Vale of Leven Wind Farm Limited

Vale of Leven Wind Farm

Environmental Impact Assessment Report (Volume 1)

Chapter 2 – Proposed Development

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2.1 Introduction

2.1.1 This chapter of the Vale of Leven Wind Farm development (hereafter the 'Proposed Development') Environmental Impact Assessment (EIA) Report describes the Proposed Development, outlines the need for the Proposed Development, describes the Site and context and discusses layout and design considerations. This chapter also considers how the design evolved for the Proposed Development.

2.1.2 This Chapter explains how potential environmental effects which have emerged early in the EIA process, and through the studies by the EIA team, have informed the design of the Proposed Development.

2.1.3 This Chapter of the EIA Report is supported by the following figures, provided in **Volume 2a**, EIA Report Figures:

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2.2 Need for the Development

Climate Change and Net Zero Targets

2.2.1 The Scottish Government declared a climate emergency in May 2019 and the provisions of the Climate Change (Emissions Reduction Targets) (Scotland) Act 2019 have a requirement for a 100% reduction in CO_2 emissions by 2045 and an interim target of 70% reduction in emissions by 2030. West Dunbartonshire Council (WDC) also declared a climate emergency in 2019 and the corresponding Climate Change Strategy: Working

Towards Net Zero[1] responds to the 2045 net zero target, and in the interim, makes a commitment to a 61% reduction of CO2 emissions by 2030.

2.2.2 The Scottish Energy Strategy has also set a target for 50% of total energy demand (including from heat and transport) from renewable sources by 2030, which will require a substantial increase in delivery of renewable energy. As such, the Scottish Government has encouraged all forms of renewable and low carbon solutions for meeting this energy target.

2.2.3 The Scottish Government's Onshore Wind Policy Statement 2022[2] emphasises the NetZero greenhouse gas targets set by legislation and notes that the 2030 interim target is "particularly challenging". In addition, the Policy Statement sets an overall ambition of 20 GW of installed onshore wind capacity to be operational in Scotland by 2030. Detailed consideration of the relevant reports, studies and policies relating to national energy policy is provided in **Chapter 4: Planning Policy Context** and in the separate **Planning and Sustainable Place Statement** accompanying the application.

Chapter 4: Planning Policy Context outlines the local, Scottish, UK and international climate change, renewable energy and planning policies that are considered relevant to the Proposed Development. Legislation, planning policy and industry guidance specific to each technical discipline are outlined in their relevant technical chapters (Chapters 5 to 14).

Benefits of the Proposed Development

2.2.4 The Proposed Development accords with NPF4 and demonstrates compliance with the key principles set out in the Scottish Draft Energy Strategy and Just Transition Plan relating to jobs, skills and economic opportunities, communities, people and equity; and adaptation, biodiversity and the environment:

- Generation of enough wind energy to power 39,664 households annually;
- Battery Energy Storage System (BESS) to store energy, providing stability to the electricity supply network, meeting energy demands and providing improved energy security;
- Delivery of a total greenhouse gas (GHG) emission savings of 1,102,474 tCO_2e over its lifespan (based on operational lifespan of 40 years for the wind farm);
- Dividing the net GHG emissions predicted for the manufacture, construction and decommissioning stages of the wind turbines by the predicted annual carbon savings from windfarm operation gives a predicted emissions payback period of 3.3 years;
- It was estimated that development and construction contracts could directly generate £3.3 million GVA in West Dunbartonshire and £12.1 million GVA in Scotland
- it was estimated that West Dunbartonshire could benefit from £0.5 million in operations and maintenance contracts, with Scottish businesses potentially benefitting from £2.5 million.

[1] West Dunbartonshire Council (2021), Climate Change Strategy. Available at: West Dunbartonshire Council Climate Change Strategy - a route map for a net zero future (west-dunbarton.gov.uk) [accessed January 2023].

[2] Scottish Government (2022), Onshore Wind Policy Statement.

- it was estimated that turnover generated by the operation and maintenance of the Proposed Development could support £0.3 million GVA and 2 jobs in West Dunbartonshire, and £1.0 million GVA and 9 jobs in Scotland.
- Over £30 million in non-domestic rates generated over the operational lifetime;
- Significant contribution to improving the security and cost of energy supply taking account the cost-of-living crisis and war in Ukraine;
- 220.8 ha and 2000 linear metres represents a considerable biodiversity enhancement for the area;
- Significant contribution to meeting onshore renewable energy generation target of 20 GW by 2030 and reduction of greenhouse gases, taking account of the climate crisis; and
- £5,000 per MW per year in community benefits for the local area. The community benefit offer from the Proposed Development is equivalent to £0.3 million annually, or £10.2 million during the 30-year operational lifetime of the Proposed Development.

Chapter 12: Socio-Economics considers the potential socio-economic impacts associated with the Proposed Development.

2.3 Site Description and Context

2.3.1 A previous wind farm proposal, Merkins Wind Farm, was located at the same location, but with a different access and site boundary. Merkins Wind Farm was submitted by the developer (Lomond Energy) as a planning application under the Town and Country Planning Act (1997) (TCPA) in January 2012 and allocated the application reference DC12/0281. The 10-turbine layout, 120 m to blade tip was refused by WDC in 2013. The Proposed Development is a wholly new project with no connection to the Merkins Wind Farm proposal.

2.3.2 The Site is located within the Kilpatrick Hills, West Dunbartonshire. The nearest settlement to the Site is Bonhill, which lies just over 2 km to the west of the nearest proposed turbine, and approximately 600m to the northwest of the Site boundary and proposed access track. The larger settlements of Alexandria and Dumbarton are approximately 4 km to the west and south-west of the Site respectively, as shown on **Figure 1.1**.

2.3.3 The land use within the Site is dominated by upland moorland predominately used for grazing sheep. Dumbarton Muir Site of Special Scientific Interest (SSSI), designated for bog habitats, is located to the east of the Site. Auchenreoch Glen SSSI, designated for its lowland calcareous grassland and springs (including flushes), lies to the south-west. There are numerous watercourses onsite, some of the which, within the south-western portion of the Site, are located within steep gullies. Search areas proposed for habitat enhancement are proposed in **Technical Appendix 6.6**, and **Figure 6.11**..

2.3.4 The Site context is shown on **Figures 1.2** and **Figure 1.3** and nearby environmental designations are illustrated by **Figure 2.1**

2.3.5 The surrounding land use in the immediate vicinity is predominantly agricultural, with some areas of forestry to the west and east. Auchencarroch Landfill Site is located to the west of the Site.

2.3.6 The Loch Lomond and Trossachs National Park (LLTNP) and the Loch Lomond National Scenic Area (NSA), lie a minimum of 1.7 km and approximately 3.5 km respectively to the north of the northern Site boundary.

2.4 Site Selection

2.4.1 There are several criteria used by the applicant to assess the appropriateness of sites for the development of onshore wind projects. These include:

- suitable wind conditions;
- feasibility of access for abnormal indivisible loads (AILs);
- favourable topography and access to enable the construction of projects;
- planning policies which support the development of renewable energy;
- avoidance of environmental constraints (where possible) (see Figure 2.2); and
- avoidance of the most sensitive landscapes.

2.4.2 A review of the site selection requirements for the Site found the following:

- initial desk-based assessments and a review of wind resource suggest that there are high wind speeds, and the Site is available for a renewable energy development; and
- there are no planning policies which, in principle, preclude wind farm or renewable energy development.

2.5 Layout and Design Considerations

2.5.1 This Section outlines the environmental and technical constraints which were taken into account during the design evolution described in **Section 2.7**.

Legislation

Schedule 9 of the Electricity Act 1989

2.5.2 The applicant does not hold a generation licence in respect of this site and therefore the statutory duties set out in Schedule 9 paragraph 3 (1) do not apply to the applicant when formulating proposals for consent under section 36 of the Electricity Act. However through the EIA process the applicant has sought to develop a design that is in accordance with the duties set out in Schedule 9 of the Electricity Act. The matters that are raised in Schedule 9 have been considered in the EIA process and the findings are presented in this EIA Report. Scottish Ministers are required, under Schedule 9, paragraph 3(2) (a) to have regard to the desirability of the matters mentioned in paragraph (a) of sub-paragraph (1) and the information provided in the EIA Report enables the Scottish Ministers to carry out this duty.

2.5.3 None the less, the applicant has done what it *"reasonably [can] do [what he can] to mitigate any effect which the proposals would have on the natural beauty of the countryside or on any such flora, fauna, features, sites, buildings or objects" as contained under Schedule 9 para 3(1)(b). This is summarised* in Sections 2.5.9 to 2.5.35 and considerations during the design process included:

- landscapes and visual impacts;

- location of residential properties – proximity to noise-sensitive receptors and potential for shadow flicker effects;
- ground conditions (including slope steepness and peat);
- forestry;
- access feasibility;
- presence of ornithology, protected habitats, including peatland habitats, and species;
- area topography, including gradients, exposure, watercourses, hydrology, and land use;
- presence of cultural heritage features;
- proximity to telecommunications infrastructure;
- compatibility with aviation interests; and
- key recreational and tourist routes.

Key Constraints

2.5.4 Constraints analysis was undertaken using Geographical Information Systems (GIS). A project-specific workspace, based on ArcGIS Online, was developed specifically for the Proposed Development. This allowed base-mapping to be overlaid with spatial data, such as environmental constraints and protected sites, and project-specific data to provide the project team with a means of interrogating environmental and project details in a single place at technical meetings and design workshops.

2.5.5 Onsite constraints can be seen in further detail on **Figure 2.2 and 2.3**. In addition to the application of GIS, 3D Civils (a 3D civil infrastructure design service) was used to assist in the constraints mapping and design of the Proposed Development. This allowed for greater inspection of topography and visual aspects.

Wind Analysis

2.5.6 Wind analysis and efficiency modelling of the wind turbines has been carried out by the applicant from project inception and throughout the design evolution process to identify the areas of the Site likely to produce the highest yields and ensure the commercial viability of the project.

2.5.7 For turbines to work as effectively as possible, they must be suitably spaced relative to the predominant wind direction. If they are too close together in this direction, the wake effects from the wind turbines located on the upwind edge of the array would create turbulent air for the next row and so on through the array, reducing overall energy output. Additionally, turbulent air increases the strain placed on the turbines, which could shorten their operational lifespan. Conversely, if wind turbines are located too far apart, the opportunity to maximise the capacity and, thereby, electricity generation from a site is reduced.

2.5.8 There is no industry standard for spacing, only manufacturer recommendations, computer modelling and professional judgment. Six times rotor diameter on the predominant wind direction against four times rotor diameter cross wind (6D x 4D) is a common starting point. This is understood to provide a reasonable compromise between turbine proximity and site capacity without unduly compromising turbine operation. The

Proposed Development may, however, employ turbines which are not yet on the market. Therefore, a more flexible methodology utilising wind yield modelling was used to find the right balance of turbine efficiency and productivity over a wide variety of potential rotor diameters.

Landscape Character and Visual Amenity

2.5.9 The landscape and visual environment of the Proposed Development has been a key consideration throughout the design process. Landscape and visual constraints do not generally constitute technical or 'hard' restrictions to development but are rather 'design considerations' that inform the layout design process. These considerations, many of which are key sensitive landscape and visual receptors, are found both on the Site and within the surrounding study area.

2.5.10 On Site considerations include:

- the landform of the Site, in terms of its scale, elevation, and complexity; and
- the topography of the Site, including the patterns of the landscape such as watercourses, field boundaries, and woodland.
- considerations in the wider study area include:
- effects on the landscape character and landform of the Kilpatrick Hills, and the role that these hills play in the wider landscape context;
- effects on the Special Landscape Qualities of national landscape designations, including Loch Lomond and the Trossachs National Park (LLTNP) and Loch Lomond National Scenic Area (NSA), which lie to the north of the Site;
- views from key sensitive visual receptors, including;
    - long distance walking/recreational routes (e.g. the West Highland Way, the John Muir Way, waterborne routes on Loch Lomond, and National Cycle Route 7);
    - settlements (e.g. the closer proximity settlements of Dumbarton and Vale of Leven, settlements to the south of the Clyde such as Langbank and Port Glasgow, and smaller settlements around Loch Lomond such as Balmaha, Drymen, Gartocharn and Luss);
    - walking destinations (e.g. Conic Hill, Ben Lomond, Dumgoyne Hill, Duncryne Hill, The Whangie, the Kilpatrick Hills and the Luss Hills);
    - visitor attractions (e.g. Balmaha, Dumbarton Rock, Finlaystone Estate, Luss, and the waterbody of Loch Lomond and its islands); and residents of the area around the Site, whose visual amenity may be affected by the Proposed Development.

2.5.11 **Chapter 5: Landscape and Visual Impact Assessment** (LVIA) describes the effects of the Proposed Development in relation to these considerations, and a range of viewpoints that represents the appearance of the Proposed Development from key landscape and visual receptors has been illustrated and described in the LVIA. The Design Statement explains the iterative process of design and describes how the final layout of the Proposed Development has taken these considerations into account.

Ecology and Ornithology

2.5.12 Ecological surveys have been carried out across the Site and surrounding area from 2020 to 2022, including a Phase 1 habitat survey, a National Vegetation Classification Survey, fisheries survey, and protected species surveys (including bats, pine marten, badger, otter, water vole, red squirrel). Sensitive and protected ecological features and appropriate buffers have been avoided. Sensitive habitats within the Site have been avoided where possible, or where unavoidable the potential impacts reduced as far as practicable. Areas of priority peatland habitat have been avoided where possible, and the recommended habitat standoff distances from blade swept path to key habitat features have been incorporated into the design to reduce collision risk to bats.

2.5.13 Ornithology surveys have been carried out across the Site and surrounding area since March 2019, including vantage point watches; black grouse surveys, scarce breeding birds (for raptors and divers listed in Schedule 1 of the Wildlife and Countryside Act 1981 and Annex 1 of the EU Birds Directive), breeding birds (waders) and winter walkovers for non-breeding birds. Suitable buffers were considered during the design evolution process and areas have been avoided owing to the presence of black grouse lekking sites.

Noise-Sensitive Receptors

2.5.14 For the purposes of early constraints mapping, avoidance buffers of 1 km were applied to residential properties in the vicinity of the Site. These buffers were further refined during the design process based on expert noise advice.

2.5.15 The Proposed Development is located in an area of fairly low population density. The nearest residential properties identified are greater than 1.7 km to the closest turbine. Three of the closest residential properties were identified for noise monitoring, and were considered representative of neighbouring residential properties closest to the turbines. Subsequently, suitably qualified noise and acoustics specialists conducted noise monitoring at the identified properties.

2.5.16 The difference between measured background noise levels and operational predicted noise levels was assessed according to the guidance described in the ETSU-R-97: 'The Assessment and Rating of Noise from Wind Farms' (Department for Trade and Industry, 1996) to assess the potential effects with a view to ensure that the impact on amenity of all nearby properties was within acceptable limits. The recommendations of the Institute of Acoustics 'Good Practice Guide to the Application of ETSU R 97 for the Assessment and Rating of Wind Turbine Noise' were also considered. Applying this design criteria in accordance with ETSU guidance as part of this assessment ensures that no exceedances of acceptable noise levels would occur from the Proposed Development.

2.5.17 The potential noise effects of the Proposed Development are addressed further in **Chapter 11: Noise and Vibration**.

Forestry

2.5.18 No forestry associated impacts are anticipated from any of the proposed wind turbines on site, as these are well sitted outwith woodland areas. Nevertheless, the access track for the proposed development will impact upon a small area (approximately 0.1ha) of woodland, within the Murroch Glen and Barr Wood Ancient Woodland Inventory (AWI) sites, resulting in the felling of up to 28 mature/semi-mature beech (Fagus sylvatica) hedgerow trees, and up to 3 mature Downy Birch (Betula pubescens), to facilitate construction of the track. Woodland loss has been minimised by routing the Site Access between the parallel old boundary/hedgerows as far as practicable. Furthermore, it has been confirmed from site surveys that several of the identified trees that could be affected, are already partially windblown and/or suffering from extensive decay.

2.5.19 The areas of forestry that would be affected to facilitate the Proposed Development are shown in **Technical Appendix 14.1: Assessment of Impact on Trees & Woodland** along with site survey results and photography. Forestry issues and compensatory planting requirements are discussed further in **Chapter 14: Other Issues**. Additionally, enhancement measures have been identified and are proposed as part of the habitat enhancement measures reported in **Chapter 6: Ecology,** and discussed further in the **Outline Biodiversity Enhancement Management, Technical Appendix 6.6.**

Telecommunications

2.5.20 Consultation was undertaken with the relevant telecommunication link operators to inform the telecommunications links within the vicinity of the Site and to advise their position with respect to the Proposed Development.

Aviation

2.5.21 Consultation was undertaken with the relevant aviation consultees to identify whether the Proposed Development would have an impact on aviation interests. Aviation is discussed further in **Chapter 13: Aviation and Radar**.

Shadow Flicker

2.5.22 There are no formal guidelines currently available on what exposure would be acceptable in relation to shadow flicker. There is no standard for the assessment of shadow flicker. The Scottish Government's web-based guide relating to onshore wind turbines (Scottish Government, 2013) suggests that shadow flicker should not cause nuisance and annoyance to dwellings beyond a distance of 10 rotor diameters from a wind turbine, which equates to up to 1720 m in this instance. During the design process, a study area of ten rotor diameters was applied to the turbines for proposed design schemes to test for potential shadow flicker effects. Turbines in the final proposed layout would not be within a ten rotor diameter distance of regularly occupied buildings; however, a complete assessment was conducted in any case to ensure a robust assessment. The potential shadow flicker effects of the Proposed Development are addressed further in **Chapter 14: Other Issues**.

2.6 Consideration of Alternatives

2.6.1 With respect to the Proposed Development, the alternatives considered were as follows:

- different turbine and infrastructure layouts/locations within the Site;
- alternative turbine heights/dimensions; and
- different access routes to and from the Proposed Development site in terms of delivery of AIL.

2.6.2 The design and layout of the Proposed Development was adapted and altered in response to environmental constraints and consultation feedback. The environmental features which constrain the Site are illustrated by **Figure 2.2**. The Proposed

Development went through a series of four design iterations. Each of these layouts is shown on **Figure 2.4** and a summary of the layout iterations is included in **Section 2.7**.

2.6.3 In considering turbine heights and dimensions, a maximum turbine tip height and approximate rotor diameter has been selected for the purposes of design and assessment of impacts. However, it should be noted that a single candidate model of the turbine has not been specified. Therefore, for the purposes of assessment, where relevant for each technical assessment, turbine models that adhere to the limits of stated dimensions, and provide the realistic relevant worst-case impact, have been assumed.

2.7 Design Evolution and Development of the Preferred Option

2.7.1 The Proposed Development has undergone four principal iterations of the layout which have been developed at different stages in the project design process:

- **Layout A** –19 turbine Scoping layout, each with a maximum height to blade tip of 200 m, representing a wind optimised layout;
- **Layout B** – 10 turbine layout, each with a maximum height of 250 m to blade tip, informed by a detailed landscape appraisal and early results of onsite surveys and consultant inputs;
- **Layout C** –10 turbine refined layout with a maximum height of 250 m, including Site Access and internal access, reflecting further baseline environmental surveys, alongside a preliminary design of ancillary infrastructure; and
- **Layout D** – the final Site layout comprising 10 turbine layout with a maximum height of 250 m with a detailed design of ancillary infrastructure and access route through Murroch Farm.

2.7.2 Design iterations (A to D) are shown on **Figure 2.4**.

2.7.3 The layout iteration process has been informed by the landscape and visual design discussed in greater detail in **Chapter 5 Landscape and Visual Impact Assessment**.

Layout A –Scoping Layout

2.7.4 The first design was developed prior to any detailed site-specific surveys being completed. The layout was based on information available at the time, including baseline environmental data recorded in the Merkins Wind Farm Environmental Statement and collected from desktop studies. In addition, technical constraints were considered, such as turbine separation distances of approximately 6 and 4 rotor diameters in downwind and cross wind directions respectively (based on a 162 m rotor) and the anticipated wind variation over the Site with topography. The scoping layout had 19 turbines with a maximum blade tip height of 200 m. These turbines were distributed across the Site and represented the maximum number of turbines that could be fitted onto the Site within the parameters of onsite constraints such as watercourses and steep slopes.

2.7.1 When the appearance of Layout A was reviewed, it became apparent that the distribution of turbines across the Site was leading to a development that extended widely across the landform of the Kilpatrick Hills and therefore across many views, with notable variations in the ground levels of the turbine bases. The arrangement of turbines also led to eye-catching clustering and overlapping of turbines in some views, with gaps appearing between groups of turbines.

2.7.2 As a result, a layout review was carried out with the chief objective of improving the appearance of the wind farm. This recommended the following actions:

- removal of turbines from the northern part of the Site;
    - to reduce the extent of the wind farm across almost all views, including those from key sensitive routes, settlements and residential properties as well as LLTNP and the Loch Lomond NSA;
    - to increase the distance of the wind farm from residential properties that lie to the north of the Site;
    - to increase the distance of the wind farm from LLTNP, Loch Lomond NSA, West Highland Way, John Muir Way and National Cycle Route 7;
    - to remove turbines from the part of the Site that has the lowest landform elevation;
- removal of turbines from the southern part of the Site;
    - to remove the most prominent turbines (the southern part of the Site is the most elevated area);
    - to reduce the extent of the wind farm across a number of views, including those from key sensitive routes, settlements and residential properties as well as LLTNP and the Loch Lomond NSA;
    - to increase the distance of the wind farm from a number of important locations, including Overtoun House, Dumbarton Rock and settlements that lie to the south of the Firth of Clyde;
- rationalisation of turbines in the central part of the Site;
    - to reduce the clustering and overlapping of turbines;
    - to increase the distance of turbines from sensitive locations around the Site;
    - to create a compact, balanced and cohesive array of turbines; and
    - to ensure relatively uniform ground levels of the turbine bases.

2.7.3

Layout B

2.7.4 Following completion of detailed site-specific surveys, which refined the environmental baseline and key constraints, a design workshop was held with technical specialists to achieve an improved layout of turbines (with consideration given to other infrastructure). This layout was presented at a series of public exhibition events in October 2022 (as detailed further in **Chapter 3: Environmental Impact Assessment Process**).

2.7.5 Implementation of the actions described above in relation to Layout A led to the design of Layout B. Landscape and visual issues were a key driver of Layout B, with all other parameters also taken into consideration, and this layout represented the main landscape and visual iteration in the full design process. Layout B comprised ten turbines that are located on the central part of the Site, with the northern and southern turbines being removed. The reduction in turbine numbers from 19 to ten allowed turbines to be located at a greater distance from residential properties and other sensitive receptors, including LLTNP and Loch Lomond NSA. The reduction in turbine numbers also reduced the overlapping and clustering of turbines, ensuring the production of a more balanced and cohesive layout that responded to the site landform.

2.7.6 This layout has an increased blade tip height of 250 m, which was considered appropriate in landscape and visual terms as the landform of the site is considered to have the ability to accommodate turbines of this scale, and due to the benefits arising from the reduction in turbine numbers described above.

2.7.7 The location and sensitivity of all identified environmental receptors were mapped in this iteration, and appropriate buffers around them were agreed between the technical specialists and project engineers. The following design principles and buffers were applied during this design iteration:

- 50 m buffer from watercourses;
- turbine separation distances of approximately 6 and 4 rotor diameters in downwind and cross wind directions respectively (based on a 162 m rotor diameter);
- 30 m buffer from designated heritage assets of medium importance and 10 m buffer from non-designated heritage assets;
- avoidance of areas of deep peat (>1 m depth);
- avoidance of development on slopes greater than 15% gradient;
- avoidance of the most sensitive habitats and protected species; and
- 75 m buffer from Dumbarton Muir Site of Special Scientific Interest (SSSI).

Layout C

2.7.8 A detailed infrastructure design was completed based on Layout B. The key design principles for the access track network were included as far as practicable, and designed to minimise new watercourse crossings. This resulted in the micrositing of turbines T1, T2, T3, T4, T7 and T10.

Further survey work comprised an engineering walkover, detailed peat depth survey and a site visit to identify any woodland within and close to the Site.

Layout D – Final Layout

2.7.9 Layout D represents the final stage of design iteration, which included finalisation of turbine locations and siting and design of ancillary infrastructure. Landscape and visual issues were considered throughout, with the layout being tested against the LVIA viewpoints to ensure that effects mitigated in Layout B were not increased by the movement of turbines.

2.7.10 Further survey work comprised a further peat depth survey, and an archaeological desk based review followed by a walkover survey. Additionally, desk-based assessments comprising a theoretical visibility mapping exercise for the proposed lit turbines to review the potential landscape and visual impacts and a review of Layout D by the construction design and management (CDM) principal designer and lead engineer was conducted.

2.7.11 A second design workshop was held to review Layout D and to identify locations for additional ancillary infrastructure, including the substation and battery storage compound, mobilisation compounds, and potential borrow pit locations. This led to a chilled layout being identified to be taken forward for further review.

2.7.12 The Phase 2 Peat Survey further covered the chilled turbine layout indicative track, and ancillary infrastructure for deep peat. The survey confirmed that all turbines and ancillary infrastructure were placed outwith pockets of deep peat., 2.7.13 The final layout including ancillary infrastructure is shown on **Figure 2.5**.

2.7.14 Individual technical assessment chapters in the EIA Report refer to design input in further detail and respond to specific matters..

2.8 The Proposed Development

Key Components

2.8.1 The Proposed Development infrastructure would comprise the following components:

- ten wind turbines of approximately 7 megawatts (MW) each, with a maximum blade tip height of up to 250 m;
- hardstanding areas at the base of each turbine, with a permanent area of approximately 7,800 m^2
- site entrance and wind farm access track up to 9.2 km in length from the south-west, via a new road through Murroch Farm, accessed from a new junction on the A813 Stirling Road, roughly opposite the Aggreko Lomondgate facility in Dumbarton;
- sub-station/control building with parking and welfare facilities;
- a network of onsite access tracks and up to 4 associated watercourse crossings;
- transformers and underground cables to connect the turbines to the onsite substation;
- telecommunications equipment;
- 3 temporary construction compounds and laydown area;
- 3 borrow pit search areas, to provide suitable rock for access tracks, turbine bases and hardstandings; and
- Battery Energy Storage System (BESS) with a capacity up to 20 MW.

Outline Biodiversity Enhancement Management Plan

2.8.2 A number of biodiversity enhancement measures are proposed as part of the Proposed Developments Outline Biodiversity Enhancement Management Plan (OBEMP). The OBEMP includes provisions for the protection, maintenance, restoration and/or enhancement of bog habitats locally, and also for the respective qualifying habitats within Auchenreoch Glen Site of Special Scientific Interest (SSSI). Furthermore, the OBEMP would deliver native broadleaved and mixed scrub enhancement, creation and expansion to enhance the existing broadleaved woodland and the assisted regeneration of ancient woodland areas, with the aim also to increase woodland connectivity and join up fragmented stands locally. The OBEMP also aims to deliver native hedgerow creation. This is discussed in greater detail in **Technical Appendix 6.6 Outline Biodiversity Enhancement Management Plan.**

Wind Turbines

Turbine Parameters

2.8.3 The turbines would have an approximate rotor diameter of 172 m. The model and actual dimensions of the wind turbines ultimately selected would be influenced by the economic market and technological advances at the time of procurement. However, blade tip height would not exceed 250 m. Indicative elevations are shown on **Figure 2.6**. Grid references and height above sea level, above Ordnance Datum (AOD) for the proposed turbines are identified in **Table 2.1**.

Table 2.1: Proposed Turbine Locations

Turbine	Easting	Northing	AOD
T1	242765	680409	248
T2	243513	680750	240
T3	243839	680273	263
T4	244381	680187	252
T5	243030	679926	220
T6	243358	679635	241
T7	244174	679536	273
T8	242788	679247	241
T9	243220	679022	248
T10	243765	678865	304

2.8.4 The proposed turbine locations and ancillary infrastructure would be subject to a proposed maximum micrositing tolerance of 50 m in any direction. This tolerance allows for minor changes in turbine or infrastructure location to respond to possible variations in ground conditions across the site, which will be confirmed following detailed site investigation work carried out prior to construction. In those places where environmental features may be affected by micrositing, tolerance would be constrained to less than 50 m, and such changes would be managed in consultation with an Environmental Clerk of Works (ECoW) for the Proposed Development during its construction phase. The micrositing constraints relevant to the Proposed Development are outlined in each technical chapter. Any movement of turbines or other infrastructure from the Proposed Development layout (shown in **Figure 2.5**), outwith the micrositing tolerance, would be agreed with WDC prior to construction, in accordance with the mitigation measures set out in this EIA Report.

2.8.5 A summary of the proposed mitigation commitments is provided in **Chapter 15: Schedule of Environmental Commitments**.

Turbine Design

2.8.6 The turbines would be three bladed, horizontal axis turbines with solid tubular towers. The blades would be made from reinforced composite materials such as fibreglass. The turbine towers would be made of steel.

2.8.7 The wind turbines would be of the same basic appearance and colour. It is proposed that the turbines would be of a matt grey colour finish. Although off-white has been an accepted colour for turbines, more recently constructed wind turbines have been a mid-grey tone, which reduces the distance over which turbines are visible, especially in dull weather or low light conditions. The choice of material and colour for the proposed turbines is an important consideration in terms of visual impact. Finishing would be expected to be agreed by a condition placed on consent.

Turbine Foundations

2.8.8 Turbine foundations would be dependent upon site-specific ground conditions at the turbine locations and the type of turbine chosen. However, it is envisaged that installation of the turbines using a steel reinforced concrete base (gravity foundation) would be suitable.

2.8.9 The concrete gravity foundations would be located underground. Therefore, a quantity of earth would need to be removed. The amount of earth to be removed would depend upon site-specific ground investigations at each turbine location. Topsoil, peat and other material would be removed from the foundation area and stored so that it may be used later for reinstatement. Indicative details on construction requirements and metrics are discussed and analysed further **Chapter 14: Other Issues**, and **Technical Appendix 14.1: Carbon Calculator.**

2.8.10 Turbine foundations would be set down to the depth of suitable bearing strata with an approximate diameter of 28 m with a circular or octagonal plan shape (see **Figure 2.7** for indicative turbine foundations). Should geotechnical investigations demonstrate that the required bearing capacities are not achievable, then a piled foundation design would be adopted using the same overall design footprint.

2.8.11 An anchor ring and foundation bolts would be cast into a central column onto which the turbine tower would be fixed. Concrete for the foundations would either be delivered to the Proposed Development in a "ready mix" form or processed in a concrete batching plant located onsite within a construction compound.

2.8.12 For the purposes of this EIA Report, a maximum (worst-case) scenario for turbine foundations of a 3 – 4 m depth and 28 m by 28 m circular or octagonal footprint has been assumed. The concrete bases would be allowed to cure (i.e., reach its design strength) before turbines are fitted.

Turbine Lighting

2.8.13 As discussed in greater detail in **Chapter 13: Aviation and Radar**, the Air Navigation Order Article 222[3] requires turbines with a tip height of or exceeding 150 m to display aviation lighting to indicate their presence. Dispensations for reduced lighting schemes can be agreed with the Civil Aviation Authority (CAA), according to the guidance provided in CAP-7648[4].

2.8.14 In accordance with the guidance in the UK Certification Specification & Guidance Material for Aerodrome Design, a reduced lighting scheme has been designed that would identify the perimeter of the Proposed Development and the highest turbine within it. The final lighting specification scheme to be implemented will be submitted to the Planning Authority and CAA prior to construction.

2.8.15 Further information on aviation turbine lighting is provided in **Chapter 13: Aviation and Radar** and mitigation is particularly discussed in **Section 13.7**. Further discussion of the

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[3] UK Statutory Instruments (2016), The Air Navigation Order Part 8 Chapter 2 Article 222. Available at: https://www.legislation.gov.uk/uksi/2016/765/article/222/made [accessed January 2023].

[4] Civil Aviation Authority (2016), CAP 764: Policy and Guidelines on Wind Turbines. Available at: https://publicapps.caa.co.uk/modalapplication.aspx?catid=1&pagetype=65&appid=11&mode=detail&id=5609 [accessed January 2023].

way turbine lights would be perceived is provided in **Chapter 5: Landscape and Visual Impact Assessment**.

Turbine Erection

2.8.16 The Turbine components would be delivered to the relevant storage area for each component, whether it be to a specific turbine hardstanding or to a storage area located at one of the construction compounds, until weather conditions are appropriate for turbine erection. The bottom turbine tower section would firstly be fixed to the anchor ring and foundation bolts embedded into the central column of the foundations, followed by the upper turbine tower sections, all being lifted into place by two cranes (a heavy lifting capacity crane, and a smaller service crane). The cranes would then lift the nacelle into place on the top section of the turbine tower. Blades would then be fitted individually to the rotor hub.

Turbine Hardstanding

2.8.17 Level hardstanding areas are required adjacent to each turbine base for the operation of a heavy lifting capacity crane, and a smaller service crane, used for assembly of the turbine components. They would also be used as storage areas for the turbine components. The hardstandings would be to the same general specification as the turbine access tracks that they adjoin, but a slightly greater depth of construction is envisaged.

2.8.18 It is anticipated that each permanent hardstanding would be approximately 80 m x 40 m with a 6 m wide track running along the length of the hardstanding. The cut-and-fill batters required on the hardstandings would be dictated by pre-construction detailed Site Investigation (SI) surveys. In addition to the hardstanding for the main assembly crane, up to two additional temporary crane pads may be required for crane assembly. These crane pads are shown by **Figure 2.8**.

2.8.19 The hardstandings would be constructed using suitable surplus material generated from the excavation process elsewhere within the turbine area and from onsite borrow pits where possible. Topsoil and peat would be excavated, and stone laid and compacted to the required depth. The depth of the hardstandings would be dependent on the ground conditions at specific locations.

2.8.20 Each turbine would be expected to have an associated transformer, located either internally or externally to the turbine. External transformers would be located within weather-proof housing, which would have indicative dimensions of 5.5 m by 5.5 m by 3 m. Transformer housing would be colour finished to blend in with the surrounding landscape.

Onsite Access

Site Entrance

2.8.21 The entrance to the Proposed Development site for vehicles delivering both construction materials and turbine components, such as tower sections and blades, would be from a new road, via Murroch Farm, to the south-west of the Site. The road would be accessed from a new junction on the A813 Stirling Road, roughly opposite the Aggreko Building.

From A813, the access track would be approximately 2 km in length until reaching the first wind turbine. Indicative Site Access details are illustrated by **Figure 2.10** and are discussed further in **Chapter 9: Traffic and Transportation**.

Internal Access Tracks

2.8.22 The Site tracks would be developed to meet the requirements of appropriate criteria (such as visibility, construction materials, surface water drainage, gradient, and safety of other road users). The following objectives were adopted during the track design:

- tracks make use of existing infrastructure and track/disturbed ground where suitable;
- track length is kept to a minimum to reduce construction time, the requirement for stone, land-take, and to reduce associated environmental effects;
- gradients to be kept to acceptable levels to accommodate the requirements of delivery vehicles, including AIL, and to allow construction plant to move safely around the Site;
- tracks are routed to avoid sensitive hydrological, ecological and archaeological features as far as practicable and to keep watercourse crossings to a minimum;
- tracks are routed to minimise tree translocation and/or felling requirements;
- to facilitate safe access to each wind turbine, ground with potential instability and deeper areas of peat has been avoided;
- tracks are designed to minimise the required cut-and-fill quantities;
- horizontal and vertical alignments of tracks are designed in such a way as to comply with Turbine Supplier requirements, for example minimum turning radius and vertical curvature on both the tracks and hardstandings;
- to build health and safety aspects into track design from an early stage, including avoiding slopes which would be too steep for access and creating clear definitions between turbine working areas and access tracks;
- to minimise watercourse crossings;
- to avoid disturbance to public access; and
- tracks used by construction vehicles would be retained throughout the lifetime of the Proposed Development for use by maintenance vehicles. The running width of the tracks would be a minimum of 5.5 m with some localised widening and a requirement for passing places and laydown areas. The track surface would have a cross fall for the runoff to drain into ditches on the downhill side of the track where necessary. Lateral and cross drains would also be installed, with erosion protection, where required.

2.8.23 The access track would generally be unpaved (stone surface) and of a minimum of 5.5 m running width, with a 1 m shoulder verge to either side and 2:1 side slopes. The track could be up to 7 m wide on bends. The access tracks are shown in **Figure 2.11**.

2.8.24 Approximately 9.2 km of new access track would require construction. Five turning heads of sufficient size to accommodate articulated vehicles would also be provided at several locations, as indicated on **Figure 2.5.** Some further widening would be necessary along the access track route to allow for passing places/temporary lay down areas, with the locations subject to detailed design post-consent.

2.8.25 In general terms, the construction method would see topsoil, including peat, being removed and stored adjacent to the construction area until required for reinstatement. The Peat Management Plan (**Technical Appendix 8.2**) states methods for reuse of the excavated material and provide guidance on management and handling of excavated peat and soils. All construction works would be conducted in accordance with a project Construction Environmental Management Plan (CEMP). The CEMP would be submitted to WDC for review and approval prior the construction works commence.

2.8.26 The tracks would be constructed in layers, with a geo-textile membrane if required, overlain by a base of coarse stone, and subsequent layers of higher graded crushed stone. Each layer of stone would be compacted and shaped to provide a profile and surface finish of a quality suitable for the turbine construction vehicles. The estimated depth of stone would be 750 mm, though the final thickness used would be dependent on local ground conditions and load capacity.

2.8.27 The requirements for access track drainage would be determined at detailed design stage and onsite during construction. The access tracks would have a suitable cross-fall to drain run-off and, where gradients are present, lateral drains would intercept any flow along the road. The dimensions of the lateral drains would be matched to the estimated water flow and outlets would be suitably located with erosion protection as required.

2.8.28 Where ground conditions are of a permeable nature, swales would be utilised alongside the access tracks to allow natural filtering of surface water into the ground. Where areas are less free draining, land drains or drainage ditches would be installed as topography and ground conditions dictate. Drainage filters would be installed at suitable locations to remove silts from the run-off.

2.8.29 Post construction, the vegetated turf layer would be used for reinstatement. This would allow re-establishment of natural vegetation to the area. Reuse of the turf layer is the preferred option over seeding the edges of the access track, as seeding rarely gives a representative cover and has been known to encourage deer grazing on verges.

Underground Cabling

2.8.30 The Proposed Development would comprise underground electric cables which would connect the turbines and the battery storage to the substation and control building compound. The majority of the underground power cables would run parallel to access tracks, connecting each turbine with SCADA (the cables being buried in the electrical cable trenches). An indicative cable trench is shown in **Figure 2.12**.

Watercourse Crossings

2.8.31 As part of the access track construction and associated hardstanding works, 4 new watercourse crossings would be required, locations identified in **Technical Appendix 8.3: Schedule of Watercourse Crossings**. Bridges and bottomless culverts would be used for the main watercourse crossings. Closed culverts may be used for minor drainage channels.

2.8.32 The watercourse crossings will be subject to registration under The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended) (CAR) and Water Environment (Miscellaneous) (Scotland) Regulations 2017. Further consultation with SEPA will be undertaken prior to commencement of construction by the applicant, to ensure compliance with CAR.

Borrow Pits

2.8.33 The Proposed Development would require crushed stone to construct new tracks, create hardstanding areas for the cranes and lay the turbine foundations.

2.8.34 The total estimated required quantity of aggregate is approximately 92,622 cubic metres, which is expected to be won from up to 3 onsite borrow pits, as shown in Technical **Appendix 8.4**. However, for purposes of assessing the worst-case scenario, **Chapter 9: Traffic and Transportation** assessment will consider the scenario where 50% of the track and hardstanding aggregate would be brought in from off-site sources, such as local quarries. Details are presented in **Technical Appendix 8.4: Borrow Pit Assessment**.

2.8.35 Locations for up to three borrow pits search areas have been carefully sited in areas with low peat measurements and rock exposure so as to minimise peat disturbance. As a result, the volume of topsoil/peat that would need to be removed in order to access the stone from borrow pits is limited. Further detail on the location and extent of the borrow pits is provided in **Technical Appendix 8.4**

2.8.36 The physical constraints of rock suitability and topography, and the requirement to plan for a suitable restoration scheme, have been primary considerations in the borrow pit design and location. An intrusive site investigation will be undertaken prior to construction to confirm the suitability of rock for aggregate use on site. However, this EIA Report has considered the worst-case scenario of not being able to source rock aggregate from the onsite borrow pits.

2.8.37 It is not proposed to retain any of the new proposed borrow pits post-construction. Materials are available locally so any requirement for rock aggregate during the operational phase would be met from those sources. It is anticipated that there would be a planning condition imposed upon consent with a requirement to agree the approach to restoration.

2.8.38 Rock extraction from borrow pits by means of blasting operations is not anticipated, especially at Borrow Pit Search area one, as shown in **Technical Appendix 8.4: Borrow Pit Assessment**, which is the nearest to residential properties. In the event that blasting would be required at Borrow Pit Search areas 2 and 3, during the construction of the Proposed Development, there would be no anticipated noise impacts due to the distance between the nearest noise receptors, and borrow pit search areas. Additional information on anticipated noise impacts are provided in **Chapter 12: Noise and Vibration.**

Substation Compound

2.8.39 The indicative layout and elevations of the substation compound are shown on **Figure 2.13** and **Figure 2.14**. The substation compound is split into two separate compounds, an Independent Power Producer (IPP) compound (to be used by the applicant) and a Transmission Network Operator (TNO) compound (to be used by Scottish Power Energy Networks). A separate control building would be located in each compound.

2.8.40 The substation compound would measure approximately 100 m x 75 m and would contain a storage yard/laydown area. The substation compound would be enclosed by palisade type fencing. Lighting would be kept to a minimum and would be limited to working areas only and would comply with health and safety requirements. Lighting would be down lit and linked to timers and movement sensors to reduce potential light pollution.

IPP Compound and Control Building

2.8.41 The IPP compound would contain a 132 kV (kilovolt) to MV (medium voltage) grid transformer (with over the fence connection to the TNO 132 kV AIS switchgear bay), a house transformer, a Neutral earth Resistor (NER) and possibly a harmonic filter or VAR (volt-ampere reactive) support unit.

2.8.42 A single storey control building would house MV switchgear, control and protection equipment, SCADA (supervisory control and data acquisition) equipment, LV battery systems, welfare facilities (toilet, washing and basic food preparation area), telecommunications equipment, workshop and offices. The approximately 18.3 m x 11.3 m control building is shown in **Figure 2.13**. The control building welfare facilities would include a suitably sized foul waste holding tank, which would be emptied by tanker and removed from the project area on an appropriate timescale for disposal at a suitably licensed off-site facility or a composting toilet, and bottled water or a small water bowser. The details of the final system to be put in place would be agreed with WDC and secured by an appropriately worded condition.

2.8.43 Cable arrays from the turbine transformers would converge at the IPP compound control building.

2.8.44 The IPP control building would be constructed in keeping with the local built environment. The final designs for the building and compound would incorporate sustainable design features and would be agreed with West Dunbartonshire Council (WDC).

TNO Compound and Substation Building

2.8.45 The TNO compound would contain a 132 kV AIS switchgear bay to which the 132 kV underground grid cable would connect at one end. At the other end of the 132 kV AIS switchgear bay an over the fence connection to the IPP grid transformer would be facilitated.

2.8.46 The TNO control building would likely comprise of a single storey modular unit measuring approximately 12.5 m x 10 m as shown in **Figure 2.13**. The control building would house control and protection equipment, SCADA equipment, LV battery systems, stores and welfare facilities.

2.8.47 The TNO control building would be constructed in keeping with the local built environment. The final designs for the buildings and compound would incorporate sustainable design features and would be agreed with WDC and secured by an appropriately worded condition.

Energy Storage

2.8.48 It is the applicant's intention to retain the construction compound located immediately adjacent to the substation, for the purpose of hosting a co-located energy storage facility for the duration of the Proposed Development. This is anticipated to comprise a lithium-ion battery technology solution, with modular elements comprising a number of battery housings (either standard ISO containers, electrical-houses ('eHouses') or otherwise) with associated heating, ventilation and air-condition (HVAC) systems, along with paired power conversion systems (PCS) comprising bi-directional inverters and transformers, as well as central switchgear, metering and transformer, and space for access and operations.

2.8.49 This area of technology is currently fast-evolving in terms of:

- technological advances in battery energy density and performance; and
- the design and existence of various potential service markets for providing revenues; and

2.8.50 For this reason, indicative designs for the installation have been provided in **Figures 2.15** and **2.16**, which form the basis of the EIA presented in this EIA Report. These indicative parameters are considered to represent the realistic worst-case scenario in EIA terms. The battery technology type for the Proposed Development would meet all the relevant safety and environmental standards. All requirements for environmental (e.g., PPC permitting) or health and safety consents (e.g., COMAH) would be discussed, confirmed and agreed with WDC prior to construction.

2.8.51 To minimise additional land- take by utilising the substation construction compound (100 m x 75 m), and as illustrated indicatively on **Figures 2.15** and **2.16**, it is considered possible to achieve an arrangement comprising approximately 14 2.6 m x 16.1 m ISO containers with top-mounted HVACs, each with a single accompanying PCS, along with a single 2.6 m by 11.4 m switchgear container, assuming that other electrical elements (including metering and grid-connection transformer) could be either included within or shared with the wind farm substation compound. Based on a current industry Grid Battery Storage solution, where a 16.1 m-long container can host between 1.2 MW (power): 5.3 MWh (energy) at configuration for “maximum energy” (roughly 4.1 hours duration), and 7.2 MW:3.8 MWh at “maximum power” (roughly 0.5 hours duration), this could relate to an indicative system of anywhere between 21.6 MW:95.4 MWh to 129.6 MW:68.4 MWh. Sufficient space within the substation construction compound remains to accommodate the battery energy storage facility alongside any bunding or drainage required.

2.8.52 The applicant’s final choice of battery model would ensure compliance with the above parameters. The number, dimensions, housing type, finish, arrangement, security fencing and landscaping of energy storage elements would be agreed with WDC prior to construction of the battery storage facility.

Permanent LiDAR

2.8.53 A permanent LiDAR (“light detection and ranging”) facility is to be included within the substation compound, shown on **Figure 2.5**. The unit would be connected to the Proposed Development’s Supervisory Control and Data Acquisition (SCADA) system. Power supply and data transfer would be via wind farm cabling (buried in the electrical cable trenches). A backup power system, data logger and a small storage facility would be sited at the LiDAR location.

Construction Phase

2.8.54 Construction of the Proposed Development is anticipated to take approximately 21 months from mobilisation to completion.

2.8.55 An indicative construction programme is set out below. Many of these construction activities would be carried out concurrently, although predominantly in the order set out in **Table 2.2**. A more detailed construction plan would be prepared prior to construction.

Table 2.2: Indicative Construction Programme

Activity	Month																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Site Establishment	■	■	■																		
Forestry Felling and Timber Export	■	■																			
Construction of New Access Tracks and Crane Hardstandings			■	■	■	■	■	■	■	■	■	■									
Turbine Foundation Construction				■	■	■	■	■	■	■	■	■									
Substation, Energy Storage and Electrical Works				■	■	■	■	■	■	■	■	■									
Cable Trenching and Installation						■	■	■	■	■	■	■	■	■							
Crane Delivery												■									
Turbine Delivery, Erection and Commissioning													■	■	■	■	■				
Site Re-Instatement				■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

Construction Traffic

2.8.56 The largest volume of traffic is anticipated during the construction phase of the Proposed Development, when vehicles are likely to be travelling from major centres and ports to deliver materials to the Site. The origins of materials and goods are expected to be from the Central Belt of Scotland, with traffic using the A82 and A813 to avoid residential areas. Further detail is provided in **Chapter 9: Traffic and Transportation** and the proposed Abnormal Indivisible Load (AIL) route is shown in **Figure 9.4**.

Construction Workforce

2.8.57 A detailed construction workforce schedule, i.e., employee numbers throughout the construction programme, and likely shift patterns, would not be known until the contract for building the Proposed Development has been awarded; however, the maximum number of staff likely to be onsite at any one time would be 50.

Mobilisation Construction Compound

2.8.58 During the construction period, a temporary mobilisation construction compound would be required. This would facilitate the construction activities prior to the main construction compounds becoming operational. The location of the compound is shown on **Figure 2.5**.

2.8.59 To create the mobilisation compound, turf and topsoil would be stripped and bunded at the edge of the compound. A layer of geotextile membrane would be placed on the subsoil, and Type 1 aggregate stone would be imported and compacted to create temporary surfaces. Appropriate temporary drainage would be installed around the compound. The compound would be decommissioned on completion of construction activities.

2.8.60 The compound would be located at the beginning of the access track near the public road, and its dimensions would be 30 m x 30 m.

Construction Compounds

2.8.61 During the construction period, a construction compound would be required that would include a laydown area for wind turbine components, and dimensions would be 120 m x 60 m. The location of the construction compound is shown on **Figure 2.5**.

2.8.62 The main construction compound would include temporary cabins, to be used for the site offices, the monitoring of incoming vehicles and welfare facilities for site staff including toilets; parking for construction staff visitors and construction vehicles; secure storage for tools and small parts; a receiving area for incoming vehicles; and temporary security fencing around the compound.

2.8.63 The compound would be used as a storage area for the various components, fuels and materials required for construction. Typically, the major structural components of the turbines would be delivered directly to the turbine hardstandings. Temporary lay-down areas, forming part of the crane hardstandings, would be provided for parking and unloading vehicles, including AIL. Indicative crane hardstanding drawings are provided in **Figure 2.8**.

2.8.64 Any lighting would be directional in accordance with Institute of Lighting Professionals (ILP) guidance and mounted on the individual portacabins.

2.8.65 The construction compound and lay down areas would be constructed by first stripping the topsoil, which would be stored in a mound for subsequent reinstatement at the end of the construction period, in line with industry best practice[8]. Care would be taken to maintain separate stockpiles for turf and the different soil types to prevent mixing during storage. A geotextile would then be placed on the sub-stratum, which would be overlain by a working surface of stone to approximately 750 mm thickness. Measures for ensuring compliance with industry best practice would be set out in a CEMP that would be finalised and agreed with WDC.

2.8.66 Reinstatement would involve removing the stone and underlying geotextile before carefully ripping the exposed substrate and replacing the excavated soil.

Construction Hours

2.8.67 It is anticipated that the main construction hours for the Proposed Development would be between 07:00 and 19:00 hours Mondays to Fridays, and 07:00 to 13:00 hours on Saturdays, unless otherwise agreed with West Dunbartonshire Council (WDC). Certain activities, such as electrical works in the substation, or turbine erection in the event of delays due to high winds, may require to be undertaken outside of these hours.

2.8.68 Construction hours generally also apply to the delivery of materials to the Proposed Development; however, abnormal loads may be delivered outwith these hours, when the road network is at its quietest, to reduce traffic disturbance. Delivery of the nacelles, towers and blades to the Proposed Development site would require the use of abnormal sized and slow-moving trucks. These trucks would require a police escort and the timing of these deliveries may be dictated by the police. More details can be found in **Chapter 9: Traffic and Transportation** and in **Technical Appendix 9.1 Transport Assessment. Assessment**.

Access

2.8.69 There are Rights of Way crossing the Site and the Site is accessible to the public via general access rights under the Land Reform Act (Scotland) 2003. During construction, access to areas where construction is taking place, or when there are construction related activities, may be restricted for health and safety purposes in accordance with the Construction (Design and Management) Regulations 2015. In this instance, notices would be placed in prominent locations around the Site outlining any areas of restricted access. Measures for ensuring public safety during construction would be agreed in advance with WDC's Access Officer and set out in the CEMP. The CEMP would outline measures to inform recreational users of the construction work and direct users into safe areas where there would be no conflict with plant and machinery.

Operational Phase

Turbine Monitoring and Control

2.8.70 All turbines are controlled by a Supervisory Control and Data Acquisition (SCADA) system, which would gather data from all the turbines and provide the facility to control them from a remote location. The SCADA system would gather data from all the turbines via communications cables connecting to each turbine (the cables being buried in the electrical cable trenches).

2.8.71 In the case of any fault, including over-speed of the blades, overpower production, or loss of grid connection, the turbines shut down automatically through integrated braking mechanisms. They are also fitted with vibration sensors so that, if, in the unlikely event a blade was damaged, the turbines would again be automatically shut down.

Meteorological Effects

2.8.72 Turbines, like any tall structure, can be susceptible to lightning strike and appropriate measures are included in the turbine design to conduct lightning strike down to earth and minimise the risk of damage to the structure. In the case of a lightning strike on a turbine or blade, the turbine would be automatically shut down.

2.8.73 In cold weather, ice can build up on blade surfaces when operating. The turbines can continue to operate with a thin accumulation of snow or ice, but would be shut down automatically when there is a sufficient build up to cause aerodynamic or physical imbalance of the rotor assembly. Many models now include de-icing technology.

2.8.74 Local meteorological conditions would be monitored by a LiDAR unit (**Figure 2.9**), which would be located as shown by **Figure 2.5**.

Turbine Servicing and Repair

2.8.75 Each manufacturer has specific maintenance requirements; however, it is anticipated that routine servicing of the turbines would typically be undertaken twice a year, with a full annual service and a minor service every intervening six months. In the first year, there would likely be an initial three-month service post-commissioning. Individual turbines would be switched off when servicing is ongoing. Maintenance and servicing would include activities such as changing of gearbox oils and individual turbine components.

2.8.76 Blade inspections would be likely to be required between every two and five years. Traditionally, these would be undertaken using a cherry picker or similar, but may also be performed with a 50-tonne crane and a man-basket, or using drones. Repairs to blades would use the same equipment. Light winds and warmer, dry conditions are required for any blade repairs, hence summer (June to August) would be the most appropriate period for this work.

2.8.77 Operational waste would generally be restricted to small volumes of waste generated from machinery repair and maintenance. Maintenance contractors would dispose of any such waste off-site, in line with Scottish waste management regulations and duty of care.

Track Maintenance

2.8.78 Once the Proposed Development is operational, the volume of traffic using the access tracks would be low. Correspondingly, the need for any track maintenance works is anticipated to be low and infrequent. Any such works required would generally be undertaken during the drier conditions in the summer months.

Operational Workforce

2.8.79 A team of several staff including engineer fitters would supervise the operation of the wind turbine installation and would visit the Proposed Development to conduct routine maintenance. The frequency of these visits would depend on the turbine manufacturer.

Decommissioning Phase

2.8.80 The Proposed Development will have an operational life of 40 years, after which it would be decommissioned, and the turbines would be dismantled and removed. .

2.8.81 During decommissioning the turbines would be dismantled and removed, along with any associated above ground electrical equipment. This decommissioning work would be the responsibility of the applicant, or any subsequent owners of the Proposed Development. Underground cables and access tracks would be left in place and foundations would be removed to a depth of 0.5 m below ground level to avoid environmental impacts from deeper removal. A decommissioning and restoration plan will be prepared and agreed with WDC prior to decommissioning. The Proposed Development would be decommissioned and the site restored in accordance with the [plan/statement].

2.9 References

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