels in the subgrade, to control surface water and groundwater from adjacent higher ground, and to carry this flow to outlet points. These ditches are nominally a uniform depth, and their invert gradient follows the track gradient. To reduce the potential for a larger volume flow collecting, it is important to install intermediate (closer-centred) offlet culverts under the built track with ditch blockers being installed immediately downstream of the culvert inlet. By introducing more offlets, this reduces the volumes of flows in the ditches and provides a more even redistribution onto the existing riparian zone. This flow reduction also lessens the potential for track edge erosion during periods of high rainfall.

Where this is not possible e.g. in sections of long cutting, it could be that a settlement lagoon is required in a suitable location to deal with the flow inrush capacity, and to allow settling out of the finer materials to take place. It is important that the track surface remains free from standing water, and



Culvert under road – better attention to detail would 'hide' the exposed pipe.

that any collected water is always allowed to be released to filter across a vegetation buffer zone, or through a settlement area, before reaching any watercourses, lochs, groundwater or sensitive wetlands.

Culverts/Headwalls/Outlets

The main method of transferring the collected surface waters 'through' the track, allowing water flow balance to be maintained, is through the use of culverts, or piped crossings. These culverts transfer flows from track side ditches, or are installed to ensure that existing lowpoints in the groundform that would have potentially been drainage paths in periods of high rainfall, can continue to fulfil that purpose.



Cross-drain on access track.

The culverts are required to be of suitable diameter to allow sufficient surface water transfer in periods of excessive rainfall, and also should have further capacity allowed as a factor of safety assuming that in some cases a build up of deposits in the invert level could reduce overall capacity. The culverts should be installed in such a way that the invert levels are slightly lower than the corresponding levels on the inlet and outlet sides, to allow a natural bed to form.

Culverts should not be installed with a "hanging" outlet (i.e. significantly higher than the corresponding ground level), as this will cause erosion of the ground through the forced action of the water flows, and also would not provide a suitable path for small mammals to use in periods of drier conditions. Headwalls should be provided around the inlet and outlet ends of the culverts to retain the track building materials, as well as to minimise any subsequent wash-in of finer materials from the track causing potential blockage to the culvert ends.

Where drainage ditches have been installed in materials that may give rise to erosion, silt traps should be installed which take the form of a formed pit, which could either be situated at the inlet, or outlet ends or both. It may be necessary to construct a retaining structure (e.g. pre-cast manhole ring units), to ensure that a robust structure is in place to allow future maintenance to take place without damage or erosion to the substrate material. A route out should be provided for small mammals that may become trapped in these pits.

Track Running Surface Cross-drains

On sections of tracks that have particularly long gradients, surface erosion can be prevalent following periods of persistent rainfall. Due to the design specifications that usually limit the amount of track camber or crossfall, the surface water tends to run down the roadline, accumulating as it nears the lower sections. This can lead to significant volumes of flow on the access track that scour out the running surface, causing runnels to form, that accentuate the problem.

To alleviate this issue, it is recommended to install a series of surface cross-drains to intercept these flows, and divert then into the side ditches, preventing the build-up of flow. These cross-drains can be constructed with channels of various materials but should be strong enough to withstand the expected traffic loadings.

9.5 Additional Protection Measures

During the construction process provision should be made for a combination of some or all of the techniques listed below:-

Silt Traps

Silt traps can be a simple and effective method of controlling sediment laden run-off, but are limited by capacity of what the expected flows are likely to be. These can be installed either on the inlet or outlet side of culverts, but require to be robust enough to allow for frequent clearing out of collected sediments.

Silt Fencing

This system involves the installation of some semi-permeable geotextile fabric, vertically held on simple timber posts, and is used primarily as an additional means of filtering out sediments from run-off water. The fences can be installed alongside any sensitive areas e.g. watercourses, large areas of stripped materials, or downstream from outlet ends of culverts, and can usually be arranged in a horse-shoe style configuration to contain, and allow settlement of suspended sediments.

Straw Bales

Straw bales can be used to filter out sediments from normal flows in drainage ditches, but their installation positions require to be carefully considered, and should allow for potential overtopping in periods of high flow. They should be pinned securely in position to avoid being washed down into larger watercourses. Bales can become saturated and can become very heavy to manually move, so a means of mechanical recovery and replacement also needs to be considered. These require to be replaced periodically, once they become silt-laden, and cease to be effective require to be discarded in an appropriate manner subject to relevant waste legislation.



Straw bale 'pinned' in place.

Settlement lagoons

Any proposed site for large capacity settlement lagoons requires careful planning and a good awareness of the expected volumes of flows that they will be required to cope with. Lagoons are particularly effective where a large run-off volume is expected and suitable small scale dispersal to existing vegetation would not be successful.

Settlement lagoons normally take the form of a large contained pool area, either partially dug in to the ground or bunded to act as a barrier to stop the surface run-off escaping. This pool should be further compartmentalised to allow different levels of filtration and settlement to occur, progressively, from the inlet end through to the eventual discharge end. Care is required to ensure that the sidewalls are strong enough to withstand any potential loadings as an uncontrolled discharge (burst) could have serious environmental consequences.

Flocculant dosing

Where all other possibilities of sediment control have been considered, tried, or discounted, another method to increase the rate of settlement would be by the introduction of liquid, or solid dosed flocculants. These work by pulling together finer suspended solids, into larger and therefore heavier particles that settle out quicker. The use of flocculant agents should be considered where there are limits on available space. Liquid flocculants can be dosed into settlement lagoons, and solid flocculant blocks can be set in flowing water to slowly dissolve, thereby giving a 'dose' to the

suspended sediments in the run-off. Some specialist assistance should be sought if this option is being considered, and approvals from the statutory agencies may also be required, prior to use.

Pumping

Where there is a significant build up of water it may be required to pump this to avoid further build up, or to allow works to progress in that area. Any required pumping should be planned to ensure that the discharge is either entering a settlement lagoon or that it can discharge directly over an area of suitable vegetation, an appropriate distance away from watercourses, lochs, sensitive wetlands and groundwater in order to filter out any suspended sediments. Proprietary equipment such as "Siltbuster" type tanks can also be used to assist with the reduction of suspended solids.

It is important that the flows from the pumping operation do not cause erosion to the vegetation that it is discharging onto. The point of delivery should be alternated to various locations to ensure that potential for scouring is minimised. If the flows need to be redistributed more generally over vegetation a connection to the hose end can be made to discharge the fluid in a spray over a much greater area.



Bridge and bank habitat. Steep sides of loose material could be washed off in a storm event. Use of splash boards on bridges can prevent contamination of watercourses and is an example of good practice.

Watercourse Crossings

The location of watercourses should be given careful consideration in determining the routing of roads and pipelines and the location of temporary and permanent infrastructure. The crossing of watercourses is to be avoided where possible. Where these do prove a necessity developers should use bridging structures or bottomless/ arched culverts which will not impact on the bottom and banks of the watercourse.

All watercourse crossings must be carried out in accordance with the Controlled Activity Regulations, controls range from general binding rules, through to complex licences. Further information should be sought from SEPA. For each level of authorisation, different timescales apply, and these timescales require to be allowed for in the overall Construction Planning.

Maintenance

- Any installed additional protection measures should be regularly inspected, and procedures should be put in place to have any collected sediment cleared out to ensure maximum capacity can be maintained. It is recommended that clearing out be done in a period of dry weather, when flows would not affect the disturbed sediment materials.
- Headwall conditions should be checked as well as the inlet, and outlet ends of culverts to ensure no blockages are evident.
- If there are any permanent settlement lagoons these should be checked for leakage and, following periods of heavy rainfall, if there has been sufficient settling of sediments, water levels should be lowered to allow increased containment capacity to be available within the lagoon for the next rainfall period.
- Ditches should be checked for blockages, and kept clear and in good order. Any growing vegetation in ditches should be left as this will aid in the filtering of some of the sediments.

9.6 Key items to address in Construction Method Statement

- Look closely at the likely travel paths of surface water run-off and the effect this may have on any downstream receptors, and plan for minimising this potential effect.
- Pollution prevention techniques and mitigation methods for spills of oils and fuels, and cement and concrete should be identified.
- Clearly discuss the pro-active measures to be put in place to prevent uncontrolled surface run-off, including pre-earthworks drainage, silt traps, settlement lagoons, silt fencing, etc.
- Discuss the intended control measures to be considered when pumping is required.
- Consider details of an Environmental Management Plan, to look at the pre-construction, construction, and post construction phase performance of the intended drainage systems.
- Identify which drains could be restored at the end of construction.



A well designed and located cement wash out bay can prevent bad practice elsewhere on site. A ticketing system to ensure it is used by all drivers has been shown to be useful.

9.7 Links/further information/Contacts

Forestry Commission: Forests and Water Guidelines (Fourth edition).

CIRIA Publications: Control of Water Pollution from Linear Construction Projects. Site Guide.

SEPA Pollution Prevention Guidelines.

HSE Avoiding Danger to Underground Services.

10 Construction of Access Tracks

10.1 Introduction

The Access Tracks constructed on a windfarm are required for four main phases of the works:

1. Initial installation to allow the main construction plant, personnel, and materials to gain access to the remaining areas of the site to allow the construction of the civil and electrical infrastructure.
2. Safe haulage of the main Wind Turbine Generator component parts, and access for cranes, required for Turbine erection.
3. Long term access for the Operational & Maintenance needs of the windfarm, as well as providing amenity access for landowners and the public.
4. Access for the eventual decommissioning of the windfarm.

Getting the track construction correct means that, with properly considered design and construction methods, you can expect to:

- Avoid track failure
- Reduce volumes of sediment laden run-off during, and post - construction
- Reduce quantities of road stone used
- Minimise waste production
- Avoid delays in allowing access for wind turbine component deliveries
- Reduce timescales for the re-generation of reinstated verges
- Limit the long term requirement for maintenance
- Minimise the impact on the existing landscape and habitat

10.2 Key considerations

Where a windfarm is proposed in an upland area then this Section should be read in conjunction with the SNH publications 'Constructed tracks in the Scottish Uplands' and 'Floating Roads on Peat' (August 2010).

- **Drainage** (please refer to Drainage section)
- **Pre-Construction tasks**
 - Existing ground conditions analysis
 - Existing ground surveys/Topography
 - Catchment/Run-off studies
 - Construction Planning (including waste management)
 - Limits of Construction
 - Existing services and other constraints
- **Track Design**
 - Alignment Horizontal & Vertical, and consideration of upgrading existing tracks
 - Peat Stability issues
 - Specification requirements
- **Track Construction**
 - Floated Construction (Grid types, structural stability, hydrology, inclusion of existing roots and vegetation).



Construction of a cut road.

Traditional 'Cut & Fill' Construction (consider an estimate of the excavated material that this technique will generate).

Rock Source; Quantity & Quality

Ditches/Culverts/Catchpits (temporary and permanent)

- **Verge reprofiling reinstatement** (please refer to section 14)
- **Operational Maintenance**

10.3 Pre-Construction Tasks

It is essential that there is a full understanding of the area where the tracks are proposed to be constructed. This understanding should cover the following points :-

Topography of the ground ought to be considered ranging from detailed reviews of current mapping, right through to detailed ground surveys. This information is also important to assess the potential catchment area for expected ground and surface water run-off, as this will be required when sizing culverts, spacing off-lets, settlement lagoons etc. It is also important that tracks and access to and from borrow pits are considered.

Results from a comprehensive ground investigation should also be reviewed to understand what the expected ground conditions will be. Important information from the ground investigations for tracks, take the form of peat/topsoil probing, and trial pitting, in-situ shear vane tests, particle size distributions. This information provides key details to allow full understanding of the ground make-up.

Initially, peat probing should be carried out over a wide corridor, within the limits of construction (set through the Planning Permission) and roughly following the intended track line. The results of detailed probing of sufficient intensity (including characterisation of peat and habitats present) could then allow a more detailed fix of the tracks' intended centre-line, avoiding areas of deeper peat, or sloping ground. A series of trial pits could then be commissioned to allow physical cross-checks to correlate the probing of the softer materials, and also to provide an inspection of the soil types underlying the "soft" materials.

This is extremely important when considering the types of track construction to be employed, when assessing the need for additional reinforcement materials and when considering any potential peat stability issues, borrow pits and waste management.

10.4 Track Design

During the more detailed *track design* stages, the specification limits for the intended track construction must be fully considered. Usually there are limits set by either the turbine supplier, or delivery contractor, for horizontal, and vertical alignment gradients, as well as minimum track widths, and load bearing capacities. At this stage, a Geotechnical Engineer may need to be consulted to ascertain any potential issues with regard to the intended track construction style, track gradients, temporary construction stages and how this may affect the stability of the existing ground form, and in particular any potential peat stability issues.

Throughout the construction phase it is also recommended that regular Geotechnical inspections are made to promote good practice, and provide a forum to review and discuss any potential concerns.

Prior to the commencement of construction of a section of track, it is advised that the centre-line of the track is “set-out”, and a walk over is performed by the site manager or general foreman, along with the Geotechnical Engineer, and appropriate Clerk of Works (please refer to Section 5). This would be carried out to check that the ground conditions/drainage paths are as expected, and if there are any instances where “fine-tuning” of the alignment is required. This can usually be accommodated without too great an effect on construction progress.

Any requirement to install pre-earthworks drainage can also be carried out at this stage, once the final line has been agreed.

10.5 Track Construction

The track construction method generally follows one of two potential options either:

- A “*Floating track*” where the vegetation and supporting subsoils remain intact, with a track built off the existing ground surface supported with the introduction of geotextiles and geo-grids to reinforce the track building roadstone. This technique may produce less waste due to a reduction in the amount of excavation required.
- A more traditional “*Cut & Fill track*”, is generally constructed where there is a relatively thin layer of vegetation, and soft (soils/subsoils) materials that can be easily removed to provide a suitable bearing layer to base the track construction, or if the topography is steeper, and floating construction is not considered acceptable. Note that this technique may generate more excavated material.

Choice of track construction will have a bearing on carbon payback times. Sufficient detail on track design will therefore be beneficial prior to consent to allow a reasonably accurate assessment of carbon payback.



Poor floating road construction e.g. attention to detail is required at track edges to prevent construction material spilling onto surrounding vegetation. Please refer to the *Floating roads on Peat* guidance.

Floating tracks

These tracks are commonly constructed across areas of deep soft materials usually gently rolling peat, or occasionally soft poor-strength clays. More detailed guidance is provided in *Floating Roads on Peat* (SNH/FCS August 2010). It is important that the topography of the surrounding area is fully understood and that a suitable peat probe survey has been carried out to base the decision on the type of construction on. Floating tracks are not recommended on areas where the “crossfall”, or slope of the virgin ground is of a magnitude that could lead to a slip or a circular failure, or where it is considered that the strength of the virgin materials could not support the superimposed loadings of the track construction plant and materials, and more significantly, the weight of the WTG components & vehicles during the delivery stages. Without due consideration, and professional

opinion, the construction of floating tracks on areas that would not support the full construction cycle could lead to catastrophic track failures with potentially serious physical and environmental results.

For best results for the support of a floating track, the vegetation layer should be left in place, and in the case of clear-felled forested areas, the tree roots systems should not be grubbed up, but the stump remains should be cut/ground to the vegetation level. Where feasible and appropriate, brash from a woodland removal undertaking can be re-used to add support to a floating road.

The first layer of woven geotextile, and/or geo-grid is carefully rolled out across the virgin ground in accordance with the manufacturer's instruction. A layer of rockfill is spread evenly and carefully across the geogrid to provide the running surface for the construction plant to access. This layer can vary in thickness, and can depend on the supportive nature of the underlying materials, the quality, and size of the rockfill materials used, and even the skill and competence of the operators of the plant involved.

If appropriate, some small diameter drainage pipes can be installed below or within the first layer of rockfill, to maintain any natural flow from one side of the track to the other. This helps to maintain the hydrology of the area.

In many cases once the initial rockfill layer is spread, a second geogrid layer is laid out on top of the levelled rockfill, prior to the second rockfill layer being spread. This second layer is usually of a slightly finer, crushed "grading", to provide a suitable durable running surface for the construction plant.

It is important that great care is taken to ensure that all minimum lap lengths on the geogrid sheets are achieved, both along and across the roadlines. Also, the grids should extend beyond the intended minimum track width in order to allow additional weight to be applied to assist the tracks to evenly spread out the applied loads. Care should be taken however when placing this material not to over-deposit arisings to the detriment of the works. For example, the provision of high verges can prevent surface water from immediately draining off the road where it arises and this can create local ponding which can infiltrate the road and weaken its construction.

It is not recommended to allow any significant lengths of cable trenching to remain "open", or allow drainage ditches to be excavated in close proximity to floating track areas, as the additional loads imposed through the track could lead to underlying soft materials migrating to fill the created void, and potentially causing a weak point to be developed in the track.

Any gathered surface water should be allowed to run off the track edges, at very close intervals across the verges, and onto the neighbouring vegetation, to avoid any surface ponding. Further guidance is available in *Floating Roads on Peat* (2010).

Cut & Fill tracks

These tracks are constructed in a more traditional form, where the vegetation layer (nominally the top 300mm) and remaining underlying "soft" materials are removed, allowing access to construct off the sub-soil or bed-rock, which would usually consist of better bearing capacity material.

After the centre-line of the track has been set-out, and any required pre-earthworks drainage provisions have been made, the corridor of the intended track is marked out to allow the excavators to commence. The vegetation and materials holding the seedbank, (300mm of the top of the softer materials) are stripped, and carefully set aside for re-use in the reprofiling and reinstatement works. Where practical, whole turves should be set aside and stored vegetation side up, for use in restoration. The



Surveying floating road structural integrity. Note that excessive material should not be placed on the side tracks as shown on the left of this image.

sub-soils materials can then be assessed, and in some cases some localised areas of soft-spots may require to be excavated and replaced with imported better quality materials. If the bearing materials are assessed as being “marginal”, it may also be necessary to install some geotextile material reinforcement to spread the track load over the bearing surface.

On significantly sloping ground it may be necessary to cut benches into the sub-soil layer to provide suitably profiled bearing surfaces for the support of the track.

Rockfill is then spread over the prepared bearing level, and profiled to suit the required levels. This roadstone is then graded and rolled to provide a well compacted durable running surface. Any undulations in the bearing level are usually taken out as the track is profiled to suit the specification provided. Care is required to ensure that the surface of the tracks do not hold standing water, as this can lead to more extensive maintenance being required to potholes, following heavy trafficking, and can lead to premature localised track failures.

For best results in constructing the final running surfaces of the tracks it is important that a good quality stone which is suitable for the specific task is utilised, as “making do” with a substandard material, that will break down more readily, will lead to :- more silt-laden run-off, more maintenance of the track surfaces, and earlier overall track deterioration. The source rock should be of good quality either from an external quarry, or from an on-site “Borrow-Pit”. As a guide, rock that can be easily extracted from the borrow-pit is generally rock that is quicker, or more prone, to deteriorate as a running surface. If the quality of rock is poor then an alternative source should be used.

As either method of track construction progresses, whether it is “Floating”, or the more traditional “Cut & Fill” system, it is strongly advised to install culverts and drainage pipes at regular intervals to alleviate any potential build-up of storm water. The culverts should be constructed in strong enough materials to withstand the expected loadings, and should at least be installed at all low points where off-let points would have existed previously. It makes sense to install all required crossings at an early stage, as any secondary excavating through a constructed track could lead to more delays, and an inherent weak point in the track.

Depending on the natural soil types it may be prudent to install silt traps at the inlets to the drainage pipe crossings to reduce the volumes of solids being carried in the discharged waters. All work associated with any open water should be carried out in full accordance with the requirements of the Controlled Activities Regulations (CAR), and all appropriate licences must be obtained from SEPA.

All ducted crossing points for expected site cabling should be protected and marked as necessary, and locations for other accesses should also be accommodated at this early stage.

Verge Reinstatements

Once the tracks’ running surface has been installed, the verges can be reinstated. The main objective with verge reinstatement is to create a good landscape tie-in with the original ground form and habitat. To secure the best results, the previously stripped soils should be brought back over the verges within as short a time period as reasonably possible, as this gives the seedbank and vegetation the best chance of an early regeneration. Replacing whole turves is the ideal method of restoration.

The soils should not be spread back on the verges too thinly as the material may then have a tendency to dry out and crack (particularly during the summer months) before the root system has had a chance to form, stabilising the surrounding soils. There will be differences in the growing performance depending on season, and altitude, but an early reinstatement generally provides for the most beneficial results.

Construction material should not be placed on track edges unless it is required for re-profiling, or to achieve a suitable tie in with the surrounding topography. Not all excavated materials will be suitable for this use. Only use peat in these instances to reprofile/finish off the edges of tracks and where construction has damaged the surface. Peat turves should be used where possible.



An example of bad practice. Excavated peat placed 4m from edge of access track. Note that no peat turves have been re-used. This peat is likely to dry out and provides no ecological benefit.



An example of good practice. Reinstated turves at road verge provide optimal restoration. Careful supervision of works may be required to achieve this.

There is no ecological benefit from using excess and unsuitable material to create shoulders on floating roads or cut tracks. This causes additional habitat loss. The peat smothers the existing vegetation, preventing natural re-growth of bog vegetation adjacent to tracks. Also, the material will likely be unstable and at increased risk of drying out, which may lead to carbon loss or runoff problems. Guidance on the appropriate use of peat for floating road edges is provided in the SNH publication *Floating Roads on Peat* (2010).

Operational Maintenance

As is the case with any unbound track, windfarm tracks require to be carefully monitored to ensure that there is no significant standing water forming, which would lead to the forming of potholes in the running surface. If there are areas of track identified that are causing concern, repairs should be carried out in favourable, preferably dry, conditions, to ensure that there is no saturation of the surface of the track. The damaged area should be raked back to disturb the previously compacted layer, and a crushed rock material is then spread, mixed, and compacted to bring up the finished level of the damaged area back to the level of the adjacent parts of the track. It is also important to check that it is always possible for the surface run-off to clear the road edges. It will be necessary to clear channels to allow the run-off to exit clearly. Transverse camber or cross fall surface profile should be maintained.

Due to the elevation and exposure of the majority of windfarm tracks they will be susceptible to the worst of any weather conditions. The most notable effects of the weather will be witnessed during the winter months, and will take the form of snow, ice and frost. Because of the unbound nature of the access tracks they will be susceptible to the freeze/thaw effects of frost (frost heave). As the temperatures drop below freezing any saturated water within the track matrix will freeze and expand. Any subsequent thawing action will leave the track surface soft, due to the previously expanded frozen material now appearing more "open" than before. Care should be taken to treat the tracks with care during this period, and they should be given a chance to recover prior to any further heavy trafficking.

It is not recommended that commercial road salts be used, in any great amount, as although they will locally melt the build-up of ice, they can also have a damaging effect on the track surface, the verge vegetation, and a negative effect on the water environment.

Any installed silt traps should be regularly inspected; procedures should be put in place to have them cleared out regularly. It is recommended that this be done in a period of dry weather, when flows would not affect the disturbed silt materials.

10.6 Key items to address in Construction Method Statement

- Pro-active measures to be put in place to prevent uncontrolled surface run-off, including pre-earthworks drainage, silt traps, settlement lagoons, silt fencing, etc.
- Consider details of an Environmental Management Plan, to look at the pre-construction, construction, and post construction phase performance of the track build.
- Plan for suitable areas for the storage of “soft” materials that are to be temporarily stored, effectively managed and suitably utilised in a later construction phase e.g. peat turves.
- Look closely at the likely travel paths of surface water run-off and the effect this may have on any downstream receptors, and plan for minimising this potential effect.
- Gather all available information to gain a full understanding of the terrain, and soil types, in the area you are to work on, with particular respect to potential peat stability issues.
- Understand the likely source, and quality of the roadstone that will be available to construct the tracks.
- Waste management (N.B this guidance does not deal directly with the issue of waste management on site. You should however be aware that in some circumstances excavated peat may be considered to be waste. Subsequent use of that material may require licensing from SEPA. Guidance on this issue should be sought from SEPA at an early stage.)

10.7 Links/further information/Contacts

Forestry Commission: Forests and Water Guidelines (Fourth edition).

CIRIA Publications: Control of Water Pollution from Linear Construction Projects. Site Guide.

The Water Environment (Controlled Activities)(Scotland) Regulations 2005.

SNH: Constructed Tracks in the Scottish Uplands.

Floating Roads on Peat SNH/FCS (August 2010).

11 Site Compound

11.1 Introduction

All wind farms require a site compound during the construction stage of the project. Typically the compound would include office and workers welfare facilities, parking, laydown area and storage areas.

Under the Construction (Design and Management) Regulations 2007 (CDM) it is the Client's responsibility to ensure that "contractors have made arrangements for suitable welfare facilities to be provided from the start and throughout the construction phase". Therefore there is a legal requirement for developers to consider the welfare facilities required on-site during the construction phase.

The size of the storage, laydown, car parking and other facilities within the site compound are usually dependant on the size of the project and the technical requirements of the turbine supplier and other contractors.

This section provides details on best practice for design considerations and construction methods, including possible environmental mitigation methods. Specifically this includes:

- Location of the site compound
- Design of the site compound and construction methods
- Environmental mitigation methods
- Reinstatement of site compound



Considerable lay-down areas are required on site.

11.2 Key considerations

a) Location of the site compound

The location of the compound is normally part of the planning consent and any impacts, including visual intrusion and ground conditions, should have been considered as part of the Environmental Impact Assessment.

The site compound is normally situated towards the entrance of the site to enable control of material onto the site, ease of access for workers and visitors, and ease of construction at the beginning of the works.

When considering the location of the compound at the construction phase the following should be reviewed from earlier planning stages:

- i) Distance from watercourses, lochs and wetlands.
- ii) Topography of the area.
- iii) Ground conditions
- iv) Hydrology
- v) Designated Sites
- vi) Visual impact

The results of baseline surveys (and any subsequent survey work) should provide much of the information required.

b) Design of the compound and construction methods

Site compounds are typically large levelled areas constructed of compacted stone. These areas are normally reinstated following construction, except where they

are retained or partially retained for use during the operational phase. During the design phase it is desirable to minimise the overall footprint of the site compound.

Where the compound has been proposed on an inclined area, the use of split level areas should be considered to reduce the excavation into the slope and balance the cut and fill required on the area thus minimising haulage of excavated material.

When designing the compound the use of a perimeter drain should be assessed. Where the surface drainage across the compound area could affect the integrity of the compound a perimeter drain should be designed taking into account mitigation for sediment transport. Where surface drainage is unlikely to affect the compound, perimeter drains should be avoided thus preventing impact on the hydrology of the area and potential of sediment transport.

When constructing the site compound the peat/topsoil should be stripped and stored in a suitable location even when using geotextile material. Suitable stone should be placed and compacted to create the compound. It is important that the content of the stone does not include a high percentage of fines which could increase the risk of sediment contamination of the adjacent area and watercourses.

The site facilities will include mess and toilet facilities for the site workers. The design of the effluent system, either septic tank and soakaway or contained tank, will depend on the sensitivity of the adjacent area. Where soakaways are proposed they should be kept as far away from watercourses as feasibly possible. SEPA licences may be required.

If compound lighting is required it should be designed to minimise light pollution to the surrounding area. All lights should face inwards to reduce overall environmental impact.

Normally bulk fuel and oil storage will be within the site compound area. Suitable bunded areas should be designed and constructed to meet the requirements of SEPA's pollution prevention guidelines and oil storage regulations.

c) Environmental Mitigation Methods

The highest risk of pollution is sediment transport from runoff across the compound area. The use of silt/sediment traps, settlement ponds and hay/straw bale barriers should be considered to prevent sediment entering watercourses. Where high percentages of clays and silts occur, the use of flocculants should be considered to reduce settlement time (which may take weeks). Flocculants should only be used following consultation with SEPA and relevant fisheries groups.

The contractors on-site should have an emergency procedure for dealing with oil and fuel spills. Emergency spill kits should be available within the compound and a contract with a 24 hour response environmental clean up company should be in place for the construction period.

d) Compound Reinstatement

The compound is required during the whole of the construction period, and without appropriate management it is likely that any turves which were stripped would have decomposed depending on the length of time for which these are stored. The reinstatement of the compound area would normally include a degree of landscaping followed by replacement of the peat/topsoil over the area. The compound area will take a number of years to fully reinstate, dependant on the type of adjacent vegetation. The use of reseedling or temporary fencing of the area to protect against grazing animals should be considered to help accelerate vegetation. Careful consideration of the site specific conditions is required to ensure successful regeneration, and in particular the creation of appropriate hydrological conditions.

If the compound is not required during the operational phase of the wind farm the area should be re-graded to match in with the surrounding levels. Suitable material for reinstatement should be appropriately stored and managed, near to the site compound but away from/suitable buffers from watercourses and other sensitive receptors.

12 Cable trenching and installation

12.1 Introduction

Most windfarms within the UK install the power and communication cables within trenches that are excavated and then backfilled. Windfarm cables on some sites however are ploughed in using machines that are capable of dealing with different ground conditions; laying power and communication cables at the same time as bedding sand and warning tapes. The main difference between these two methods is the ability to inspect the cables following them being laid.

It is important to balance land, ecology, economic, drainage requirements and safety factors when designing the wind farm electrical collection system.

This section provides advice on good practice construction methods to minimise the impact during construction.

Specifically this includes:

- Designing the location of cable trenches
- Design of the cable trenches and construction methods
- Timing of construction and reinstatement works



Cable trench adjacent to constructed road.

12.2 Key considerations

Designing the location of cable trenches

a) Design at planning stage

Typically the location of wind farm cables, as noted within an Environmental Statement (ES), are either not mentioned or referred to as “generally following the track routes”. It is often difficult to identify the exact cable routes at the planning stage and it is normally preferable to leave it to be dealt with within the Construction Method Statement (CMS), as it would normally require more detailed electrical design than typically undertaken at the ES stage.

Generally it is accepted that wind farm cables should be buried rather than installed as overhead lines on the basis of visual impact and potential impact on birds. The impact of a cable trench being constructed adjacent to a site track is likely to be negligible but a separate cable trench crossing the wind farm area may have a more significant impact.

b) Cable route design

When designing the cable route for the wind farm it is important to take the following into consideration:

- i) The design of the consented turbine and site track layout.
- ii) The environmental/ecological sensitivity of the area.
- iii) Existing land use.
- iv) Archaeological sites.
- v) The hydrology of the area.
- vi) Ground conditions.
- vii) Topography of the area.

viii) Economics of the cable route.

ix) Ability and speed to repair the cables during the operational phase.

When designing the cable routes it is important to take into account the physical layout of the turbines and site tracks. Generally it is more convenient to install the cables adjacent to the site tracks to allow easy access for the cable laying and trenching plant.

The existing land use and habitat should be considered when designing the route to minimise the impact. Any impact on existing land drainage systems should be taken into account. Cable trenches can act as water drainage routes; the amount of water transport dependant on the design of the cable trench.

The hydrology of an area can be affected by a cable trench containing disturbed backfill material, sand bedding and surround. The steeper the cable route the higher the volume of water is likely to be transported through the cable trench. It is important to consider the gradient of cable routes and the use of clay plugs and impermeable barriers within the cable trench to limit water flow.

Ground conditions and topography need to be considered for various practical reasons. Separate cable routes on steep gradients, especially with soft ground have high risks of causing machines to topple and may be more difficult to reinstate and be subject to erosion by surface water flow. Cables should not be installed in deep soft peat as they will slowly sink adding tension into the cable, which may require premature replacement.

It is possible to install cables in nearly all ground conditions, but when planning a route, the possible replacement and repairs of the cables should be considered. Installing cables in areas which require specialist installation equipment or through designated/protected areas, which may require notification, will cause delays to repairs.

Cable routes should avoid areas of potential archaeological interest. Where this may not be possible mitigation should be proposed, including a written scheme of investigation. Consultation with Historic Scotland or the Local Planning Authority may be required.

c) Cable trench design, installation and reinstatement

Cable trenching involves:

- i) Stripping and storing separately the topsoil/peat layer.
- ii) Excavating the trench through the subsoil.
- iii) Laying earth tape/cable in contact with the base of the trench.
- iv) Placing sand bedding.
- v) Laying power and communication cables and sand surround.
- vi) Installing marker tapes/tiles and back filling the trench.
- vii) Reinstating the topsoil/peat layer.

Where cables are installed adjacent to floating track sections, trenching in the reinstated track edges should be considered as part of the track design. This can minimise any additional land take area for cable trenching as well as giving support to the cables preventing them sinking through the peat or soft sub-soils. This has the additional benefit of not requiring separate cable trenches in virgin ground thus minimising hydrological and ecological impacts.

It is important to consider the timing of other construction activities. Where possible trench reinstatement works should take into account adjacent activities which may disturb any reinstatement works already carried out.

Windfarms have recently been targeted, due to high metal prices, by thieves wanting to steal cables and earth tapes/cables. It is important that security is considered during the construction stage as much of the cable stolen has been pulled out of the ground. As well as cost of the theft this activity can destroy the reinstated area and reduce the quality of any further reinstatement attempts.

Generally the quality of reinstatement of cable installation areas is dependent on the following:

- i) The amount of time between the excavation of the trench and the reinstatement of the topsoil/peat. Peat turfs poorly stored or stored for a long period of time can impact on the quality and time required for the area to fully recover. Cable trenches should not be excavated prior to the electrical contractor having cables ready on-site for installation. A method should be used which minimises the amount of time cable trenches are left open and the time between peat stripping and reinstatement. Trenches left open for long periods of time tend to act as conduits for water causing erosion and potential sediment pollution of adjacent watercourses and land.
- ii) Poor separation of excavated material will lead to mixed soils e.g. contaminated peat, thus leading to poor reinstatement. A method should be used which clearly separates the different excavated materials. Consideration should be given to over stripping for the cable trench areas to prevent mineral soil/sediment contamination of the adjacent vegetated areas. The over stripping method will be dependant on the materials excavated from the trench. Where cable trench arisings are comprised entirely of peat it may not be worthwhile to over strip. Where cable trench arisings are mineral soil or weathered bedrock over stripping should be considered.
- iii) Where the depth of the original topsoil/peat layer is very thin there may be insufficient material for reinstatement. Where the use of peat with little or no seed bank, from another area of the site is proposed, the method of reseedling should be agreed with SNH. The use of sand and other materials may be appropriate. Advice should be sought from SEPA and SNH.
- iv) Consider the hydrology at the design stage to ensure the type of vegetation on the reinstated area does not differ from the adjacent area.

13 Turbine Foundation and Crane Pad construction

13.1 Introduction

Before detailed foundation and crane pad design can be carried out, adequate ground investigations are required. Typically this involves: trial pits, boreholes, in-situ testing and laboratory testing of samples.

The type and design of the foundation will typically be based upon the findings of the ground investigation. Some turbine manufacturers insist on using their standard foundation design, which are normally designed for a large range of ground conditions. A key consideration should be waste minimisation and the reduction of carbon emissions. In areas of poor ground conditions greater than 3m in depth, it may be more appropriate to consider alternative methods such as piling.

As the specific turbine model is unlikely to have been selected prior to the consent of the wind farm, the size of the foundation and crane pad discussed in the Environmental Statement (ES) is either generic/typical or based on an actual turbine which could fit the wind farm design. The most appropriate type of the foundation (gravity, piled or rock anchored), can only be determined following ground investigation works. Ground investigation works (due to their invasive nature and cost) are generally carried out following planning consent, and gravity foundations, as the most common form, are considered within the ES. However the use of piled foundations should be considered in future. The results of a peat survey completed during the EIA stage should inform whether piling is a feasible option.

This section will generally refer to gravity foundations, except where other foundation types require particular consideration. Generally gravity foundations are located within a weathered rock stratum, or on soils that can provide adequate bearing capacity. Piled foundations are used in soft sediments or deep peat, where the piles are either driven into underlying bedrock, or the friction of the pile within the soft sediment is sufficient to support the turbine or in some cases a combination of both. Rock anchored foundations utilise steel anchors which are drilled and secured into



Lifting of final turbine components.



Preparation of turbine foundations.

strong competent rock. These are less common, but do allow reduced volumes of concrete to be used.

The construction of foundations and crane pads involve heavy civil and earthworks, which have a high risk of sediment pollution and chemical contamination of the water environment. When considering the foundation and crane pad design it is important to take into consideration the following ecological, hydrological and operational factors:

- Minimising excavation of material.
- The possible effect on the water table.
- The possible effect of drainage on the type of vegetation.
- How to deal with silty water within the excavated areas.
- How the topsoil/peat stripping should be carried out.
- How excavated material should be stored temporarily or re-used.

13.2 Key considerations

a) Turbine and crane pad location

The location of the turbine and crane pad will determine how much earthworks will be required to enable the civil works. A turbine located on a steep gradient will require extensive earthworks to level a large enough area to accommodate both the foundation and crane pad area. Areas of deep peat should be avoided to minimise the volume of peat excavated.

b) Soil and overburden stripping

When designing the turbine foundation it is essential to understand the existing ground conditions. Typically the topsoil/peat is stripped and stored around the perimeter of the foundation excavation.

Where stripped/excavated peat is not suitable for reinstatement it is likely to be considered to be a waste material and the relevant waste management legislation will apply (this should be discussed with SEPA). In light of these discussions the CMS should identify appropriate handling and storage methodologies.

Subject to any waste management control a plan showing areas which are safe for stockpiling should be created prior to works beginning. In areas where stockpiling is not allowed the excavated material should be transported straight away to the nearest agreed safe area. Where excavated material is not suitable for back filling over the foundation or for reinstatement purposes, if possible it should be transported to its final agreed location. Double handling of silty material increases the risk of pollution and contamination of the adjacent land.

If designed properly the use of a temporary low bund of sub-soil around the perimeter of the excavated area can be a useful mitigation method, to prevent silt from stockpiles being washed into the adjacent area or watercourses.

Deep excavations should be fenced with appropriate warning signs, until suitably restored.

c) Drainage

Cut off drains are commonly used on the top side of excavations to prevent surface water runoff entering the excavation. If a cut off drain is to be used they should be designed to prevent high erosion flow rates and include appropriate sediment transport mitigation measures.

The amount of water that may accumulate in the bottom of the excavation is dependant on the permeability of the rock, the water table and the weather over the construction period. The excavations can produce high amounts of fine sediment, which could have a significant affect on local watercourses. Each excavation requires a tailored drainage/mitigation plan which takes in to account its specific characteristics.

If possible the excavation should be designed to allow drainage out through a limited number of controlled outlets, where sediment can be controlled through a series of settlement ponds or filtering systems. Flocculants should be considered to assist sediment precipitation. A flocculent specialist as well as SEPA should be consulted prior to use.

Where water collects in the bottom of an excavation it may be necessary to pump the water out to allow continued works. If pumping is required it is important to agree locations away from water courses where discharging or further treatment can occur.

The turbine foundation design has to consider the water table in the area. If the water table in the area is higher than the formation level the foundation will be affected by buoyancy (uplift). The typical solution to this problem is to install a drain around the outside of the foundation (sometimes underneath the foundation) to lower the water table below the formation level. Alternatively the foundation size can be increased to account for the buoyancy effect. It is important to assess if localised lowering of the water table will have an undesirable effect on the vegetation or water environment of the local area. Lowering of the water table is not recommended where these undesirable effects are likely.

d) Crane pad (hardstanding) size and layout

The size of the crane pad is normally directly related to the size of the cranes required for installation. The turbine manufacturers also require the crane pads for temporary storage of turbine components e.g. blades and nacelles. The crane pads are normally designed to accommodate all types of cranes that could possibly be used.

It is possible to reduce the size of the crane hardstanding area by designing separate pads for the crane outriggers, but only if the precise installation crane is known. Specifically designed crane pads also limit the type of crane that can be used for maintenance during the operational phase. A storage area for turbine components would also be required either on-site or near to site.

e) During construction

Turbine foundations and crane hardstanding involve heavy earthworks and civil works. It is important that any mitigation measures designed are monitored (by the contractor and the Environmental/Ecological Clerk of Works) and maintenance carried out.

f) Reinstatement

Within environmental statements crane pad reinstatement is often either not mentioned or a layer of topsoil/peat is described as being spread over the hardstanding.

From experience the use of crane pads during the operational period is higher than previously estimated. Where crane pads have been reinstated with a layer of peat following construction, the peat is often stripped off within the first 2 to 3 years of operation to allow for turbine maintenance.

When the layer of peat is stripped off using an excavator the peat becomes mixed with the stone from the hardstanding and is usually not suitable for reuse. Typically reinstatement over crane pad areas take 2 to 3 years to establish, but due to the reuse of the hardstanding the reinstatement of these areas rarely reaches a high percentage of vegetation cover unless reseeded is used.

In the light of operational experience it is recommended that crane pads are not covered with peat, in particular catotelmic peat, or topsoil for the operational period of the windfarm. It is critical that the area around the crane pads and any exposed batters are reinstated to reduce visual impact. Long term storage of peat material, in this circumstance is not a recommended option due to weathering, drying, erosion and run-off. If possible micro-siting of the crane pad should be considered at the design stage to reduce excessive excavation and visual impact.



Careful micro-siting of crane pads will be required to minimise longer term impacts.

14 Habitat Restoration

14.1 Introduction

This section provides an overview of habitat restoration measures that may be required for wind farm developments including case studies and examples. Further guidance will be developed on this topic in the near future.

Management and restoration of habitats that may be impacted by a wind farm development is often required. This may be to prevent and/or minimise impacts on sensitive habitats (or species dependent on a certain habitat) during the construction and operational phases of the wind farm. Developers may also be required to implement restoration measures for certain habitats as compensation for damage, or to improve the overall carbon balance of the development.

14.2 Habitat Management Plans

Wind farm developers are often asked to complete Habitat Management Plans (HMP) to fulfil conditions as part of planning consent. The purpose of the plans is to ensure successful restoration of the site after construction and mitigate effects on ecology. Restoration during construction should be identified in a Construction Method Statement and will require due consideration throughout the construction process. Early consideration of the HMP at the preconstruction stage ensures that movements of materials are minimised (e.g. peat for drain blocking), saving money and ensuring successful restoration. In some cases it may be necessary to include land outside the site to enable long term management of the habitat.

14.3 Restoration of Peatland

If a wind farm is located on degraded peatland it is desirable to implement measures to restore the peat land for biodiversity and to improve both the overall carbon balance of the development and wider ecosystem benefits. This is often a requirement of planning consent and the details should be outlined in the HMP.

The aim of peatland restoration should be to restore the original function (e.g. habitat, carbon store and sequestration) of the peatland, in consultation with a specialist. This is often an approximation of the original condition with the primary aim to avoid the loss of soil carbon and to create the conditions for peat accumulation, for example via recolonisation of Sphagnum mosses. Consideration should be given to the need to modify current land management practices, such as grazing, to achieve restoration.

On operational windfarm sites in Scotland the periods of restoration have been too short to show successful restoration to a fully functional peatland. Restoration of a peatland can take from 5 to 30 years depending on the initial condition and primarily the effectiveness of raising the water table to or near to the surface. Long-term monitoring is essential to develop cost-effective techniques and methods that work to ensure successful restoration.

14.4 Use of excavated peat

Acceptable uses for excavated peat on a windfarm site are limited. Give careful consideration, during the Planning stage, to peat use and depths, as this should influence the final location of wind farm infrastructure and material final use solutions. Guidance on the use of excavated peat is provided below:

- Excavated peat (particularly peat turves) may be used for finishing track edges, turbine bases and other disturbance from infrastructure, where this is necessary.
- A *limited* amount of peat can be used to restore ditches, by completely infilling the

ditch. This process requires timely planning and organisation to ensure effective restoration (see below).

- Excess peat should not be used to create 'shoulders' on floating roads or for cut tracks, or spread on land adjacent to tracks (See Verge Reinstatement section in Chapter 10 Construction of Access Tracks).

14.5 Ditch blocking for peatland restoration

Excavated peat may be used to block drainage ditches as part of restoration proposals for blanket or raised bog. Existing guidance is available (see below) and should be followed. Any proposals to use excavated peat to block ditches should consider the hydrological and ecological conditions of the bog and be planned in advance of material being excavated. The difficulties of transporting material and access to ditches are also important considerations.

The aim of ditch blocking is to raise the water table and restore the appropriate conditions for blanket bog habitat. Generally, humified peat that is saturated (and impermeable) is most suitable for ditch blocking. Dry, unconsolidated peat and surface peat should not be used to block ditches. The suitability of the peat for the intended use should be carefully considered. Measures including plastic piling on steeper slopes or at the end of main ditches or heather brash to infill the ditch may also be required.

The main requirements for successful restoration are:

- A water table at or no less than 15cm from the surface for most of the year (required to support bog vegetation)
- Targeted drain blocking
- For afforested sites - remnant bog vegetation in forest rides, open areas, or adjacent unplanted bog left undisturbed as these act as a seed source.



Peat dam construction.



Blocked drainage ditch using plastic sheet dam.

14.6 Key issues to consider

(a) Creation of peat dams

In some cases it is more appropriate or cost effective to install peat dams rather than plastic piling.

Circumstance where it is beneficial or possible to use peat dams:

- **Shallow peat**

In some cases particularly on intermediate raised bog the peat thickness reduces to between 50 and 75 cm, often with a rock substrate below. Plastic piling will not provide a watertight seal in the rock substrate, so peat is often a more suitable alternative.



Peat dam blocking water flow in old forestry drainage ditch. The peat may slump and in time the dam becomes ineffective. In addition, to improve stability, peat turves should cover the top.



Good practice: Blocked drainage ditch (plastic sheet dam in centre of photo) with Sphagnum sp.

- **Extensive areas of peat**

Some sites have a high density of ditches (every 10 metres) often over large areas. Installation of plastic piling becomes logistically difficult and expensive.

- **Peat with a shallow slope**

Peat dams can only successfully be built on peat with a shallow slope. As the peat dam does not have a spillway, if the gradient is too steep the water flows cause erosion over the top of the dam resulting in failure. It is therefore advised that dams at the edges of raised bogs are of plastic construction.

b) Key considerations for ditch blocking using peat:

- **Availability of suitable machinery**

Low ground pressure excavators are generally based on peat extraction sites. Currently peat extraction is occurring in the Central Belt and in Aberdeenshire, but the machines can feasibly be moved up to 50 miles from base. In Caithness where large peatland projects have been undertaken contractors have purchased or adapted machinery to work on deeper peat.

- **Peat condition**

The peat used for damming must be saturated, as once peat has dried it shrinks and loses the ability to retain water and will not form a watertight dam. Therefore the original ditch spoil should not be used and only that taken from the bottom and wet sides of the ditch is suitable.



Dense layer of mulch spread across clear felled blanket bog. This is an example of poor practice - the chips should be smaller, the layer less dense and the water table closer to the surface.

To restore the original blanket bog habitat it is acceptable to mulch the trees that are not commercially viable following felling. The use of mulch or woodchips should be carefully considered during the Planning stage. Options for commercial use of the woodchips should be considered and is preferable to leaving on site particularly if there is likely to be a large quantity of material.

For certain sites it may be an option to spread a very thin layer of mulch/woodchips on the surface of bare peatland as part of restoration efforts. This must be included in peat restoration plans in the HMP. This is very site specific with hydrological conditions being the most important factor for successful restoration. The influence of mulch on blanket mire restoration is unclear, however, use of mulch is not essential for restoration and quicker restoration.

14.7 Case Study: Blawhorn Moss

The following example is taken from Blawhorn Moss. Whilst this isn't a wind farm site it demonstrates the level of restoration which can be achieved and the length of time (comparable to the expected life of most windfarms) which is required.

Blawhorn Moss is a National Nature Reserve in the Central belt of Scotland. It is easily accessible and is a demonstration for bog restoration and different types of ditch blocking. Please visit the Reserve Website for further information.

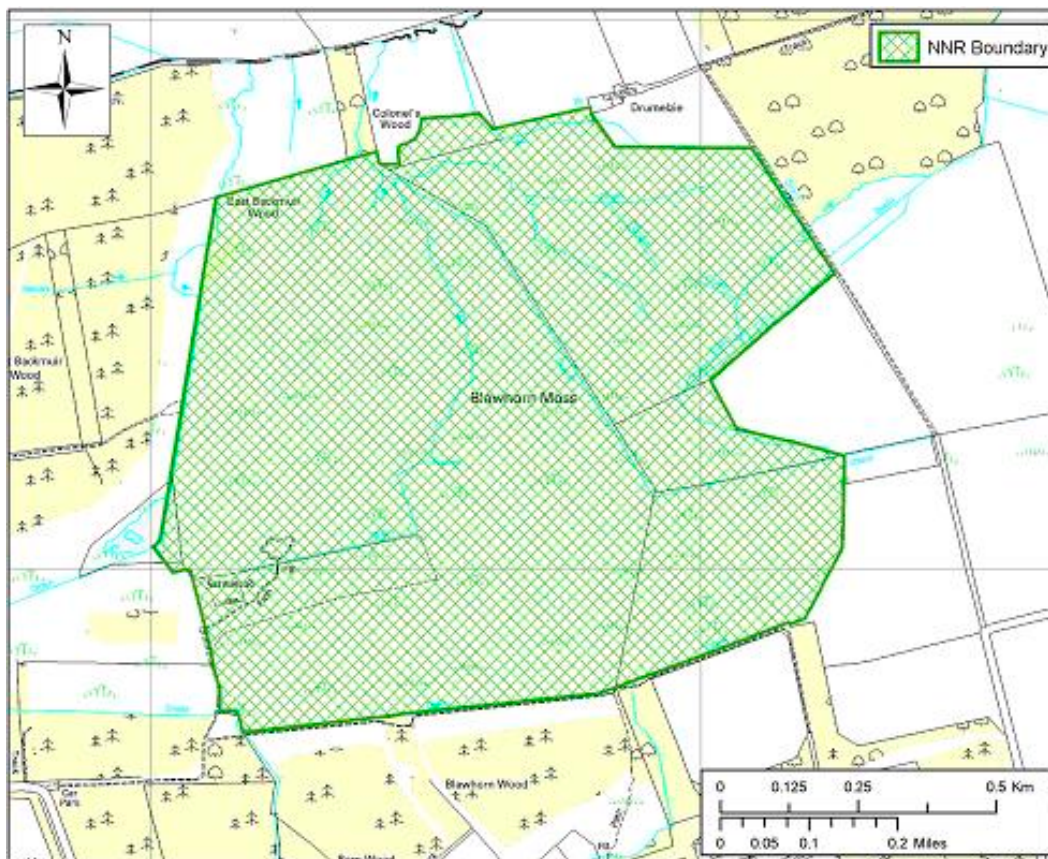
The main threat to the hydrology of the mire came from the continued erosion of the larger gullies and the lowering of the water table through the ditches.

The main thrust of management has been to try and block the extensive network of drains and reduce the impact of the gullies on the site, particularly the increased run-off and fragmentation of the bog edge. Over the years, different techniques for ditch blocking have been tried. These have included peat, plastic piling, heather bales, timber piles and steel piles.

The first trials for ditch blocking started in 1984, when two surface drains were in-filled with peat sods. The drains retained some water upslope but there was still considerable leakage.

A major programme of ditch blocking took place between 1987 and 1989. All of the small section drainage channels were blocked at 12-20 metre intervals and stepwise up the gradient along their length. One metre corrugated steel sheets, plastic coated on one side and painted on the other, were fitted into cut slots across the drains. Over 1000 small dams were installed, achieving almost total drain blockage with only three drains on the western boundary remaining unblocked. Six timber pile dams using elm beams at the southwest corner of the Moss in the over-deepened ditch. Following on from this trial, 61 timber dams were installed the next year on all the main erosion gullies, principally on the north side of the Moss.

The above programme worked reasonably well; all the small drainage channels are now water filled with new Sphagnum growth covering some of the sheet dams in



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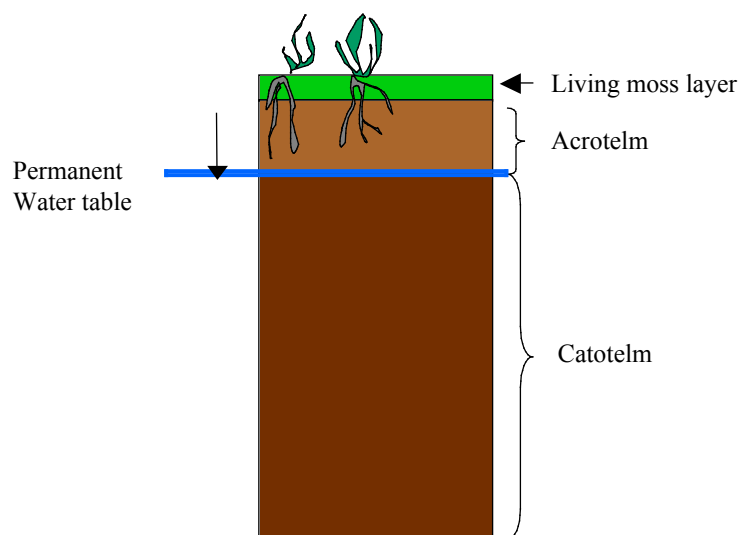
the wettest parts. The timber dams have proven effective at preventing ongoing gully erosion but are leaky so do not raise the water table fully.

In 2000, mowing and baling heather and rushes for use in ditch blocking was tried. The following year, over 400 mini bales were placed into ditches on two sections of the Moss near the central flush and northern edge of the Moss. The heather bales are effective at slowing down water movement and providing a framework for Sphagnum moss to grow.

The next phase of ditch blocking came in 2003, when 30 large (3.6m) plastic pile dams were built along the central ditch. These dams successfully hold water, with depths of 1.5 metres being maintained in the ditches throughout the year. In addition, water levels are raised in the adjacent ground, encouraging the growth of Sphagnum moss. More dams were installed on smaller ditches on the south side of the Moss. The dams were set at a height aimed at raising the water another 15cm above the existing dams. The most recent damming has involved the construction of large steel piling dams in the largest ditch. This and recent peat damming is seen as the final stage of damming on the site. The peat dams are being created in areas where the original dams were set too low and therefore the water levels were not at the surface.

14.7 Key Words

- **Acrotelm** – Upper layer of fibrous peat in which the water table naturally fluctuates. It is more permeable than the lower layer of peat (catotelm).
- **Catotelm** – The layer of peat below the acrotelm. It is permanently saturated, mostly impermeable, and is typically pseudofibrous and/or amorphous in texture.
- **Amorphous peat** – Highly humified (decomposed) peat with few visible plant remains. Typical of catotelm layer although conditions for decomposition/humification dependent on hydrology.
- **Fibrous peat** – Peat composed of densely packed but relatively intact (not decomposed) plant remains. Typical of acrotelm layer.
- **Sphagnum species** – species of moss that forms peat bogs.



14.8 References and links to guidance

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Good practice during windfarm construction

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