5 Construction and Decommissioning

Introduction

5.1 Impacts arising during the construction and decommissioning process are temporary, generally short-term and intermittent. Nevertheless, they can be sources of potentially significant effects on environmental resources and residential amenity, and can be an important factor in planning decisions. This chapter describes the proposed programme of site preparation, construction and decommissioning works for the proposed wind farm site and the key activities that will be undertaken during the works to inform the prediction of environment effects set out in the assessment chapters. This chapter also describes the management controls that will be implemented during the site preparation, construction and decommissioning phases to control potential environmental effects.

5.2 Construction effects are inherently difficult to predict with any certainty as they are dependent on the specific nature of construction activities, and vary depending on the stage of construction. Much depends on precisely what activities are taking place and at what locations. Prevailing weather conditions can also have a strong influence on the significance of effects arising.

5.3 Given these uncertainties, the approach taken in the EIA is to describe the principal activities that will occur during the construction phase, and demonstrate how environmental effects will be controlled/mitigated by the adoption of specific policies, procedures and controls contained within construction management plans and the Construction Method Statement (CMS), which will be prepared before the construction phase begins.

Construction Programme

5.4 The estimated duration of the construction of the proposed wind farm is 18 months. This period is somewhat weather dependant and could also be affected by ground conditions found at the proposed wind farm site.

5.5 The envisaged sequence of events for the construction programme will be:

- start forestry felling;
- start construction of access tracks, sufficient to facilitate removal of timber;
- upgrade the site entrance and any existing track to the position of the compound and construct the compound;
- construct the site access tracks with field gates and temporary fencing (where required) and excavate the foundations;
- construct the wind turbine foundations;
- construct the substation and install the grid connection;
- excavate the trenches and lay the power and instrumentation cables;
- undertake upgrading works along the abnormal loads delivery route;
- install temporary calibration masts;
- erect the turbines;
- commission the turbines; and
- carry out land reinstatement, remove temporary site office, reinstate temporary compound and clear the site.

5.6 The timing of commencement of construction of the project will be dependent upon:

- timing of the granting of planning permission and determining conditions, should the application be successful;
- ongoing farming activity; and
- weather, ground conditions and ecological factors.

Construction and Contracting Strategy

5.7 The civil and electrical sub contracts will be tendered to a number of pre qualified companies who meet with the stringent RES requirements for Sub Contractors based on performance, Health & Safety and environmental issues.

5.8 Local Sub Contractors will be encouraged to tender for contracts.

5.9 As required, for example during sensitive construction activities, these works will be overseen by an Ecological Clerk of Works (ECoW) to ensure that good practice measures are implemented on site.

5.10 An Archaeological Clerk of Works (ACoW) will be employed to oversee any works in sensitive areas.

Construction Employment

5.11 During construction, there will be a temporary workforce varying between 10 and 50 over a period of 18 months. The average number employed during this period will be approximately 30. As for all of RES's construction projects elsewhere in Scotland, local contractors will be used where possible.

Hours of Work

5.12 It is proposed that construction and civil works will be restricted in time to Monday to Saturday from 7.00am to 7.00pm. However, construction activities will be confined to the days of the week and hours of working agreed with DGC prior to the commencement of construction.

5.13 Any extensions to working hours will be agreed in advance with DGC.

5.14 During turbine erection, RES will request permission to work a 7 day week where required. Erection will span 6-10 weeks towards the end of the construction phase. The extended working week is likely to be required in order to make the best use of good weather as the turbine erection process is weather sensitive. Additionally, erection requires the hire of specialist lifting equipment and as such it makes economic sense to maximise the time-in-use. Experience has shown that the turbine supplier will aim to work through the hours of daylight in the summer and up to 12 hours in winter. Noise levels associated with turbine erection are minimal.

Construction Traffic and Plant

5.15 In addition to staff transport movements, construction traffic will consist of heavy goods vehicles (HGVs) and abnormal load deliveries.

5.16 Vehicle movements associated with the proposed wind farm are at their peak during the construction phase. Based on a worse case forecast, the total number of vehicle round trips during the construction period would be around 14,534 This number can be broken down to: staff vehicle numbers (4,680 private car, mini bus or 4x4 return trips); construction vehicles (up to 8,071 loads) and vehicles associated with the timber felling (1,783). A detailed assessment of the traffic impacts can be found in **Chapter 15: Access, Traffic and Transport.**

5.17 Approximately 120 abnormal load deliveries (turbine blades, tower sections, transformers etc) would be generated, which would, for logistical reasons, be spread throughout the turbine erection and commissioning phases (2 – 4 per day maximum). Turbine components will be supervised during their transportation using appropriate steerable, hydraulic and modular trailer equipment where this is required. Axle loads will be appropriate to the roads and access tracks to be used. The transportation of turbine components will be conducted in agreement with the roads authorities and local police. RES will notify the police of the movement of abnormal length (e.g. turbine blade delivery) and abnormal weight (e.g. crane) vehicles and obtain authorisation from Autolink Concessionaires plc (as representatives of the Scottish Government) and the roads authority prior to any abnormal vehicle movements.

5.18 Police escorts will be used, and the appropriate permits obtained, for the transportation of abnormal loads to ensure that other traffic is aware of the presence of large, slow moving vehicles. Where long vehicles would have to use the wrong side of the carriageway or need to swing into the path of oncoming vehicles, a lead warning vehicle will be used and escort vehicles will drive ahead and stop oncoming traffic. Vehicles will also be marked as long/abnormal loads. For return journeys, the extendible low loaders used for wind turbine delivery will be retracted to ensure they leave the proposed wind farm site with a trailer length of no more than 16 metres.

5.19 As described in **Chapter 4: Development Description** most construction traffic will enter the site through the north entrance coming off the B7068 near Callisterhall and abnormal loads will access the site through the southern entrance at Pingle Farm. Construction traffic will approach the site on the B7068 from either the east of west depending on the source location of the construction materials. Abnormal loads will be transported to the site via the A74(M), exiting at Junction 21 (Kirkpatrick). The route then follows the B6357 to the north-east, through Chapelknowe before turning left, to travel north past Tympanheck. The route continues north to Solwaybank then turns right and travels east to Pingle Farm where the site entrance is located.

5.20 A Traffic Management Plan outlining all the detailed access route information will be developed and agreed with DGC prior to the start of construction.

Timber Felling

5.21 To install and freely operate the wind turbines, the forestry surrounding 10 of the turbines will be felled. The area to be felled totals approximately 198 ha of mainly commercial coniferous forest.

5.22 Forest felling operations will take place over a period of approximately 12 months and will be tightly coordinated with the construction works to ensure traffic impacts are spread out and also that felling operations avoid particularly busy periods during the construction works, for health and safety management and traffic impact reasons.

5.23 Initial felling works will clear the forest along the path of the planned infrastructure to allow the access track construction and turbine location preparations to begin. Once these initial forest areas are cleared, the construction works can continue in parallel with the remaining felling activities.

5.24 Other than areas to be kept clear for the habitat improvements and for the site infrastructure, a programme of replanting will be undertaken throughout the site. It is expected that approximately 159 ha of forestry will be replanted. The replanting is not planned to take place until approximately 5 years after construction of the wind farm. More detail on the forest felling and replanting can be found in **Chapter 6: Forestry**.

Description of Construction Works

5.25 In this section, descriptions are given of the civil engineering elements, their design features and their construction processes. The descriptions cover access upgrades, on-site tracks, turbine foundations, and temporary features such as temporary calibration meteorological masts and the construction compound. The turbine assembly process is also described.

Main Road Access and Site Entrances

5.26 The existing entrance to Pingle Farm will be suitably widened to accommodate turbine delivery vehicles turning off the unclassified road. The existing forest entrance near Callisterhall will be improved to allow access by normal construction traffic. Figures 4.12a and 4.12b show the detail of the north and south entrances respectively.

5.27 Specific construction details at all locations would be agreed with the Local Roads Authority and Trunk Road Operator. However, there would be a preference to retain any upgrades for the life of the wind farm to allow access for maintenance purposes.

5.28 Some upgrading works will be required along the abnormal delivery route. This will include strengthening, realigning and widening. These works broadly comprise:

- A requirement for three over-run areas on the unclassified road between the junction of the B6357 east of Tympanheck and Cadgillhead, with associated general widening of the running surface to between 4.5 and 5 m
- General widening of the running surface to between 4.5 and 5 m from Cadgillhead to Solwaybank including an over-run area opposite the entrance to Solwaybank
- General widening of the running surface to between 4.5 and 5 m from Solwaybank to the abnormal load site entrance at Pingle Farm
- Associated diversion or relocation of utility services for the sections of general widening on the unclassified road from Tympanheck to the abnormal load site entrance at Pingle Farm
- Associated clearance of overhanging tree limbs to provide a 5 m x 5 m clear corridor for the sections of general widening on the unclassified road from Tympanheck to the abnormal load site entrance at Pingle Farm

On-Site Access Tracks - Design

5.29 On the proposed wind farm, the track layout has been optimised to reduce total track lengths, visual impact and environmental disturbance (in particular disturbance of blanket bog). Figure 4.1 shows the on-site track layout and Figure 4.6 shows cross-sections of typical track types. The overall length of the access tracks is approximately 10.4 km.

5.30 The tracks will permit access by construction vehicles and are also required throughout the life of the project for maintenance vehicles.

5.31 As explained in **Chapter 3: Site Selection, Design Evolution and Alternatives**, the final layout of the wind turbines and access tracks has been designed to avoid sensitive ecological and hydrological areas where possible. The movement of heavy construction vehicles on the site may cause some localised soil compaction, however, the effect of this is considered negligible since most construction work will be carried out from the site access tracks. Any off-track movements will occur in a very local context, thus any significant negative effects are considered unlikely.

5.32 Initial site investigations of the proposed wind farm site indicate that tracks could be founded at least 500 mm beneath the ground surface. Based on this, the more direct method of track construction (i.e. excavation) is likely to be possible over all of the proposed wind farm site. Should the more detailed ground investigations undertaken prior to construction reveal any softer ground conditions, tracks may also be of a 'floated' design. The detailed design of the access tracks and the selection of the method of construction will be finalised after the detailed site investigation prior to construction. Further details are also provided under the 'On-site Tracks Construction Method'.

5.33 The access tracks will have a running surface of 5 - 5.5 m, with local widening on bends, at passing places and around turbine bases. The tracks will have shoulders each side of approximately 1 m width in total. They will be constructed of crushed and graded stone giving a 'less-engineered' farm-track appearance. If the running surface is flush with or raised above the ground surface, the excavation could be deepened to improve visual characteristics. This could help reduce the thickness of the tracks since the suitability of the ground formation may improve with depth. RES will, where possible, use materials such as road stone and concrete from local quarries and suppliers to minimise transportation requirements. A stone thickness of approximately 250-1200 mm, dependant on construction method and ground conditions, will be used. The total volume of imported stone has been conservatively estimated to be just over 50,000 m^3. This has been considered in the vehicle movement calculations. Peat Slide, Erosion and Compaction

5.34 Although many, if not most, peat-lands are stable, some show clear evidence of past movement and activity. In carrying out engineering works in such environments there is the twofold aim of ensuring the future integrity of the works (in this case to safeguard an investment of in the region of £1million per MW of plant) and of avoiding upsetting the equilibrium of the peat mass and accelerating or triggering movement. Peat slide, rather than simply movement, has become a focus for concern due to the sudden nature of slide events and to the severity and acuteness of consequential effects such as sedimentation of adjacent watercourses.

5.35 In October 2003, a wind farm development on peat-land at Derrybrien in the Republic of Ireland triggered a major peat-slide in the Sliabh Aughty Hills with significant environmental consequences. This peat-slide event raised the profile of peat-slide as an issue and as such became a focus of consideration for all other wind farm projects on peat-land.

5.36 A site walkover survey and peat probing was undertaken to determine the baseline ground conditions at the Solwaybank site. This information was used as part of a qualitative risk assessment based approach to determine the baseline (pre-construction) level of risks of peat landslides occurring within the site.

5.37 Based on a review of the existing literature, it is evident, both internationally and in the UK, that the incidence of peat-slides appears exceedingly low and the effects rarely result in significant harm to people and property. Nevertheless, management of the risk of peat slides is now recognised in the literature and a range of measures, arising from the findings of the Derrybrien incident, have now become standard engineering practice for construction over peat. These will be adopted as appropriate on the proposed wind farm site, and include that the following:

- concentrated loads, such as those arising from stockpiling of material from turbine foundation excavations, will not be placed on marginally or potentially marginally stable ground;
- concentrated water flows arising from any aspect of construction or operation of the scheme will not be directed onto peat slopes and unstable excavations;
- construction will be supervised on a full time basis by engineers fully qualified and experienced in geotechnical matters;
- robust drainage plans will be developed;
- work practices will be reviewed, modified as necessary and adopted to ensure that existing stability is not compromised; and
- appropriate ground investigation and movement monitoring practices will be adopted.

5.38 The major contributory triggering cause of peat-slides is heavy rain. Almost invariably, peat-slide events are preceded by unusual weather conditions, typically characterised by a long dry summer that leads to desiccation cracking of the peat profile followed by a prolonged continuous rainfall including exceptionally heavy rainstorms.

5.39 The condition of the sliding surface at the base of the profile has a strong influence on potential mobility and depends on the regularity and smoothness or roughness of the underlying rock-head.

5.40 According to the Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments[1], peat slides tend to occur where the peat slab is less than 2 metres deep and where the slope is steeper, between 5 and 15 degrees.

5.41 Compared to other soils, peat has geotechnical characteristics which make construction challenging. For most soils, inherent strength (the ability to resist load) derives principally from inter-granular friction. A dry soil will exhibit load stiffening; as the load is applied, the granular structure will compact and the soil will deform less under additional loading. Much of the deformation will be plastic i.e. will not recover after removal of the load, so that once compacted, a high and consistent strength will subsequently be maintained. During compaction, the pores between grains close up.

5.42 For saturated soils, air (a compressible gas) in the pores is displaced by water (an incompressible liquid) and this changes the resistance characteristics under loading. Initially, loads will be reacted by a rise in the pore pressure, but under sustained loading, water will be ejected from the pores and load will be transferred to the soil structure.

5.43 Peat is no different from other soils in these regards but compared to other soils, peat has high compressibility, has a high ratio of saturated to dry density and has a granular (or rather fibrous) structure that behaves differently when wet than when dry. The specific gravity (i.e. density relative to water) of peat can vary from 0.4 when dry up to 1.1 when fully saturated and is typically 0.8 when moist.

5.44 Additionally, the open structure of peat and its typical high water content give rise to characteristics that can approach those of a liquid. This was realised in early railway construction in Scotland and northern England when it was appreciated that if the density of the railway bedding structure could be kept low by the use of light and open materials (such as heather) then it would 'float' upon the denser moist peat-lands.

5.45 Peat slides rarely affect people directly by causing injury or death. Of greater concern is potential damage to water bodies, watercourses and fisheries interests. Other impacts on the environment

[1] Scottish Executive (2006) *Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments*. Published by the Scottish Executive

include the loss of peat, discolouration of downstream watercourses by dissolved organic matter, loss of wildlife habitats, visual obtrusion on the local landscape, removal of vegetation cover and exposure of bare faces of peat to erosion.

5.46 Peat was found to be predominantly shallow or absent within most of the site. However, peat accumulations were found to the south of Gowdmuir, south-west and south of Collin Hags and around Allfornought Hill.

5.47 Peat probing in areas of shallow depressions between low rounded hillsides indicated that peat depths range between 0.5 m to 2.6 m, varying in depth according to local topographic conditions.

5.48 The peat at the site appeared severely degraded by grazing and burning as well as forestry and agricultural drainage schemes. Natural erosion of the peat gives rise to minor disruption of the ground surface in a few places and an old turbary[2] exists on the south facing slope of Leaheads Hill.

5.49 The site was divided into 42 terrain units of which 28 units were assessed further using a Qualitative Risk Assessment (QRA) to determine the baseline risks from peat landslide hazards. The 28 terrain units were selected due to the presence of wind farm infrastructure within these areas.

5.50 A Peat Landslide Hazard Risk Assessment was undertaken for the site. The results of this assessment categorised the baseline risk rating of the proposed site to be predominantly low. More detail can be found in **Appendix 12.1: Peat Landslide Hazard Risk Assessment**.

On-Site Tracks - Construction Method

5.51 In areas of peat and topsoil less than 1.5m thick, the vegetation and soil will be stripped to the subsoil. This forms a cut batter on either side. The cut batter will have an angle of 30 degrees or less, designed to hold turf cover following re-instatement. The track (300-500 mm thick) will be constructed on the subsoil. Approximately 100-150 mm of the upper topsoil layer, together with turfs, will be stored separately from the rest of the subsoil in piles adjacent to, or near the tracks for later reinstatement.

5.52 Once the soil has been removed, as described above, to a suitable founding layer, the track and running surface will be constructed by tipping and compacting imported stone to the required shape and thickness. Cross sections of the final track can be seen in Figure 4.6.

5.53 The development area slopes are generally in the range of 2 to 4 degrees (see Figure 5.3), however five turbines are on slopes of up to 6 degrees and some short sections of tracks will cross steeper slopes, particularly the section leading to the turbines from the southern and northern site entrances. These sections will be similar to that shown as 'excavated track – poor ground' in Figure 4.6 but with a ditch only on the up-slope side. The down-slope side will follow the existing slope rather than rising back up as shown in the cross section.

5.54 Initial studies suggest that all tracks will be excavated, however, if deeper peat over more extensive lengths is found during detailed site investigation works prior to construction commencing, 'floating roads' may be used in such locations. In this circumstance, a layer of geotextile reinforcement will be placed directly onto the route of the track. The track will then be built up on the geotextile by laying and compacting crushed rock up to a thickness of approximately 500-1000 mm, the exact depth being dependant on ground conditions (see Figure 4.6) which will be confirmed post-consent. The use of 'floating roads' in areas of deep peat eliminates the need for excavation, minimises effects on ecology and disruption to existing water paths, and allows for some filtration. However, should floating roads be used this will result in additional loads to the peat and consequently the stability of the peat deposits require to be verified through further assessments specific to areas prior to the adoption of solution.

5.55 The final appearance results from the reinstatement of the trackside slopes by replacing the layers of excavated material in the correct order. The track surface and ditches will be left clear. The final cross-section will be similar to those shown in Figure 4.6.

On-Site Tracks - Drainage

5.56 The tracks will be constructed with sufficient drainage channels to prevent erosion of the track structure. Water running down the channels will be intercepted and diverted onto the surrounding vegetation for the natural filtering of any silt that might be suspended. Positive drainage into existing streams will be avoided.

5.57 The access tracks will be designed to allow the efficient drainage of rain water. Where possible, tracks will be laid along contours thus interrupting natural run off and cutting field drains. When this occurs, field drains/streams will be piped directly under the track through appropriately sized drainage pipes. Where appropriate, a lateral drainage ditch will be cut along the uphill side of the track to intercept the natural run off. This lateral drain will be drained under the track at regular intervals through correctly sized cross drains. In these cases, the cross drainage pipes will outfall into a drainage ditch cut directly downhill at minimum slope until the bottom of the ditch reaches ground level. Water will then flow out of the end of the ditch onto the hillside, through a soak-away, so transferring the natural run off through the track.

5.58 Where appropriate, a second lateral drainage ditch on the other side of the track will catch runoff from the track itself. This lateral ditch will also outfall into the drainage ditches cut directly downhill from the cross drains. Any material washed off the track surface will be removed through natural filtration before reaching any watercourse.

5.59 In cases where the tracks must run significantly downhill, transverse drains will be constructed, where appropriate, in the surface of the tracks, to divert any runoff down the track into the drainage ditch.

5.60 Mitigation measures to minimise the hydrological effect of constructing the access tracks have been proposed in **Chapter 12: Geology, Hydrology and Hydrogeology**.

Watercourse Crossings

5.61 The design of the new watercourse crossings will be agreed with SEPA prior to construction and would be dealt with under the standard General Binding Rules of the Controlled Acoustic Regulations (CAR) 2005.

5.62 The infrastructure has been designed where necessary to avoid watercourses or to utilise existing crossings where possible. Watercourses and drains will be crossed by the placement of a suitable culvert to cope with storm water flows as shown in Figure 4.10. Where appropriate, culverts are designed with a dry culvert to ensure mammal movement is not restricted. The culvert will also be suitably bedded in to ensure the free movement of fish upstream. Details on specific ecology mitigation measures are included in **Chapter 9: Ecology**.

[2] A Turbary is an area of peatland from which fuel in the form of peat or turf is sourced.

5.63 Guidance on the sizing, design and construction of the crossings will be taken from the CIRIA Culvert design and operation guide (C689)[3]. The crossing shall be designed to ensure that they do not disconnect the watercourses at times of low flow, and willhave appropriate flood capacity.

Crane Hard-Standings

5.64 During the erection of the turbines, crane hard-standing areas are required at each turbine base. Typically, these consist of one main area of 30 m x 40 m adjacent to the turbine position, where the main turbine erection crane will be located. The other areas totalling 665 m^2 will be temporary and will be used during the assembly of the main crane jib and assembly of the rotor. Figure 4.4 shows the expected crane hard-standing layout including temporary areas. The hard-standing will be constructed using the same method as the excavated access tracks. This involves the topsoil being replaced with hardcore to ground level. The final position of the hard-standing would be decided at the time of construction based on a number of considerations including; size of crane required, depth of excavation required, hydrological/ ecological features in the vicinity, and local topography. Topography is important because it is preferable to position the crane hard-standing on the same level as, or higher level to, the turbine foundation level since this eases the lifting operations.

5.65 After construction operations are complete, the temporary areas will be reinstated. There will be a need to use cranes from time to time during the operational phase of the wind farm, so the main crane hard-standing 30 m x 40 m would be left uncovered for the lifetime of the wind farm to ease maintenance activities.

Foundations

5.66 It is anticipated that the foundations for the turbines will be of gravity base design. Excavation of the rock at each turbine location is likely to require tools mounted with rock picks together with hydraulic breaking equipment.

5.67 For a typical 2.0 – 2.5 MW machine, the foundation will characteristically comprise around 300 m^3 of concrete reinforced by 50 tonnes of steel bar, in a tapered octagonal block of approximately 16 – 20 m diameter and from 2-3.5 m depth, (see Figure 4.3). Each turbine base will require 50 concrete deliveries (based on 6 m^3 of concrete in a truck), which will be brought to the proposed wind farm site by local ready mix suppliers. Each base will be poured over the course of a day and generally one base will be poured per day.

5.68 The foundation surface lies up to 1 m below the normal ground surface and is back filled with soil and reinstated. The foundation plinth will protrude from the ground up to 1 m. Approximately 400 m^3 of material will be excavated for each turbine base. All of the rock and most of the excavated material is placed back on top of the foundations. Within these areas, any excess material will be laid around the turbine site, landscaped into the contours of the existing topography and re-seeded as required. Figure 4.3 illustrates foundation construction, albeit for somewhat smaller turbines.

5.69 The exact quantities of concrete, reinforcement, diameters and depths will vary depending on the actual make of turbine used. Different turbine foundations may also be considered for different turbine locations depending on the local ground conditions. In the development of the foundation, geo-technical tests are carried out to determine the strength of the soil layers beneath the turbines, and the soil behaviour under loading over time. This information is used to produce the foundation design into which is also incorporated factors of safety.

5.70 The code of practice for concrete design, BS EN206:1:2000 Concrete Part 1: Specification, performance, production and conformity and BS8500-1:2006 Concrete – Complementary British Standard to BS EN 206-1 Part 1: Method of specifying and guidance for the specifier, gives specification for the required resistance of concrete to sulphate attack. This ensures that when constructing in areas of acidic groundwater, the concrete mix is designed to withstand sulphate attack. It is therefore likely that the rate of alkaline leaching will be low, and will not be expected to have a significant effect on the local soil or groundwater conditions. The concrete used will be specified for Class 2 sulphate conditions in accordance with BS EN206:1:2000 and BS8500-1:2006, as this is appropriate for mildly acidic groundwater.

Wind Turbine Generators

5.71 Wind turbine towers, nacelles and turbine blades will be transported to the proposed wind farm site as abnormal loads. The tower sections and other turbine components will be stored at each turbine hardstanding until lifted into position.

5.72 The components are lifted by adequately sized cranes and constructed in modular fashion. Assembly generally requires only fixing of bolts, torquing of nuts and electrical and hydraulic connections.

Cabling, Substation and Control Building

5.73 The location of the substation and control building is shown on Figure 4.1. Layout and elevation drawings for these structures are presented in Figures 4.7 and 4.8 respectively. All cabling between the turbines and the substation on the proposed wind farm site will be laid in underground trenches, excavated by a mechanical digger. The top layer of soil is removed and used to reinstate the excavation, following the installation of the cables. Cabling will generally run parallel and adjacent to the site tracks.

Construction Compound and Other Temporary Works

5.74 Two temporary construction compounds of approximately 50 m x 60 m will be established in addition to a temporary gatehouse compound of approximately 20 m x 20 m and a temporary car parking area of approximately 30 m x 30 m. These compounds will contain:

- temporary 'Portacabin' type structures to be used for site offices, the monitoring of incoming vehicles and welfare facilities;
- toilet facilities with a packaged treatment system to be designed in liaison with SEPA;
- containerised storage areas for tools, small plant and parts;
- parking for cars/construction vehicles;
- a receiving area for incoming vehicles; and
- a bunded area for storage of fuels and greases.

5.75 Figure 5.1 shows a typical layout for the site construction compound, the exact layout may be different in practice.

5.76 It is currently proposed that a waterless wheel washing facility would be established to ensure vehicles entering the proposed wind farm site do not bring contamination onto site, in addition to ensuring they do not deposit material after leaving the site. The design of this facility would be

[3] Balkham, M. et al (2010) *Culvert design and operation guide*. Published by the Construction Industry Research and Information Association (CIRIA)

produced before site works commence, in conjunction with the landowner, SEPA and DGC. This facility would be located on the site access road, before the construction compound, so that only vehicles entering and leaving the site will pass over the wheel wash and not those operating on site every day.

5.77 The compound area will be constructed by topsoil excavation in a similar manner to the access tracks. Stone will be laid over a geotextile membrane which will provide a good structural base. Following construction of the wind farm, the temporary facilities will be removed and vegetation reinstated over the construction compound area.

5.78 As outlined earlier, prior to commissioning, there will be up to six guyed calibration metrological masts of up to 80 m metres height. These will be confined to the turbine locations plus three additional locations which will serve as reference points for turbine acceptance trials.

5.79 During construction, temporary fencing may be erected, as required, around the construction compound area, working areas, areas under restoration and, if necessary, areas identified as ecologically or archaeologically sensitive.

Reinstatement

5.80 A programme of reinstatement will be implemented upon completion of construction. This will relate to track shoulders, the construction compound, crane hard-standings and cable trenches.

5.81 In terms of site access tracks, after commissioning of the wind farm, the shoulders of the tracks will be graded with the excavated subsoil, and then top soil and the vegetated layer will be placed on top of this. The shoulders will be allowed to revegetate either by leaving the incorporated seed bank in the topsoil to regerminate or by application of the appropriate seed mixes. Any seed mixes will be agreed with the landowner and DGC. Reinstatement minimises the landscape impact of the tracks and allows development of a natural vegetation cover on the tracks using local plant material.

5.82 It is essential that the access track width is retained during the operation of the wind farm to allow occasional crane access if required, hence no works to reduce width post-turbine erection are proposed.

5.83 Following the completion of construction, the two temporary construction compounds will be revegetated. The temporary facilities will be removed and topsoil that will have been scraped off during the creation of the construction compound will be re-used for landscaping.

5.84 After construction operations are complete, all of the jib assembly hard-standings would be reinstated. There will be a need to use cranes from time to time during the operation phase of the project, so the main crane hard-standing would be left uncovered to ease maintenance activities. This area will be 40 x 30m at each turbine.

5.85 The turbine bases will be treated in a similar manner to the access tracks after turbine construction is completed. The topsoil and subsoil from each base will be stored separately and once construction of each foundation is complete, soil will be replaced in the correct sequence and the seed bank in the topsoil allowed to germinate or appropriate seed mixes applied. A path approximately 1.5 m in width will remain around the turbine base for the duration of the project lifetime.

5.86 Cable trenches will be similarly reinstated. Where practicable, vegetation over the width of the cable trenches will be lifted as turfs, and replaced after trenching operations, to reduce disturbance.

Description of Decommissioning Works

5.87 The expected operational life of the wind farm is 25 years from the date of commissioning. At the end of this period, a decision would be made as to whether to refurbish, remove, or replace the turbines. If refurbishment or replacement were to be chosen, relevant planning applications would be made. If a decision were to be taken to decommission the wind farm, this would entail the removal of all the turbine components, transformers, the substation and associated buildings. Cables would be cut away below ground level and sealed. Some of the access tracks could be left on site to ensure the continued benefit of improved site access for the landowner or they could be reinstated. It is not currently good practice to remove the concrete turbine foundations from the site as this would cause more land damage than leaving them in situ. It is anticipated that the exposed concrete plinth would be removed to a depth of approximately 1 m below the surface and the entire foundation would be graded over with soil replanted. This follows advice given in the Scottish Government's web based renewable advice4 (which replaced PAN 45) which advises "turbine bases tend to be left 'in-situ' to avoid damage taking place through removal".

5.88 In alkaline or neutral pH ground water conditions, no chemical degradation of the concrete foundation would take place. The concrete mass would remain intact and have no effect on the local soil or groundwater. In soft, acidic groundwater conditions (low dissolved calcium content, and high dissolved carbon dioxide content), where the water table is in contact with the concrete mass e.g. peat or marshland, sulphate attack of the concrete would tend to take place. This may cause alkali to leach into the ground water in contact with the concrete. If this effect occurs, it would be highly localised around the foundations.

5.89 However, as discussed in the foundation construction section above the concrete mix for the turbine foundations would be designed to withstand sulphate attack and it is therefore likely that the rate of alkali leaching would be low, and would not be expected to have a significant effect on the local soil or groundwater conditions. Significant chemical effects of leaving concrete foundations in the ground after decommissioning at the end of the wind farm's working life are therefore not considered likely.

5.90 If the proposed wind farm obtains planning permission, it is expected that an agreement will be put in place to allow for the establishment of a decommissioning bond or fund to be set aside for when the wind farm is decommissioned after its operational life. Prior to decommissioning of the proposed wind farm site, a method statement would be prepared and agreed with DGC.

5.91 Unlike most other forms of energy production, wind farms enjoy particular ease of decommissioning. Plant can readily be dismantled and removed from the site. Site restoration is relatively straightforward and after restoration, there would be no significant visible trace of prior existence, and no legacy of pollution.

Construction and Decommissioning Management

5.92 This section details the environmental management controls that will be implemented by RES and its contractors during the construction of the proposed development to ensure that potential significant adverse effects on the environment are, wherever practicable, prevented, reduced and where possible offset.

4 http://www.scotland.gov.uk/Topics/Built-Environment/planning/National-Planning-Policy/themes/renewables

5.93 It will be a contractual requirement that the appointed construction contractor complies with the Construction Method Statement (CMS) which will be agreed at the detailed design stage in consultation with DGC, SNH and SEPA. The purpose of the CMS is to:

- Provide a mechanism for ensuring that measures to prevent, reduce and where possible offset potentially adverse environmental impacts identified in the ES are implemented;
- Ensure that good construction practices are adopted and maintained throughout the construction of the proposed wind farm;
- Provide a framework for mitigating unexpected effects during construction;
- Provide assurance to third parties that their requirements with respect to environmental performance will be met;
- Provide a mechanism for ensuring compliance with environmental legislation and statutory consents; and
- Provide a framework against which to monitor and audit environmental performance.

Pollution Prevention, Water Quality Monitoring and Emergency Response Plan

5.94 The CMS will detail a number of measures to deal with pollution prevention, including:

- The sustainable drainage (SUDS) design philosophy,
- Water quality monitoring procedures,
- Contaminant spill procedures,
- Environmental requirements for contractors.

5.95 SEPA has produced Pollution Prevention Guidelines 5 for Works in, near or Liable to Affect Watercourses and 6 for Working at Construction and Demolition Sites for civil engineering contractors. The proposed wind farm will be constructed using best practice in conformance with these requirements.

5.96 Contractors and sub-contractors shall be required to follow Pollution Prevention Guidance published by SEPA, and the following pollution control measures will be explicitly incorporated into the CMS:

- Equipment shall be provided to contain and clean up any spills in order to minimise the risk of pollutants entering watercourses, lakes or flush areas.
- Trenching or excavation activities in open land shall be restricted during periods of intense rainfall, and temporary bunding shall be provided as required to reduce the risk of oil or chemical spills to the natural drainage system.
- Sulphate-resistant concrete (as detailed in BS EN206:1:2000 Concrete Part 1: Specification, performance, production and conformity and BS8500-1:2006 Concrete – Complementary British Standard to BS EN 206-1 Part 1: Method of specifying and guidance for the specifier) shall be used for the construction of turbine bases to withstand sulphate attack and minimise the resultant alkaline leaching into groundwater.
- Refuelling of vehicles and plant shall be confined to the construction compound and shall be carefully controlled.
- Equipment, materials and chemicals shall not be stored within or near watercourses. At storage sites, fuels, lubricants and chemicals shall be contained within an area bunded to 110 %. All filling points shall be within the bund or have secondary containment. Associated pipework shall be located above ground and protected from accidental damage.
- Concrete is expected to be brought onto site ready mixed, and any onsite washout shall occur in bunded areas.
- Drip trays shall be placed under standing machinery.
- All solid and liquid waste materials shall be properly disposed of to controlled landfill sites away from the site.
- Routine maintenance of vehicles shall be carried out off site.
- There shall be no unapproved discharge of foul or contaminated drainage from the proposed wind farm site either to groundwater or any surface waters, whether direct or via soakaway.
- Sanitary facilities shall be provided and methods of disposal of all waste shall be approved by SEPA.
- A programme of surface water quality monitoring shall be undertaken during the construction phase to provide assurance as to the absence of water quality impacts
- RES has a policy that no wind turbines, auxiliary and electrical equipment would contain askarels or PCBs.

5.97 In the unlikely event of an environmental pollution incident, there will be an emergency response procedure in place to manage and minimise the impacts. For example, this would cover the use of spill kits to contain the material and emergency contacts including responsible site personnel and SEPA officers.

General Drainage Design

5.98 A minimum buffer distance of 70 m between the watercourses on the proposed wind farm site and the wind farm infrastructure has been adopted. No development should occur within this buffer, with the exception of watercourse crossings.

5.99 Correct design of the site drainage is an important element in minimising erosion and the potential for pollution of the watercourses draining the site. The potential effect of preferential routing of drainage, and associated erosion and sediment wash-off within the sub-catchments draining the site will be mitigated through the following measures, which will be incorporated into the CMS:

- If utilised, construction of the floating tracks shall allow for continued drainage across the track, either through constructing the sub-base with coarse granular material or by constructing sub-surface drains through the peat at regular points along the length of the track.
- Site track construction materials shall be free draining, strong, durable and well graded.
- Settlement/attenuation ponds and silt fences shall be provided adjacent to the drains to avoid pollution and sedimentation of watercourses.
- Direct drainage into existing watercourses shall also be avoided to ensure that sediment and runoff from disturbed ground is not routed directly to the watercourses.
- Existing drains shall be piped directly under the track through appropriately sized drainage pipes or culverts. Appropriate scour prevention and energy dissipation structures shall be constructed at each culvert outlet. Where appropriate, a shallow, lateral drainage swale shall be installed at the toe of site track cuttings to intercept the natural run off. This lateral drain shall be piped under the track at regular intervals through correctly sized cross drains away from watercourses. Again, appropriate scour prevention and energy dissipation structures shall be constructed at each culvert outlet.
- Flow and sediment transport in any track drainage swales shall be minimised by reducing concentrated flows, installing regular cross culverts and the use of checkdams placed at regular intervals within the roadside drainage swales.
- Track drainage swales, where required, shall discharge into sediment/attenuation ponds excavated on the downslope side or silt fences. A shallow drainage swale shall be cut directly downhill as a fan, and at minimum slope until the bottom of the swale reaches the natural

surface level. The discharge point of track drains shall be constructed to minimise concentrated flows and ensure flows are dispersed over a large area with appropriate surface protection.

- The depth of individual drainage swales shall be kept to the minimum necessary to allow free drainage of the tracks, and swale lengths shall be minimised to avoid disruption of natural drainage paths. Direct drainage into existing watercourses shall also be avoided to ensure that sediment and runoff from disturbed ground is not routed directly to the watercourses.
- Clay plugs shall be inserted within cable trenches at a frequency agreed with an Ecological Clerk of Works to suit the specific location to prevent gullying of trenches and preferential routeing.

Runoff and Sediment Control Measures

5.100 The following measures would be used to mitigate any potential effects on water quality through peat erosion, stream acidification, and metals leaching during construction.

- Appropriate sediment control measures (silt fences, settlement/attenuation ponds etc.) shall be used in the vicinity of watercourses, springs or drains where natural features (e.g. hollows) do not provide adequate protection.
- Sediment control measures (e.g. checkdams, silt fences etc.) shall be employed within the existing artificial drainage network during construction. These would be regularly checked and maintained during construction and for an appropriate period following completion. Consideration shall be given to the permanent infilling of any major drains.
- Watercourses shall be monitored throughout the construction period by the Ecological Clerk of Works to identify any enhanced scouring of the catchment surface. If sediment from disturbed ground is excessively mobilised through the minor channels network these shall be mitigated by temporary sediment control measures (e.g. geotextiles/straw bales/brash).
- The extent of all excavations shall be kept to a minimum and during construction activities surface water flows shall be captured through a series of cutoff drains to prevent water entering excavations or eroding exposed surfaces. If dewatering of excavations is required, pumped discharges shall be passed through settlement/attenuation ponds and silt fences to capture sediments before release to the surrounding land.
- Where practicable, vegetation over the width of the cable trenches shall be lifted as turfs, and replaced after trenching operations, to reduce disturbance.
- The movement of construction traffic shall be controlled to minimise soil compaction and disturbance. Vehicle movements outside the defined tracks and hardstanding areas shall be avoided.
- Trenching or excavation activities in open land shall be restricted during periods of intense rainfall, and temporary bunding shall be provided as required to reduce the risk of sediment transport to the natural drainage system.
- Construction of the track and cable watercourse crossings shall take place within dry conditions. If required, upstream of the crossing shall be dammed, and water shall be pumped around the construction zone. The construction period shall be minimised as much as is practicable.
- Stored excavated materials shall be placed so as to minimise the potential for erosion.

Health and Safety Management

5.101 All Sub Contractors will be pre qualified before tender and their Health and Safety records vigorously reviewed. All Sub Contractors will be required to adhere to RES Health and Safety Requirements for Sub Contractors.

Site Waste Management Plan

5.102 A Site Waste Management Plan will be prepared and implemented for the construction, operation and decommissioning phases, and RES site staff shall ensure that all Sub Contractors adhere to this plan.

5.103 The anticipated waste streams from the proposed wind farm are as follows:

- Waste from welfare facilities, e.g. food, paper, glass and other typically domestic refuse;
- Concrete washout water;
- Waste fuels and oils;
- Waste metals; and
- Packaging and miscellaneous wastes.

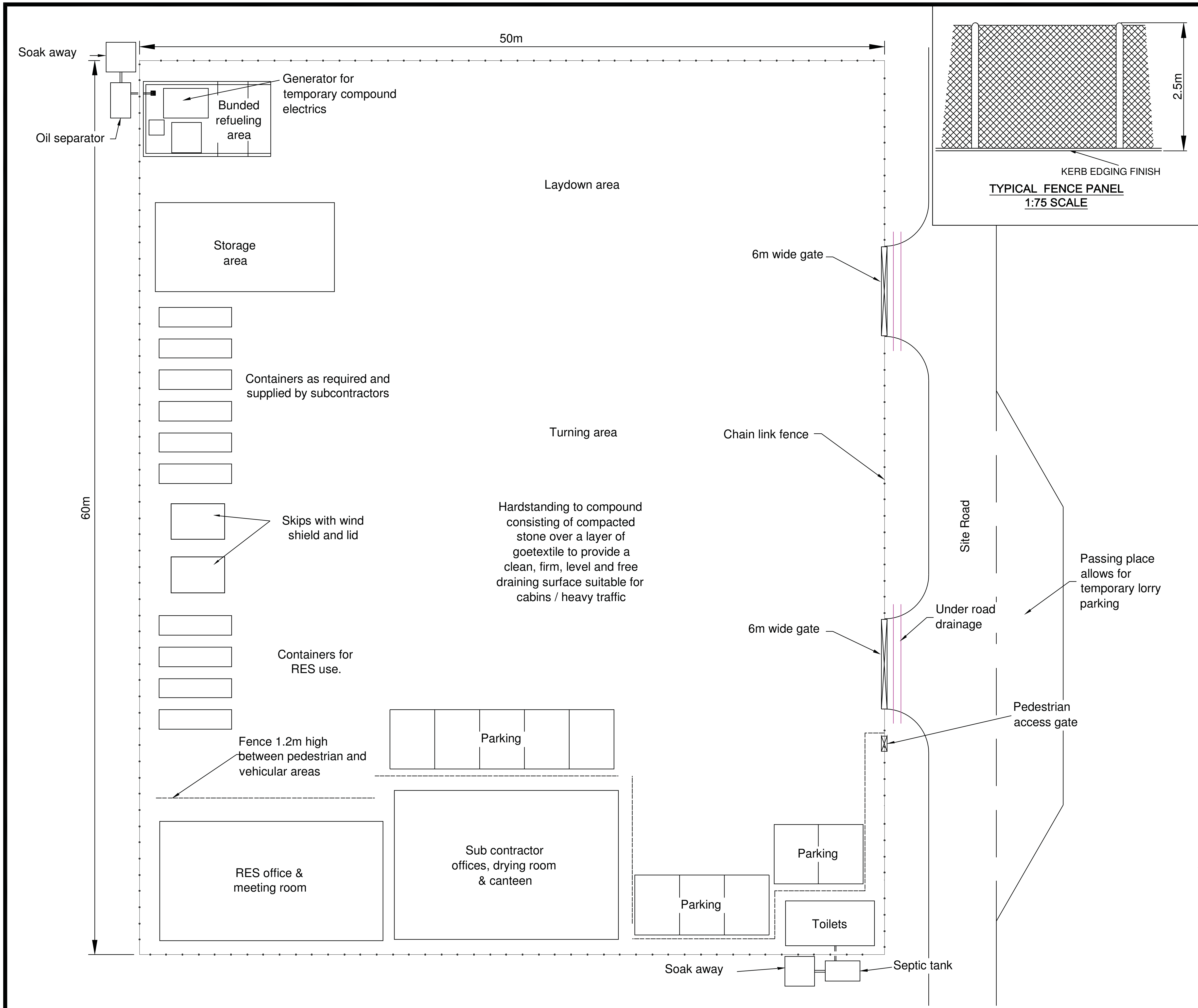
5.104 Dedicated storage areas and facilities to segregate waste streams will be provided on-site. A concrete washout facility will be provided adjacent to the temporary construction compound. The Site Waste Management Plan will be further developed in conjunction with the ultimate Contractor.

Ecological Management Plan

5.105 A Habitat Management Plan (HMP) will detail measures required to protect and enhance ecology at the proposed wind farm site, including pre-construction surveys, vegetation management and biodiversity enhancement. Refer to **Chapter 9: Ecology** for details.

Protection of Archaeology and Cultural Heritage

5.106 A Written Scheme of Works will be prepared prior to the commencement of works and the Sub Contractors shall ensure that their plant and employees do not disturb any known archaeological features. Written guidelines will be issued for use by all construction contractors, containing arrangements for calling upon retained professional support in the event that buried remains of potential archaeological interest should be discovered.



SOLWAYBANK WIND FARM

FIGURE 5.1

TYPICAL CONSTRUCTION COMPOUND LAYOUT

NOTES

NUMBER AND LOCATION OF COMPOUND EQUIPMENT AND FACILITIES ARE INDICATIVE ONLY

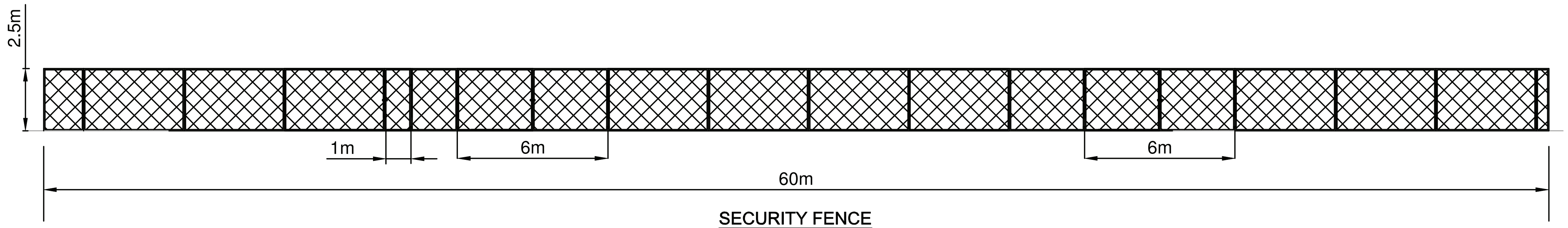
STRUCTURE TO BE TEMPORARY AND TO BE REMOVED AFTER CONSTRUCTION.

LAYOUT DWG N/A	T-LAYOUT NO. N/A
DRAWING NUMBER 01307D2208-07	
SCALE - NOT TO SCALE	
ENVIRONMENTAL STATEMENT 2011	

SOLWAYBANK
WIND FARM

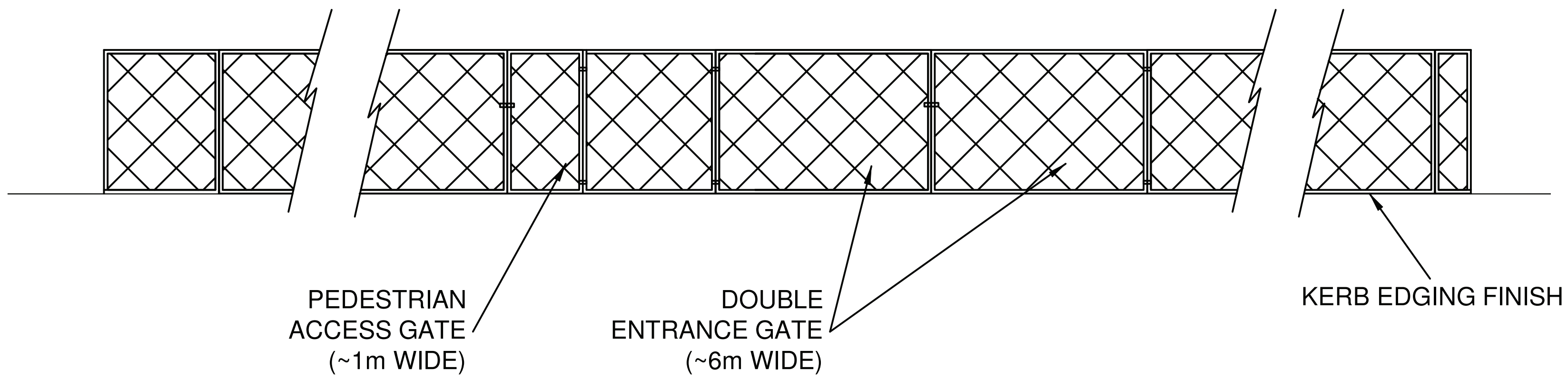
FIGURE 5.2

TEMPORARY CONSTRUCTION
COMPOUND ELEVATION



SECURITY FENCE
ELEVATION

SCALE : 1:200@A3



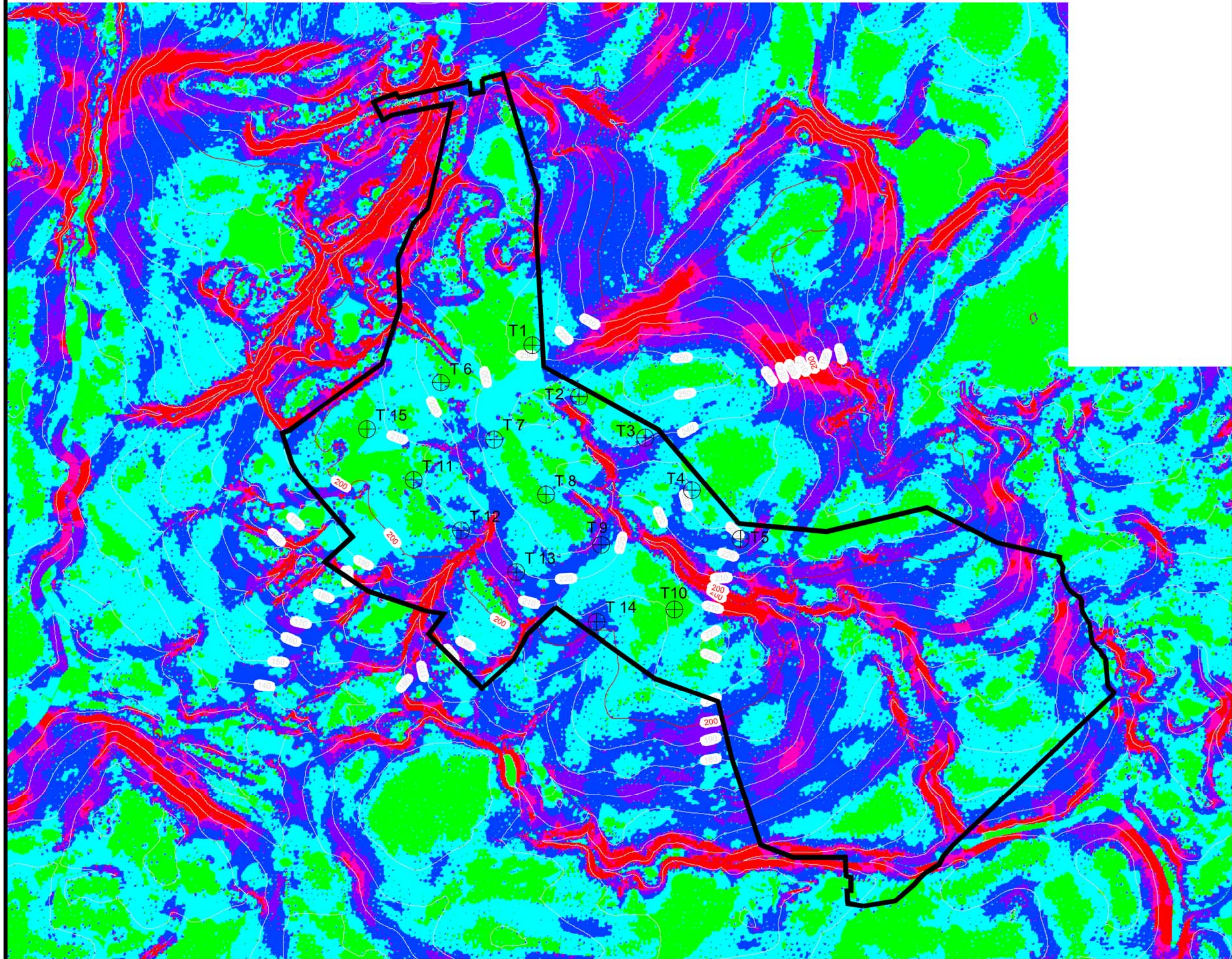
SCALE 1:100 @ A3

LAYOUT DWG N/A	T-LAYOUT NO. N/A

DRAWING NUMBER 01307D2313-01

SCALE - AS SHOWN @ A3

ENVIRONMENTAL STATEMENT
2011



SOLWAYBANK WIND FARM

FIGURE 5.3

SLOPE MAP

DATA TAKEN FROM NEXT MAP BRITAIN 5m DTM

KEY

TURBINE LOCATION

SITE BOUNDARY

SLOPES TABLE

MINIMUM SLOPE	MAXIMUM SLOPE	COLOUR
0°	2° (3.5%)	
2° (3.5%)	4° (7%)	
4° (7%)	6° (10%)	
6° (10%)	8° (14%)	
8° (14%)	10° (17%)	
10° (17%)+		

LAYOUT DWG 01307D0007-09 | T-LAYOUT NO. PSCOswb051

DRAWING NUMBER **01307D2228-04**

SCALE - 1:20,000 @ A3

ENVIRONMENTAL STATEMENT 2011