5 PROJECT DESCRIPTION

5.1 Introduction

5.1.1 The planning application comprises:

- Three wind turbines, approximately 150m tip height, with a combined installed capacity of up to approximately 15MW, each with external transformers, foundations, crane hardstandings and storage areas
- Ground mounted solar photovoltaic panels with an installed capacity of approximately 5MW
- Electrical substation and control building
- Access tracks
- Underground power cables to link the turbines and solar array to the Distribution Network Operator (DNO) substation and a private wire connection to Convatec's manufacturing facility
- Temporary construction and storage compounds

5.1.2 The following sections describe the design elements of the Project. Where appropriate, approximate dimensions have been provided to assist in the assessment of the significance of effects, the methodology of which is set out in the relevant chapters.

5.1.3 The detailed construction programme and methods would be developed by the contractor appointed to design and construct the works however an indicative construction programme is provided for information purposes. The contract would require certain essential design parameters fixed by the planning consent to be adhered to, but there may be a degree of flexibility to some elements of the work to permit the development of innovative, environmental best fit and best value solutions for design and construction by the contractor, provided this can be achieved within the confines of the consent as granted.

5.1.4 A plan showing the layout of the windfarm, solar panels and other components of the Proposed Development is shown in Drawing BR10167-01RevD (Volume 2). This layout may be subject to minor micro-siting variations which have been included within the redline development boundary (i.e. up to 70m per turbine and 5m for tracks). This is expected to be secured by an appropriately worded planning condition, to ensure that the turbines are not sited beyond the relevant micro-siting allowance.

5.2 Development Layout

5.2.1 Figure 5.1 outlines the proposed development boundary in red with the wider option area marked in blue. The turbine locations are represented by the three red points adjacent to the grey crane-pads, and the solar PV arrays are shaded blue, surrounded by a fence marked green. Elements of potential offsite development are currently outlined in brown. These areas would potentially require minor modification for site access or to facilitate cable runs to Convatec.

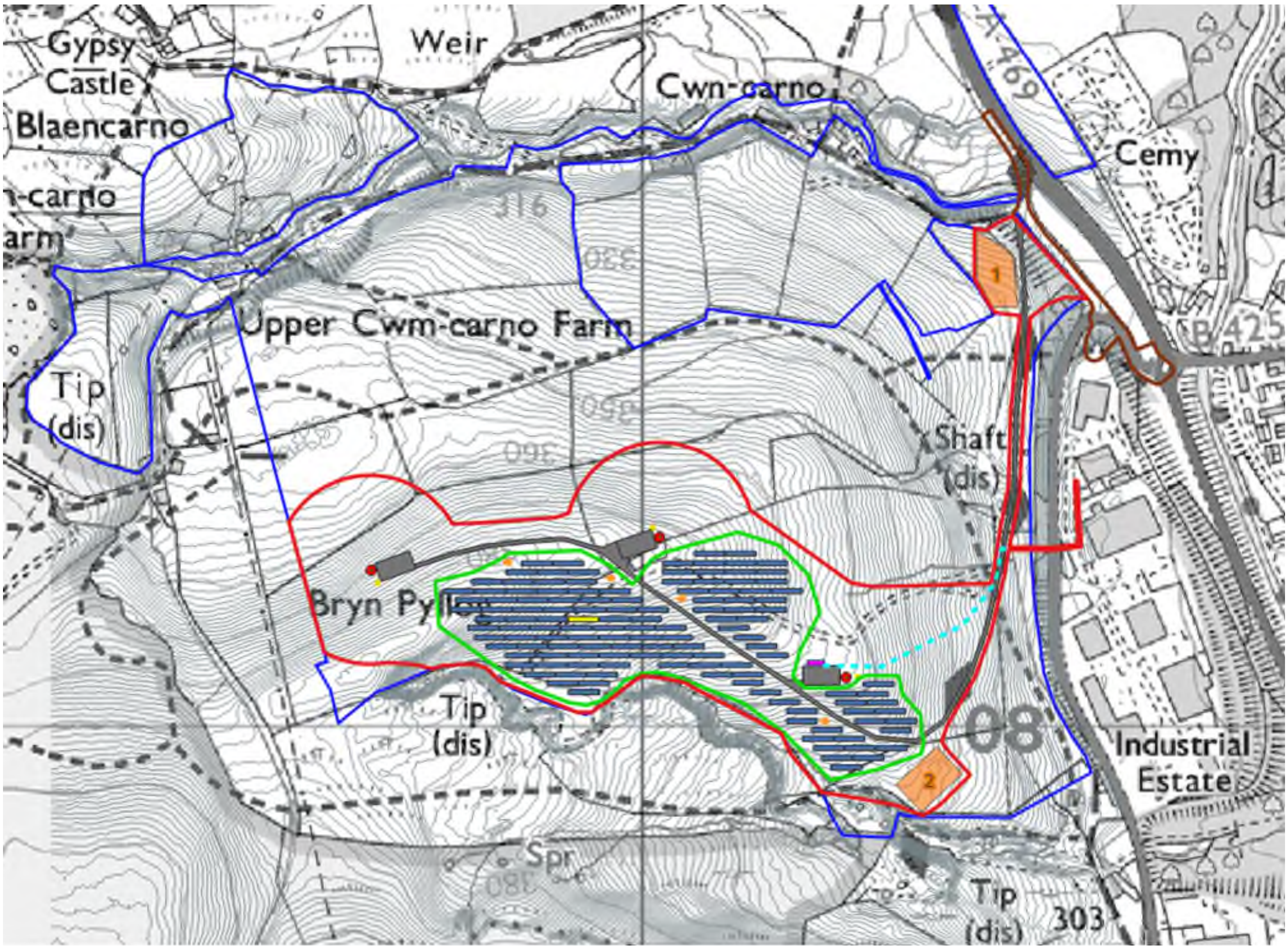

Figure 5.1: Proposed Site Layout

5.2.2 The proposed wind turbines would be located at the grid co-ordinates listed in Table 5.1, subject to a micro-siting allowance of 70m per wind turbine. The redline development boundary has been adjusted to incorporate this allowance except where environmental constraints indicate it would not be possible to accommodate the wind turbine. In such situations the redline boundary has been extended for micro-siting purposes only as far as the environmental constraints allow.

Table 5.1: Turbine Locations

Turbine	Easting	Northing
T1	310,265	208,115
T2	309,990	208,323
T3	309,576	208,320

Figure 5.2: Illustrative Image of a Wind Turbine of the Type Likely to be Installed[1]

5.2.3 Figure 5.2, above, shows a representative image of an E138 turbine. It should be noted, it displays the colour patterns used for the European market – the UK version of the turbine will not have the red blade tip or tower markings.

[1] Note: This picture is copyrighted material. The right of use is restricted to a one-time publication, exclusively for the purpose agreed upon. All further publications as well as the distribution of the pictures, also in extracts, demand an explicit written agreement by ENERCON GmbH.

5.2.4 Drawing BR10167–108 (Volume 2) shows an elevation plan of a candidate turbine illustrating the maximum height dimension applicable for the three turbines, along with the proportions of the example E138 candidate turbine. Although the 150m turbine tip height should be considered to be an upper envelope for the proposed turbines, the other dimensions may vary in the event that an alternative model is selected for installation. The candidate turbine is representative of the likely proportions that would be suitable though. Further detail of this design is provided in Appendix 5.1.

5.2.5 Further detail relating to the transport and delivery arrangements for the wind turbines is given in Chapter 14.

5.2.6 The solar PV panels would be located to the south of the proposed wind turbines, orientated in an east-west direction. They would be tilted southwards at an angle of approximately 15 degrees. The panels would be fixed to metal framing with the lower edge of the panels raised approximately 0.7 m above ground level (agl), and the higher edge up to 2.5m agl. The frame would be attached to legs piled up to 1.8m into the ground. A drawing showing the expected mounting arrangement is included in Drawing BR1067-113 (Volume 2).

Figure 5.3: Solar PV Mounting Arrangement

5.2.7 Once operational, the three wind turbines, which are expected to be rated at up to 5MW each, would generate a considerable amount of renewable energy per year. Based on an assumed total installed capacity for the site of 15 MW, it is estimated that approximately 28,000MWh of electricity could be generated per year from the wind alone.

5.2.8 The solar PV installation is expected to be around c.5MW. Based on this figure it is expected to generate around 5,000 MWh/year.

5.2.9 The combined energy generation for Solar PV and wind (33,000MWh) is equivalent to the amount of energy used annually by approximately 10,187 average UK households per year[2] (or 11,890 homes based on typical usage in Caerphilly), based on average local consumption figures, and would avoid 6,833 tonnes of $C0_2$ equivalent emissions per year (based on the current grid intensity figures from DESNZ[3]).

5.2.10 The project presented in this chapter is the mitigated proposal that is the result of the EIA process presented in this document. It should be acknowledged that there are a few elements of the design that have yet to be finalised. These include detailed foundation design which will be refined following further site investigation undertaken to determine the presence of any historic mine workings once consent has been granted. The final design and approval of these will need to be conditioned. Dialogue is ongoing with the Cardiff airport regarding any potential effects on its radars as a result of the development. Again, this design aspect is considered to be appropriate for a suitable condition.

5.2.11 Detail of the design iterations and mitigation that have led to the final design presented here are detailed below and in the individual technical chapters that follow. The evolution of this design and a mitigation summary are presented in Chapter 6.

5.2.12 The total area of land within the redline development boundary including all infrastructure, micro-siting allowances and onsite tracks is 25.98ha. Including offsite enabling works as well adds a further 1.89ha, with the total area increasing to 27.87ha.

5.3 General Site Conditions

5.3.1 The site is located to the west of Rhymney, in Caerphilly, South Wales at the head of the Rhymney River valley on land east of Gelli-Gaer Common and northeast of Bryn Pyllog Tips. Please refer to Site Location Plan for further detail.

5.3.2 The Site is broadly bound by the Nant Carno stream, local roads with scattered properties and further improved grassland to the north. The site is adjacent to the Heads of the Valley Industrial Estate, where Convatec UK has a major manufacturing facility, and the A469 to the east. There are further unimproved grassland and disused

[2] Dept for Energy Security & Net Zero, "*Subnational electricity consumption, Great Britain, 2022*", 25 Jan 2024,
Mean consumption (kWh per meter) All Domestic 3,239.5kWh (GB average)
Mean consumption (kWh per meter) All Domestic 2,775.3kWh (Caerphilly average)
https://www.gov.uk/government/statistics/regional-and-local-authority-electricity-consumption-statistics

[3] Dept for Energy Security & Net Zero, "*UK Government GHG Conversion Factors for Company Reporting*", 28 Jun 2023
2023 Grid emissions factor for electricity generated (per kWh): 0.207074kgCO2e
https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2023

tips to the south and an un-named local road, unimproved grassland and disused tips to the west.

5.3.3 The A465 'Heads of the Valleys' Road is located c. 200m to the north of the Site. The Biffa Trecatti Landfill site and opencast workings are located c. 800m and c. 1.4km to the south-west, respectively. An overhead line and pylons pass through the western parts of the site on a broadly south-west to north-east direction.

5.3.4 The nearest bodies of standing water are c. 100m to the north and c. 600m to the south.

5.3.5 The town of Rhymney lies c. 625m to the east of the nearest proposed wind turbine, on the opposite side of the A469. The town of Merthyr Tydfil is located c. 1.86km to the west, and the village of Fochriw is located c. 1.96km to the south.

5.3.6 There are several existing wind turbines within the area, the nearest being three 110m tip high wind turbines at Pen Bryn Oer 1.6km to the east, several 77m tip high turbines at Pengarnddu Industrial Estate c.2.1km to the north-west, and a single 74m tip high wind turbine at Tafarnaubach Industrial Estate, Tredegar 2.4km to the north-east.

5.3.7 There is one existing solar farm within the area, c. 2.4km to the south-west.

5.3.8 The site is within National Landscape Character Area (NLCA) 37: South Wales Valleys.

5.3.9 This NLCA is described as:

"Many deep, urbanised valleys dissect an extensive upland area. Combined with industrial heritage and the distinct identity of its people, the South Wales Valleys provide some of Wales' most widely known and iconic national images. Extensive ribbon development fills many valley bottoms and lower slopes. Their urban and industrial character is juxtaposed with dramatic upland settings with steep hillsides, open moors or forests. Networks of railways and roads connect valley settlements. Topography constrains passage between valleys, and there are only a limited number of high passes between valleys. The noise and business of many valleys contrast with the relatively remote and wild qualities of adjacent hill plateaux".

5.3.10 Rhymney is built around a rich heritage of heavy industry and mining, with the establishment of the Union Ironworks in 1801 using local coking coal, iron ore and limestone. From the mid-19th century, steam coal pits were sunk to the south of the town.

5.3.11 There are several recreational routes within the site and surrounding area. Footpath RHYM/FP96/1, RHYM/FP95/5 and RHYM/FP91/1 are the main footpaths that pass through the site in a broadly east to west direction. There are a number of other Public Rights of Way (ProW) within the 45km study area, forming a comprehensive network of public access throughout the Heads of the Valley Area.

5.3.12 The nearest residential property is Cwm Carno Farm, 530m north of the site (owned by the project Landowner). Further residential properties are located 640m east of the site, on the edge of the settlement of Rhymney, and 650m northwest of the site at Blaencarno Farm.

5.4 Access Roads to Site and Entrance

5.4.1 For the purpose of this assessment, it is anticipated that all turbine components will be transported to site from the port of Swansea, via the A465 and A469, approaching the site from the Heads of the Valley Road to the north.

5.4.2 The turbine components (comprising the blades, which at c.69m are the longest single components within the development, tower sections, nacelles and generators), and the cranes used for erection, are all expected to travel along this route. The route is shown in Drawing BR10167-062 (Volume 2).

5.4.3 As described in more detail in the transport chapter (Chapter 14), there are two possible approaches into the Site for the abnormal loads, both of which are currently retained as potential options (See Drawing BR10167-065 (Volume 2). One route will exit from the main A469 carriage way crossing the western verge to join the private access lane just to the north of the site entrance. This will be the easiest option to achieve and involve the least disruption but access across the highways verge still needs to be negotiated with the local highway's authority. The second option is to proceed down the A469, just past the Carno Street roundabout. The turbine transporters would then need to reverse backwards along the northern Convatec access road, before diverting off towards and then beyond the Site entrance. This manoeuvre would then allow the abnormal loads to pull forward into the Site entrance.

Photograph 5.1: Typical Turbine Blade Transportation Vehicle[4]

5.4.4 Delivery of the turbine components and cranes involves access to the site by abnormal loads. As a result, the police and Highways Agency must be notified and an abnormal load certificate may be required for some parts of the delivery. In order for the vehicles transporting turbine components to access the site some minor modifications to the public roads may be required. This is expected to include the temporary removal of street furniture and signage, strengthening and clearance of verges and temporary traffic control. Full details of all work expected to be required is given in Chapter 14.

5.4.5 For construction traffic using the public highway, a traffic management plan will be agreed with Caerphilly Borough Council (CBC). The details of this are set out in Chapter 14. This will include details of routing, scheduling and any traffic signage that may be required.

[4] Wind Turbine blade delivery passing through Edenfield cc-by-sa/2.0 - © Paul Anderson - geograph.org.uk/p/708529

Photograph 5.2: Transportation of a Turbine Nacelle[5]

5.4.6 Construction and delivery vehicles will be required to use approved transport routes whenever possible. Local contracting firms may however access the site using other approach routes. All abnormal load movements will be via approved routes, and at approved times.

5.4.7 As discussed above there remain two possible options for approaching the Site entrance. The preferred option is for a new temporary junction to be created near the northern end of the A469, and if this is secured, all deliveries will enter the site from this direction – abnormal, HGV or otherwise. A short existing section of track would be improved where necessary and used to approach the site entrance, which will, itself need to be modified, widened and tarmacked to enable site access.

5.4.8 A temporary site compound/laydown area will be formed either close to the site entrance or near to southeast of T3. This will provide storage and a staging area for

[5] Nacelle en route to Scout Moor Wind Farm cc-by-sa/2.0 - © Paul Anderson - geograph.org.uk/p/974254

duration of the construction period. The distribution of construction vehicle movements is discussed in detail in Chapter 14.

Photograph 5.3: Transportation of a Turbine Tower Section[6]

5.5 Site Tracks

5.5.1 Once at the site boundary, some improvements of tracks will be required in order to access the turbines and other development areas. These have been designed so as to minimise the amount of new track required and co-ordinated with the proposed development of the co-located solar PV development. The complete track layout is shown in Drawing BR10167-01RevD (Volume 2).

5.5.2 All on site tracks will incorporate a 5m micro-siting allowance within the red line development boundary which will be used to ensure any necessary localised feature avoidance can be carried out in such a way as to minimise environmental effects.

[6] Wind turbine tower transport cc-by-sa/4.0 International- © Elgaard, 16/08/2015

Photograph 5.4: Typical Access Track[7]

5.5.3 The total track length will be approximately 1200m. Photograph 5.4 above shows typical access tracks.

5.5.4 The Proposed Development would be served by new on-site access tracks to enable construction and facilitate maintenance once operational. These tracks are anticipated to have a maximum running width of approximately 4-4.5 m with widening at bends and internal passing places, where required. They would follow the path of existing tracks wherever possible, and be formed of locally sourced crushed aggregate.

5.5.5 It is expected that a small amount of cut and fill will be required to facilitate the appropriate gradients to enable to abnormal loads to access the Site. For the most part, any surplus fill requirements will be achieved using materials from within the site boundary, for example from the turbine foundation excavations.

[7] Access track and turbines at Fairburn Wind Farm cc-by-sa/2.0 - © Alpin Stewart - geograph.org.uk/p/4993870

5.5.6 Figure 5.4, shows the indicative access track composition which includes a geotextile lining, with binder and surface course on top. This detail is repeated in Drawing BR10167-110 (Volume 2).

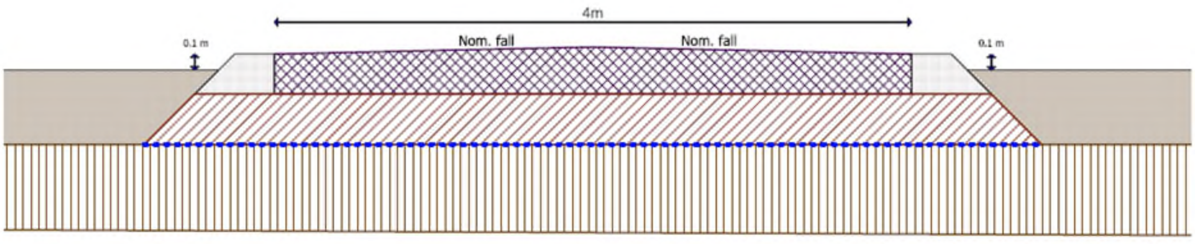

Figure 5.4: Cross-section Showing Indicative Access Track Composition

5.5.7 Upon completion of construction, when the wind and solar farm becomes operational, the access tracks will be retained to allow for maintenance and, should the need arise, the future repair of the turbines themselves.

5.5.8 It is anticipated that electric cabling connecting the turbines, ground mounted solar array and the control building would be laid in trenches running alongside the access tracks. The layout of the tracks would be determined by the final turbine and solar panel positions and informed by consideration of relevant environmental receptors and effects, such as on-site ecology and ground conditions.

5.6 Public Rights of Way

5.6.1 Within the site there is a network of public rights of way (PRoW), both footpaths and bridleways[8]. In addition, National Cycle Network Route (NCN) 468 runs the length of the Rhymney Valley (bar a gap to the south), through Rhymney town centre and up to the A465 via the A469.

5.6.2 Some of these PRoW will need to have temporary diversions put in place during the 6-8mth construction period. Safe alternative diversionary routes will be provided for the duration of this time. In places where potential conflict is unavoidable, for example, where the site entrance coincides with the entry point to several PRoWs, a banksman will be used to ensure users are safely able to access those PRoWs (or their diversionary routes) while deliveries are being managed through transit on to Site.

[8] https://www.caerphilly.gov.uk/things-to-do/green-spaces/public-rights-of-way

Wind Turbine Details

5.7 Wind Turbine

5.7.1 Table 5.2, below, provides the specification of a candidate turbine that could be considered for deployment. Further details on each of these turbines is provided in the form of the manufacturer's brochure which can be found in Appendix 3.1 (Enercon).

Table 5.2: Candidate Turbine Specifications

Manufacturer	Model	Rating	Hub Height	Rotor Diameter	Tip Height
Enercon	E138	4200kW	80.0m	138.35m	150.0m

5.7.2 The final selection of a turbine type will be subject to a competitive tendering exercise following the granting of planning permission.

5.7.3 The EIA has been undertaken on the basis that the turbines will be horizontal axis machines with a rotor consisting of three blades. The blades are mounted to the wind turbine nacelle. The maximum height to vertical blade tip will be about 150m. For the purposes of the noise modelling, the Enercon E138 turbines have been assessed as these are representative of wind turbines being considered for this site. It may be necessary to operate these turbines in a reduced sound power mode when the wind is blowing from certain directions, but further details on the noise modelling that has been undertaken are provided in the noise chapter to this EIA (Chapter 8). The final choice of turbine will be required to lie within the size parameters noted above and comply with the calculated ETSU-R-97 noise limits that have been derived for this Site.

5.7.4 Each turbine requires its own transformer to step up the voltage to comply with the requirements of the local electricity grid. Transformers may be internally housed within turbine nacelle or towers, or housed externally within a cabinet adjacent to each tower base. For the purpose of the planning application, external cabinets have been included to cover this eventuality.

5.7.5 These cabinets may also contain external switchgear. If external cabinets are used, they will be located close to towers, coloured appropriately for the site and would be c. 3m high, 3m wide and 2.5m long. Due to their relatively small size they are generally indistinct from the tower base unless viewed close-up or in silhouette against the skyline at greater distances.

Photograph 5.5: Example of Wind Turbine Electrical Cabinets

5.7.6 Each of the candidate wind turbine models, has a set speed range within which its blades will rotate. The range during generation is generally between 2.5 and 12 revolutions per minute (rpm).

5.8 Turbine Lighting

5.8.1 It is currently expected that aviation lighting will be required on the wind turbines. This is typically 200 candela and lights will be installed on top of the nacelle.

5.9 Wind Turbine Foundation

5.9.1 The exact design of the turbine foundations will vary depending on the final choice of turbine and the ground conditions at each turbine location. Site specific designs will therefore be developed once turbine selection has taken place and detailed ground investigations have been undertaken.

5.9.2 The description below assumes a typical gravity foundation will be appropriate at this Site. If ground conditions dictate that an alternative foundation design is required, then details may deviate slightly from this description. The final choice of foundation design will depend on the size of turbine, the magnitude of the loads and the ground conditions on site, but the configuration will be optimised to ensure the minimum volume of concrete is poured whilst still achieving a suitably engineered and ultimately safe foundation design.

5.9.3 Typically, the turbines will be supported on reinforced concrete foundations, which can be square, circular or octagonal in plan and will be of reinforced concrete construction. Rock anchors and piled foundations may be considered dependent upon ground conditions.

5.9.4 For the size of turbine proposed, the foundation is expected to be approximately 25m x25m, although a slightly larger area with a diameter of up to 20m has been allowed for in the layout plan. The overall depth to the underside of the foundation will be approximately 4m.

5.9.5 Foundations will be constructed by first excavating the ground using conventional construction equipment. The excavated topsoil and subsoil will be stockpiled separately for use in later backfill and reinstatement. If drainage is required, typically a French drain will be installed around the edge of the foundation.

5.9.6 The foundations are prepared, first with a concrete blinding mix to level the base, on which the steel reinforcement bar structure is assembled. Pours of concrete then form the main slab and upstand containing the connection between the foundation and the tower base section and the conduits for the turbine cabling. This connection can either be an embedded flange section or a number of holding down bolts. Temporary shuttering would be fixed to prevent loss of concrete and cement paste to the ground. The concrete is placed in the excavation by machine, pumped or placed in small hoppers that are lifted over the area being concreted and then tipped. Conventional concrete lorries of approximately 8m^3 capacity will be used for this.

5.9.7 Although the detailed foundation design will be determined post-consent after further site investigation, a typical gravity turbine foundation is shown below in Figure 5.5. It is expected that each turbine foundation will require approximately 900m^3 of steel reinforced concrete to facilitate construction.

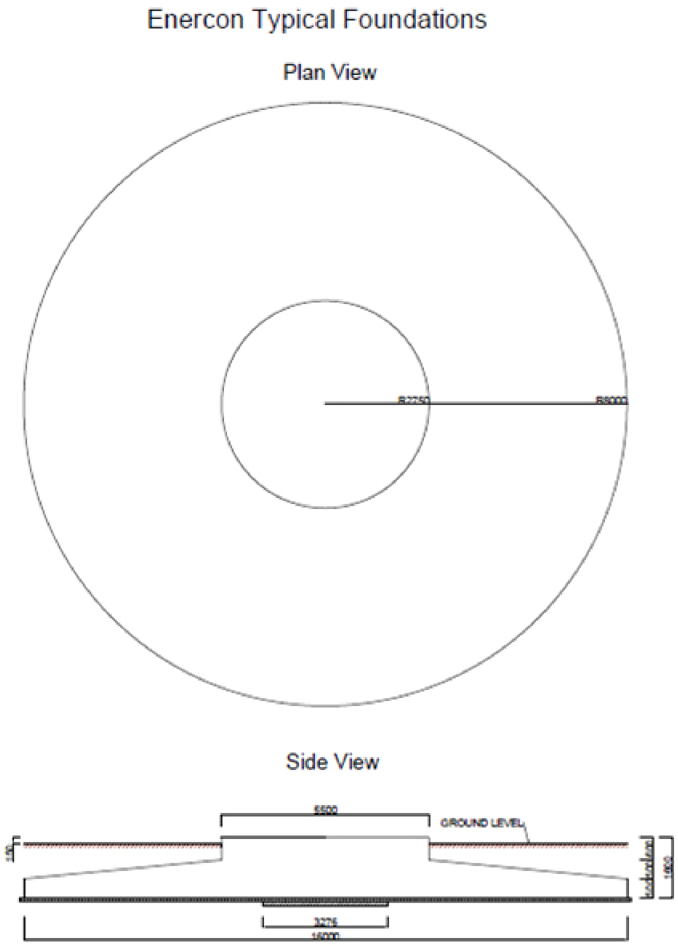

Figure 5.5: Typical turbine foundation

5.9.8 Designated bays will be set up on site for the washing out of the concrete lorries. These areas would be formed as settling ponds or similar, such as skips, with impermeable liners, which would prevent any materials from being washed out directly on to the ground. Periodically, the washout sumps would be pumped into a tanker for disposal off-site at a licensed disposal point.

5.9.9 To complete the foundation, the void above the main slab is backfilled with previously excavated material from the foundation pit. This will be added in thin layers and compacted mechanically. The cable conduits and wind turbine earthing ring and tails will be placed within this backfill and self-boring earthing rods will be installed as necessary, depending on the ground conditions on site. The specific foundation design will determine whether a final pour of cementitious grout may be required when the bottom tower section is fitted. Again, temporary shuttering will be used to prevent this material spilling outside of the foundation.

5.9.10 Once the foundation is completed, the area around the turbine will be reinstated using topsoil retained from the excavation and allowed to return to its former use.

5.9.11 Photograph 5.6, below, shows construction of a typical turbine foundation.

Photograph 5.6: Foundation Construction and Steel Reinforcement[9]

5.10 Wind Turbine Construction

5.10.1 A permanent hardstanding area approximately 40m x 30m will be located adjacent to each turbine foundation to accommodate the cranes required for construction and to provide additional laydown space for each turbine.

5.10.2 The construction areas are where possible located in cuttings (dug into the slope rather than having the ground built up), upslope of the turbines, so that following construction the area can be restored to grassland using the previously excavated subsoil and topsoil profiles and leaving the hardstanding area in situ under the reinstated ground level. This facilitates the restoration of these areas but leaves the hardstandings available to be "opened" up and reused should maintenance operations require the use of a large crane.

[9] "*Concrete Pour 2: Turbine 1*" by Hepburn Wind, licensed under CC BY 2.0

5.10.3 The mechanical installation of the turbines would initially comprise the delivery of the required components, prior to in-situ erection. The delivery of the turbines would be undertaken using specialist contractors (see Photographs 5.1-5.3) and purpose-built vehicles would be used for their erection, undertaken by the turbine supplier using specialist heavy lifting subcontractors (see Photograph 5.7 & Photograph 5.8).

Photograph 5.7: Erection of Tower Sections

Photograph 5.8: Example of Rotor Lift

5.11 Construction Compound and Laydown Area

5.11.1 It is proposed to establish one temporary construction compound approximately 50m x 75m either close to the site entrance, or close to the eastern extent of the PV panel arrays. The location is shown on Drawing BR10167-01RevD. The construction compound will accommodate all of the required temporary welfare facilities, as well as acting as a storage compound for construction materials and plant, and a laydown area for the turbine components during construction. It is expected that up to four containerised office/welfare units will be required. Other storage and laydown areas may be established on turbine craneage areas as required. These will not require any additional hard standing to that proposed for the craneage areas.

5.12 Site Anemometry

5.12.1 The wind turbines themselves would be fitted with anemometry equipment which would be capable of recording the wind regime at the site. There are no plans to deploy any additional onsite meteorological mast to log wind data.

Solar PV Details

5.13 Solar PV Panels & Arrays

5.13.1 The solar PV panels would be located to the south of the proposed wind turbines, orientated in an east-west direction. They would be tilted southwards at an angle of approximately 15 degrees. The panels would be fixed to metal framing similar to that shown in Photograph 5.9, with the lower edge of the panels raised approximately 0.7m (within a range of 0.5m to 1.0m) from the ground and the higher edge at the rear up to 2.5m off the ground.

Photograph 5.9: Example of Panel Configuration

5.13.2 No firm decision has yet been made about which panels will be installed at this site and this will only be decided based on a competitive tendering exercise carried out upon planning consent. For the purposes of this application Canadian Solar panels are considered as a representative candidate but any other panels used would have no material difference in appearance.

5.13.3 For the purpose of this ES, it has been assumed that the panels will be rated at 230W(p). If higher rated panels are deployed the overall generating capacity and therefore CO_2 savings arising from the site could be greater than predicted. Appendix 5.2 includes a datasheet providing more detail on the typical panel specification.

5.13.4 The arrays will be set out in long rows running in an east-west orientation across the site. The mounting structure will either have a single central leg (as shown in Photograph 5.10) or two legs, one at the front and one at the back, subject to the detailed tendering process that will be completed post-consent.

5.13.5 In the unlikely event that piling is found to be insufficient an alternative foundation design will need to be developed to fix the mounting system in place. The precise scale and nature of the foundations for the solar panel mounting systems will be designed based upon the geophysical surveying and geotechnical testing of onsite ground conditions. At this stage it is believed that the piled foundation systems described below will be suitable for use throughout the site.

Photograph 5.10: Example of Piled Single-leg Mounting Frame

5.13.6 The majority of leg structures for the frames will be piles driven into the earth to a depth of ca. 1.2m. If ground conditions are particularly poor this depth may need to be increased to up to 1.8m in specific locations but this is expected to be unlikely. The piling system requires no concrete and as such no evidence of the foundations will remain when the solar farm is eventually decommissioned.

5.13.7 The PV panels will be bolted on top of the frames and, should it be determined that mini-inverters be used rather than centralised inverters, these will be mounted at regular intervals on the frames underneath the panels. The mini-inverters would still feed into the transformer stations via the cable trenches as detailed below. Low voltage cabling connecting the solar PV panels will be run in conduits through the mounting system.

5.14 Site Security

5.14.1 Inside the development boundary a deer fence approximately 2.4m high will be installed to further increase security. The security fence will enclose the panels and solar infrastructure, but it is not necessary to install additional fenced security around the turbine towers as these will be secure in and of themselves.

Photograph 5.11: Security Fence Example

5.14.2 This fence will be designed for minimal additional visual impact. Photograph 5.11**Error! Reference source not found.** above shows an example of the type of fencing proposed. Figure 5.6, below, and Drawing BR10167-111 (Volume 2) provide further information on the proposed deer fence design. There are no hedgerows on Site that will be disturbed by the proposed fence, but a minimum clearance gap of 4m will be left between the fence and any other obstacles to ensure access is possible for maintenance purposes.

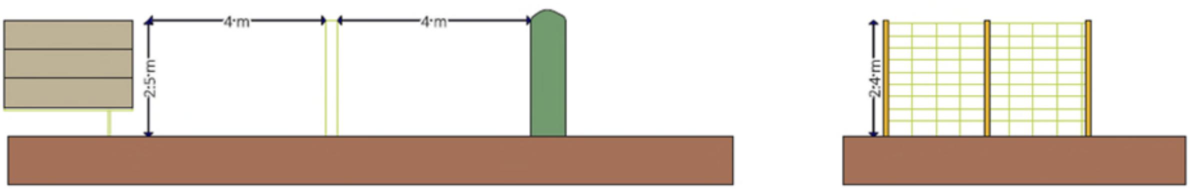

Figure 5.6: Proposed security fence design

5.14.3 The entrance to the site will be fitted with a double-leaf security gate of similar construction and design as the fencing. This gate will be up to 6m wide to accommodate vehicular access.

5.14.4 A number of discreet infra-red activated security cameras (CCTV), will be mounted at various points around the site (ca. 50m apart) These CCTV cameras will be focussed on the interior of the site for monitoring purposes. There will be no requirement to illuminate the solar farm during the night for security. Drawing BR10167-115 (Volume 2) shows an indicative design for the CCTV mounting system.

5.15 Electrical and Control Infrastructure

5.15.1 As can be seen in Figure 5.1, the solar farm will consist of a number of discrete arrays of panels with the layout being determined by the existing boundaries and, where appropriate, allowances for shading from features such as trees and overhead cables. The layout shown should be considered to be the maximum extent of the solar PV intended to be deployed on Site. Depending on the specification of the panels brought forward (which is subject to the post consent tendering process), the extent of panels may be reduced slightly but the layout shown is the worst-case scenario.

5.15.2 Regardless of the final array size, the onsite cable runs will be laid in shallow trenches and will follow the lines of the arrays of panels to the tracks. Cables will then follow the line of the access tracks back to the nearest medium voltage (MV) station, and these MV stations will be connected to the substation. Figure 5.7 shows a typical cable run.

5.15.3 It is expected that the final build will include up to four centralised inverters/transformer stations, known as (Medium Voltage (MV) Stations), each rated at up to 3000kVa, positioned strategically throughout the site near to the access tracks. If mini–inverters are adopted as an alternative to the centralised inverters then these will be mounted discreetly on the frames below the panels. They would then be connected to the nearest transformer.

5.15.4 The purpose of the inverters is to convert the direct current (DC) produced by the solar panels into alternating current (AC) for transmission across the site. Photograph 5.12, below, shows an example of a candidate Inverter/transformer station, the SMA MV Station, that may be installed at the site. Further details are included in Appendix 5.3.

5.15.5 In addition to the inverters, the SMA MV station also contains a transformer used to step up the voltage of the generated electricity for onward transmission whilst at the same time minimising losses in the cables. Should standalone inverter cabinets be adopted then a separate transformer cabinet will also be required so three small cabinets would replace the single larger enclosure at each transformer/inverter station location. If mini or micro inverters are used on individual panels arrays, then just the transformer cabinets will be retained at these stations.

Photograph 5.12: SMA Sunny Central Inverter

5.15.6 Regardless of the configuration, the transformers will each be connected via underground cables to the central substation. At this stage it is expected that the grid connection will be at 11kV.

5.15.7 The MV-Stations will be prefabricated and delivered to site as single items. They are designed to be deployed without the need for additional foundations other than a gravel base.

5.16 On Site Cabling

5.16.1 Panels within rows will be connected by cabling running through conduit in the mounting frame. The PV arrays would then be connected together by DC cables buried in c. 600-1000mm deep trenches. Beyond the inverters AC cables will be required and these will be placed in trenches approximately 1.0-1.2m deep leading back to the substation.

5.16.2 The network of cable trenching would, where possible, be designed and implemented in a manner which minimises the length of trenching required, but will generally follow the lines of the table arrays. The trenches would be excavated and backfilled by a tracked excavator.

5.16.3 Typical cable trench details for a variety of cable types are shown in Drawing BR10167-114 (Volume 2), and Figure 5.7, below.

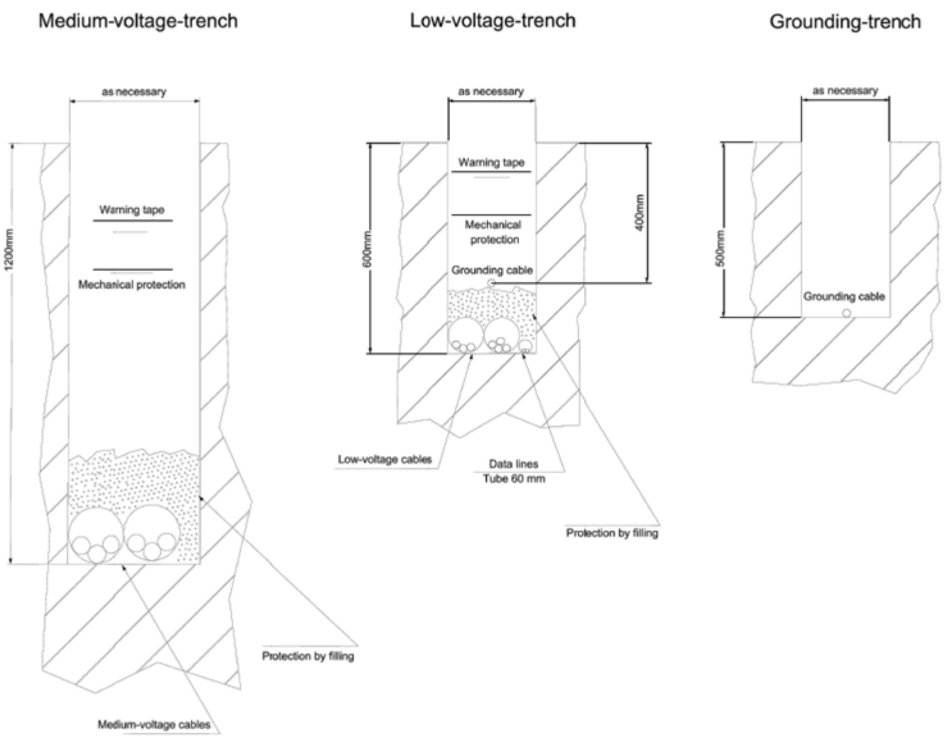

Figure 5.7: Typical Cable Trench

5.16.4 The wind turbine cables would also be laid in similar 1m deep trenches following the path of the site tracks, where practicable, and running back to the onsite substation. The trenches would be excavated and backfilled by a tracked excavator.

5.16.5 All new cabling on the Client side of the Proposed Development will either be mounted on the site infrastructure (e.g. smaller low voltage cabling strung underneath the panels), or be buried underground, and will link the turbines and solar array to the substation.

5.16.6 The private wire connection to Convatec's manufacturing facility will follow one of two potential routes. The first follows the access track back to the Site entrance and then down the grass verge alongside the road to Convatec's plant, while the second extends east from the substation, through a gap in the hedgerow and down the back crossing the road to reach the plant. This second option would be subject to agreement from third party landowners.

5.17 Grid Connection

5.17.1 It is intended to construct an 11kV substation within the Site, close to T3. The substation will receive generation from the wind and solar panels and control where it is delivered. There will be a private wire connection directly to the Convatec manufacturing plant and the developer is looking at options for further private wire connections to other local businesses to export some of the surplus generation during sunny and windy periods. Any residual surplus electricity will be exported to the grid.

5.17.2 As such, the substation will have two distinct sides, one which will be accessible only to suitably qualified staff employed by the Convatec Green Manufacturing Hub, and the other of which will only be accessible to employees of the DNO, National Grid. It is proposed to connect directly, via a new on-site substation, to the existing 11kV power distribution network. The DNO would oversee this grid connection.

5.17.3 All grid connection works beyond the construction of the control building (see Drawing BR10167-109 (Volume 2) and para **Error! Reference source not found.** below), will be the responsibility of the DNO.

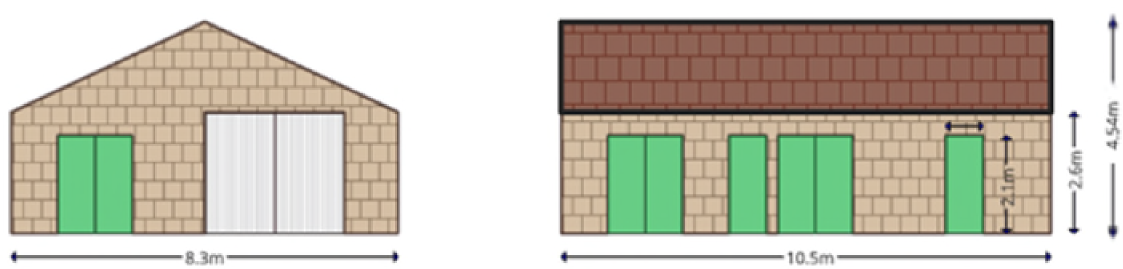

Figure 5.8: Example of 11kV Substation Building

5.17.4 The substation building is expected to be block-built and rendered with a pitched roof and would have a height of approximately 5m. The detailed design of the substation will be agreed with the DNO and the Planning Authority via an appropriately worded planning condition prior to any works taking place but an indicative plan is also included in Drawing BR10167-109 (Volume 2).

5.17.5 In the event that additional external electrical components are required, these would be located in a small secure compound directly adjacent to the substation building.

5.18 Construction Operations

Wind turbines

5.18.1 The construction period for the project will take approximately 6-8months and will comprise of the following activities:

- Mobilisation to site
- Creation of site entrance and exit
- Establishment of site compound and lay-down area
- Establishment/upgrading of site tracks and crane hard standing areas
- Establishment of Electrical Compound
- Construction and electrical fit-out of substation
- Power and signal cable laying
- Establishment of turbine foundations
- Delivery of turbine components
- Erection of the turbines
- Commissioning of the turbines
- Reinstatement works for new constructions
- Demobilisation from site.

Solar PV

5.18.2 The anticipated construction period for the Project would be approximately three months and would consist of the following principal operations:

- Mobilisation to site
- Maintenance to hedgerows and erection of fence and gate
- Preparation of onsite tracks and laydown areas
- Delivery of panels, frames, inverters, transformers and substation

- Installation of frames and panels
- Cable laying
- Commissioning of the panels and grid connection
- Reinstatement works
- Demobilisation from site

5.19 Working Hours

5.19.1 Construction work will be scheduled to occur only between the hours of 07:00 to 19:00 on Monday to Friday.

5.20 Staff Numbers and Programme

Wind turbines

5.20.1 Full time equivalent staffing levels on site during construction are expected to be:

- 10 staff during civils operations;
- 5 staff during substation works;
- 15 staff during turbine erection; and
- 15 staff during panel installation.

5.20.2 These numbers will be cumulative where activities are taking place over the same periods and may be increased or reduced should the construction schedule require it.

5.20.3 Construction activities will be restricted to the times identified above. The only exception to this will be during the erection of the new turbines; working hours may then be extended into the night to facilitate completion of this stage under the most secure and safe lifting conditions. This would only happen during the two-three weeks expected to be required for erection and then only where it was deemed to be essential and would be subject to the wind conditions at the time. In the unlikely event of an “emergency” situation arising then it may also be necessary to work outside of these identified hours.

Solar PV

5.20.4 Full time equivalent staffing levels on site during construction are expected to be around 25 people

5.20.5 Construction activities will be restricted to the times identified above. In the unlikely event of an "emergency" situation arising then it may also be necessary to work outside of these identified hours.

Overall Site Development

5.20.6 The construction phase works will be undertaken in approximately the order listed above. However, many of the tasks would be undertaken concurrently in order to minimise the duration of this phase. The proposed construction phase programme is highlighted in Table 5.3. It should be noted that the programme schedule is indicative only and does not include for any unforeseen delays.

<table>
<tr><th colspan="22">Table 5.3: Indicative Construction Programme</th></tr>
<tr><th rowspan="2"></th><th rowspan="2">Task</th><th colspan="20">Week</th></tr>
<tr><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>10</th><th>11</th><th>12</th><th>13</th><th>14</th><th>15</th><th>16</th><th>17</th><th>18</th><th>19</th><th>20</th></tr>
<tr><td>1</td><td>Mobilise site compound</td><td colspan="3">Mobilse + Site Comp</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2</td><td>Site Tracks</td><td></td><td></td><td colspan="4">Site Tracks</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>3</td><td>AC Cable Installation</td><td></td><td></td><td></td><td></td><td></td><td colspan="5">AC Cable Installation</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>4</td><td>T1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Excavation</td><td colspan="2">Concrete</td><td></td><td></td><td>Erection</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>5</td><td>T2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Excavation</td><td colspan="2">Concrete</td><td></td><td></td><td>Erection</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>6</td><td>T3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Excavation</td><td colspan="2">Concrete</td><td></td><td></td><td>Erection</td><td></td><td></td><td></td><td></td></tr>
<tr><td>7</td><td>Array Security Fence</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="3">Erect Security Fence</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>8</td><td>Mounting Structure Installation</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="4">Panel Mounting Structures</td><td></td><td></td><td></td><td></td></tr>
<tr><td>9</td><td>Panel Installation</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="4">PV Panel Installation</td><td></td><td></td><td></td></tr>
<tr><td>10</td><td>DC Cable installation</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="3">DC Cable Installation</td><td></td><td></td><td></td></tr>
<tr><td>11</td><td>Inverter Transformer Stations</td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="4">Install Inverter Transformer Stations</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>12</td><td>Substation Excavation</td><td></td><td colspan="2">Excavation</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>13</td><td>Substation Groundworks</td><td></td><td></td><td colspan="2">Groundworks</td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="3">Groundworks</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>14</td><td>Substation Foundations</td><td></td><td></td><td></td><td colspan="3">Concrete</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>15</td><td>Substation Walls</td><td></td><td></td><td></td><td></td><td colspan="2">Walls</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>16</td><td>Substation Roof</td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="2">Roof</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>17</td><td>Substation Finishes</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="2">Finishes</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>18</td><td>Substation Fit Out</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="5">Electrical Fit Out</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>19</td><td>Install Private Wire</td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="3">Private Wire Installation</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>20</td><td>Commissioning</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="3">Commissioning</td><td></td><td></td></tr>
<tr><td>21</td><td>Reinstatements/Fencing</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="2">Reinstate</td><td></td></tr>
<tr><td>22</td><td>Demobilise Site</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Demobilise</td></tr>
</table>

5.21 Vehicle Movements

5.21.1 It is expected that the turbines will be installed before most of the arrays are completed. Some of the areas which will be set out with panels will need to be clear in order for the turbine transporter to access the Site, with blades in particular needing to over sail some of the panel areas which in transit in order to reach the turbine locations. Once the turbines are in place, the panels would be able to be installed in these areas, barring any subsequent need for replacement blades to be transported.

5.21.2 Erection of the turbines would be undertaken by two cranes; the largest would be the main crane and would lift the major turbine components into position. The smaller of the cranes would assist by assembling the larger crane, moving materials on site and tailing.

5.21.3 A typical turbine takes approximately 2-4 days to assemble from completion of the foundation. Although the turbines need to be installed in advance of some of the PV arrays, a lot of the onsite construction operations can run concurrently with the turbine site preparation with only the final panel arrays needing to wait until the turbine transporters have completed their deliveries. The proposed timing of the construction works across the whole Site is shown below Table 5.4, which outlines a 20-week construction period.

5.21.4 The total number of vehicle movements expected to be required is estimated to be in the region of 2,504, each consisting of one journey onto site and one journey off site.

5.21.5 A number of these movements would comprise daily personnel movements, which would peak during turbine erection. Where possible staff will be required to car share to further reduce vehicle numbers required to attend the site.

5.21.6 Abnormal loads would be brought to site during a relatively short window during the construction period. HGVs would be required to convey the crushed stone for the tracks, concrete for the foundations and various other construction materials. These would have a maximum frequency of approximately 18 deliveries per day.

Table 5.4: Anticipated Construction Schedule and Estimated Weekly Vehicle Movements

	Task	Week																				Total
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
	Vehicle Movements (each expected to consit of 2 journeys ie one to and one from the site)																					
	Abnormal Loads	0	0	0	0	0	0	0	0	0	0	0	27	0	0	2	0	0	0	0	0	29
	HGV Loads	4	15	80	83	84	91	7	6	5	36	88	90	74	29	38	25	18	2	3	5	783
	Personnel Transit	15	20	20	20	20	20	25	25	25	25	25	25	20	30	30	30	20	15	15	15	440
	Total	19	35	100	103	104	111	32	31	30	61	113	142	94	59	70	55	38	17	18	20	1252
	Site Establishment																					
	Compound Plant	2																				2
	Compound Stone	2																				2
	Cabins		4																			4
	Crane		1																			1
	Misc plant (JCBs etc)		4																			4
	Tracks																					
	Swing Shov		1																			1
	Roller		1																			1
	Stone On-Site Track (Gang 1)			54	54	54	54															216
	Geogrid		1	3	3	3	3															13
	Drainage (pipes & stone)		1	1	1	1	1															5
	Cables						1	1														2
	Plant away								2													2
	Turbine Foundation																					
	Swing Shovel						1															1
	Concrete Trucks										30	58	58	30								176
	Rebar and other										3	3	3									9
	Plant away													2								2
	Turbine Erection																					
Abnormal Loads	650 Tonne Crane												1									1
	120 Tonne Crane												1									1
	Tower Low Loader												9									9
	Nacelle Low Loader												3									3
	Blade Low Loader												9									9
	Misc Turbine Parts												2									2
	Local Switchgear + Housing												2									2
	Cranes away															2						2
	Cable Laying																					
	Sand						2	2	2	2	2											10
	Cables						3	2	1	1	1											8
	Substation																					
	Disposal of Arisings		2	2																		4
	Concrete/Aggregate Wagons			20	25	25	25					25	25	25								170
	Blockwork					1	1							4								6
	Roof							1								3	3					7
	Finishes									1								2	2	2		7
	Electrical Equipment (Sub)											1	1									2
	Electrical Equipment (Ext)											1	1	2	3	3						10
	Reinstate																					
	Perm Fencing/Cattlegrids etc																			1		1
	Low Load All remaining plant away from site																				5	5
	Misc.																					0
	Private Wire Cable							1	1	1												
	Photovoltaics																					
	Security Fence Installation												2	2	2							6
	Mounting Structures for PV													9	9	10						28
	Panel Installation														15	15	15	10				55
	DC Cable Installation															7	7	6				20
	Staff movements/5 day week	15	20	20	20	20	20	25	25	25	25	25	25	20	30	30	30	20	15	15	15	440
	Overall Movements all HGVs	4	15	80	83	84	91	7	6	5	36	88	90	74	29	38	25	18	2	3	5	783
	Overall Movements Abnormals	0	0	0	0	0	0	0	0	0	0	0	27	0	0	2	0	0	0	0	0	29
	Movement = two journeys (i.e. to and from site)																					
	Total Moves	**19**	**35**	**100**	**103**	**104**	**111**	**32**	**31**	**30**	**61**	**113**	**142**	**94**	**59**	**70**	**55**	**38**	**17**	**18**	**20**	1252
	Total Journeys (to and fro)	**38**	**70**	**200**	**206**	**208**	**222**	**64**	**62**	**60**	**122**	**226**	**284**	**188**	**118**	**140**	**110**	**76**	**34**	**36**	**40**	2504

5.22 Pre-Construction Works

5.22.1 Prior to commencement of the construction phase of the Proposed Development, a detailed geotechnical site investigation will be undertaken in order to confirm the findings of preliminary studies. Where necessary, micro-siting will be used to avoid conflicting with any onsite mine workings (see further details in Chapter 10). If workings are present and avoidance is not possible, additional localised intervention such as piling or void filling may be required to make the ground safe for some of the proposed uses. This will only become apparent once the groundworks commence.

5.22.2 The wider site will be prepared ready for construction to commence. This will include clearing the site, preparing the perimeter and erecting a temporary boundary fence around active areas of construction work.

5.22.3 Construction will take place in line with the outline Construction Environmental Management Plan (CEMP) and the Transport Statement, which incorporates a Construction Traffic Management Plan (CTMP).

5.23 Testing and Commissioning

5.23.1 The testing and commissioning of the wind farm and the photovoltaic plant would be undertaken by the general contractor and appointed electrical engineer, in conjunction with the DNO, National Grid.

5.24 Site Reinstatement on Completion of the Construction Phase

5.24.1 Once the construction phase has been completed the site will be landscaped. Disturbed groundcover will be reinstated to its original condition as far as possible and/or improved to enhance the biodiversity on the site. More detail of habitat creation and enhancement is provided in Chapter 6, Ecology.

5.25 Construction Materials

Materials Required for Wind Turbines

5.25.1 The turbine towers will be formed of steel while the blades will largely be constructed of fibreglass resin/glass reinforced plastic (GRP). Other metals including iron, copper and aluminium will be used in the generator and associated electrical infrastructure.

Materials Required for Panel and Frame Erection

5.25.2 The Panels will be manufactured offsite and transported to site on pallets ready for installation. Panels are generally manufactured with aluminium or steel frames with a glass frontage and the PV cells are encapsulated in a silicon rubber or similar material inside. The frames for mounting the panels are likely to be made of galvanised steel or similar and the legs will be piled into the ground, avoiding the need for concrete.

Concrete Requirements

5.25.3 The largest requirement for concrete will be for the turbine foundations, where, subject to detailed foundation design, an estimated 760m^3 will be required for each turbine base. Foundations will also be required for the substation buildings. Small quantities of concrete will be required for the fence posts, security camera poles, and, if required, pads for the electrical substation.

Other Aggregate Requirements

5.25.4 Gravel/stone chippings will be required for the inverter/transformer station bases and the access tracks. Approximately 3000m^3 of crushed stone of various grades will be required, although a proportion of this will be sourced from the existing access tracks.

5.25.5 The material for the tracks and hardstanding areas may comprise both new and recycled stone; however, all materials will be sourced locally where practicable.

5.25.6 The exact quantity of construction materials required to build the windfarm will be largely dependent on the detailed geotechnical properties of the ground beneath the turbines, tracks and crane pads.

5.25.7 Stone and aggregate will be required for the construction of the turbine foundations. Aggregates used for these purposes are accounted for above under concrete and will most likely be delivered to site as “ready-mix”.

5.25.8 Imported aggregate will be checked to ensure that it is inert in relation to its use in order to preclude any potential adverse effects on the local hydrology and ecology.

Electrical Materials

5.25.9 The electrical infrastructure will be connected by cabling running between the panels and the on-site substation. Some of this cabling will be buried in trenches as described above while some will run above ground on the underside of the panel frameworks. The earthing and communication cables for the panel control systems would also be laid in the same trenches. To protect the cables, they would be laid on a bed of coarse granular sand or fine gravel, approximately 150mm thick, and covered with a similar thickness of the same material. The material would be imported from off-site sources.

5.26 Turbine operations

5.26.1 The power output from a wind energy development largely depends on the strength of the wind blowing across the site. Typically, wind turbines start to generate electricity at a wind speed of about 2.5m/s. Output generally increases with wind speed up to the maximum rated power at a wind speed of about 15m/s. As the wind speed increases further, the output is limited to the rated capacity until the wind speed reaches about 25m/s (28m/s in some cases) when the wind turbine shuts down automatically for protection.

5.26.2 Although wind turbines are designed to stop generating at wind speeds above their cut out level, they are built to withstand very high wind speeds, and are certified against extremes of wind speeds up to 52.5 m/s (3 sec. gust) (in excess of 115 mph).

5.26.3 The proportion of time that the turbines will be generating electricity is therefore dependent on the time that the wind speed is between 2.5 and 28m/s.

5.27 Maintenance Requirements

5.27.1 Turbine maintenance will be undertaken by specialist contractors with experience working on turbines including at height. Teams of two people with a 4x4/van would undertake the servicing. It takes two people (on average) up to 2 days to service each turbine. Routine maintenance or servicing of turbines is carried out twice a year, with a main service generally taking place in the summer and a minor service in the 6 months following. In year 1, there is commonly an initial 3-month service after commissioning. The turbine being serviced will be switched off for the duration of its service. In the unlikely event of major repairs being required, these will be scheduled in as soon as possible after a failure, to bring generating capacity back online without delay.

5.27.2 General maintenance of solar panels will be undertaken annually to clean and check the solar panels. Again, maintenance crews visiting the site will use small vehicles (e.g. 4x4 or small van) to access the site.

5.27.3 The High Voltage equipment is also inspected and tested on an annual basis by a specialist engineer.

5.27.4 Ground maintenance methods may vary with potential for sheep grazing beneath the panels, mowing, or strimming.

5.28 Track Maintenance

5.28.1 Following completion of the construction phase, the on-site tracks will be retained and maintained by the Applicant in order to ensure ready access to all areas of the development.

5.29 Decommissioning

5.29.1 The Proposed Development would have an operational lifespan of 30 years. Having reached the thirtieth year, the Project would enter its decommissioning phase, whereby all equipment would be dismantled and removed from the site.

5.29.2 The turbines would be lowered to the ground and transported offsite for resale or recycling. The upper sections of the turbine foundation structures would be removed to below ground level with the large flat bases left in-situ, although no part would be visible. The area would be reinstated to its original use following removal of the upper foundation construction. Farming activities (grazing)can then resume over the foundations of the turbines.

5.29.3 By the time the proposed windfarm is decommissioned, vegetation would have re-established itself naturally. Underground cables would typically be left in place as removing them would cause more environmental disturbance, however where they could easily be removed and where the value of the materials warranted this they would be carefully removed and any disturbance restored. The control building and substation would be removed.

5.29.4 The majority of the wind turbine components are recyclable, as most of the components are made of steel with an appreciable amount of copper in the generator, although the remaining components would need to be disposed of via a local licensed waste operator. It is hoped that the wind turbines would ultimately be refurbished for reuse elsewhere.

5.29.5 All traces of the panels would be removed during this phase and either sold for scrap value or recycled. The perimeter security fence would also be removed.

5.29.6 After the removal of the solar farm's structures and infrastructure, the site would be returned to its original use. All waste materials would be transported to appropriate, licensed disposal facilities.

5.30 Post Construction Site Restoration

5.30.1 The methods to be used for site reinstatement form an integral part of the post-construction restoration programme.

5.30.2 Site restoration will involve the restoration of disturbed ground caused by the construction of and dismantling of the onsite compounds and laydown areas. This will restore the ground profile to its original form with non-geometric surfaces and tie ins with existing undisturbed ground levels to prevent the collection of surface water. The onsite tracks will be retained, and the verges will be restored to their original use. Reinstatement work will be undertaken at the earliest opportunity to provide completed restoration without delay.

5.30.3 Reinstatement will be undertaken using soils excavated during the construction process replaced to replicate their natural layers and profiles. On completion of grading, the finished surface will be allowed to regenerate a natural grass sward or will be reseeded to match the adjacent areas.

5.31 Sustainability

5.31.1 The Project is inherently sustainable in its nature and once operational it will provide a net CO_2 saving throughout its lifetime, as well as other environmental benefits. These are discussed in Chapters 21 (Socio-economics) and Chapter 15 (Climate Change).

5.31.2 The manufacture of the wind turbines presents the largest impact arising from the proposal. This is due to the energy consumption and CO_2 emissions associated with the extraction of the raw materials and turbine production process. However, as demonstrated in Chapter 15 (Climate Change), this will be offset in the first year of operation through the generation of renewable electricity.

5.31.3 During the construction phase, every effort will be made to reduce any adverse effects arising from the erection of the turbines. This will include the use of recycled materials where possible, and materials and construction workers will be sourced locally where available. Transport movements will be kept to a minimum and site workers will be encouraged to lift share.

5.31.4 Once operational, the windfarm will be monitored remotely reducing the need for site visits. Minor problems and system failures will be detected and dealt with through the supervisory control and data acquisition (SCADA) system. This will allow improved management of maintenance and reduced interruption to power generation.

5.31.5 It is expected that following decommissioning, at the end of the 30year life of the windfarm, approximately 80-85%% of the wind turbine components would be recycled[10].

5.32 Environmental Management Plan and Construction Method Statement

5.32.1 An outline Construction Environmental Management Plan has been prepared and as one of the supporting documents to the planning application for this Proposed Development. When the scheme is consented and once a principal contractor has been appointed, a Construction Method Statement will also be produced for approval prior to the commencement of construction work on site. These documents will be adhered to during the construction, operation and decommissioning phases of the project. The purpose of these documents would be to ensure that best practice procedures and technologies would be observed during all phases of development.

5.33 Land Take

5.33.1 The red line planning application boundary for the Proposed Development has an area of 25.98ha, consisting of the three proposed wind turbines, crane pads, c.21,648 solar PV panels, 11kV substation, four centralised inverter/transformer stations, security fence, cabling and access track etc. A further 1.89ha of offsite development area is currently proposed.

5.34 Releases and Effects of the Project

5.34.1 Due to its relatively short lifetime (30yrs) and ease of removal, the Proposed Development is considered to be temporary and reversible. The environmental impacts arising during the construction, operation and decommissioning phases of the Proposed Development are also considered to be temporary. However, it is necessary that they are fully identified in order to assign appropriate mitigation measures to reduce their severity while they are present.

5.34.2 The environmental impacts of the Proposed Development are assessed in detail within this ES.

[10] Khalid, Arif, Hossain and Umer, '*Recycling of wind turbine blades through modern recycling technologies: A road to zero waste', Renewable Energy Focus, Vol 44, March 2023, Pages 373-389,* https://www.sciencedirect.com/science/article/abs/pii/S1755008423000121