Chapter 4

Development Description

SCOTTISHPOWER RENEWABLES

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4 Development Description

4.1 Introduction

1. This chapter provides a description of the Proposed Development and its geographical context. It also outlines the anticipated construction and operation activities connected with the Proposed Development. The Proposed Development layout is illustrated in **Figure 4.1: Site Layout Plan**.

4.2 Description of the Development

2. The Proposed Development would comprise eight turbines, with a blade tip height of up to 200m with associated infrastructure including:

- turbine foundations;
- crane hardstandings;
- transformer/switchgear housings located adjacent to turbines;
- access tracks (existing, upgrade of existing or new as required);
- watercourse crossings (upgrade of existing or new as required);
- underground electrical cabling to the operational Harestanes Windfarm substation;
- permanent anemometer mast and LIDAR compound;
- temporary power performance mast;
- closed-circuit television mast(s);
- communication mast(s);
- permanent control building;
- container to house electrical equipment to facilitate connection to the grid;
- up to three borrow pit search areas; and
- reuse of an existing construction compound area.

3. As an extension to the operational Harestanes Windfarm, the Proposed Development would re-use and share existing infrastructure from the operational Harestanes Windfarm where possible. This includes sharing much of the access track, construction compound, borrow pits and substation, thus maximising efficiency and reducing the cost to the consumer.

4.2.1 Access to Site

4. It is proposed that the turbine components are delivered to the King George V Dock in Glasgow, as this is the most suitable port of entry for the Site. The turbines would then be moved from the dock to the Site under escort via the motorway (i.e. M8, M74) and then onto the A75 and finally the A701, before accessing the Site. The port of Cairnryan may be considered as a secondary option however it has some restrictions including limited water depth and port handling facilities/component storage. Should this port be considered going forward, further route assessment would need to be undertaken.

5. A transport assessment has been undertaken in support of the application for the Proposed Development and this provides detail on access routes to the Site for construction vehicles and provides an estimate of trip generation during construction. The transport assessment includes a review of the proposed route, construction traffic impacts, and an abnormal load route review based on the use of the King George V Dock. Traffic and transport effects are discussed further in **Chapter 11: Access, Traffic and Transport**.

6. Prior to construction, any required improvements to public roads would be undertaken and appropriate highway safety measures would be agreed with Dumfries and Galloway Council roads department, other authorities as necessary (depending on the final route selection) and Transport Scotland, with necessary signage or traffic control measures implemented throughout the construction phase on the agreed basis.

4.2.2 Grid Connection

7. The electrical power produced by the individual turbines would be fed back to the operational Harestanes Windfarm substation, via underground cables predominantly parallel to new and existing access tracks, for onward connection to the national electricity network. The grid capacity is readily available with no significant network infrastructure upgrades required. The substation compound, located within the operational Harestanes Windfarm site, and the indicative cable route from the proposed turbines to the substation are shown in **Figure 4.1 Site Layout Plan**.

8. The cables would be laid in trenches, typically approximately 1.0m deep and up to 1.45 m wide, surrounded by sand and then backfilled with suitable as-dug material. The trenches would also carry earthing and communication cables for the operation of the Proposed Development. At road crossings where additional protection may be needed, the cables would be placed into ducts with 0.4m concrete covers. Trenches would be 1.0m deep and approximately 1.9m wide.

9. To enable the Proposed Development to connect to the National Grid a containerised solution would be used to house the necessary electrical equipment. The container would measure approximately 15m x 3.5m and would be located within the Application Boundary on an area of existing hardstanding, within close proximity of existing substation compound and yet to be constructed Battery Energy Storage System (BESS).

4.2.3 Wind Turbines

10. The Proposed Development would comprise eight wind turbines of up to 200m maximum tip height. The exact model of wind turbine to be installed would be selected through a competitive procurement process, however for the purpose of assessment, a currently available turbine model is being used which fits these parameters and which has a typical generating capacity of around 5.6MW, giving a combined generating output of approximately 45MW. There are a number of potential turbine models which fit within these parameters but which differ in properties, such as noise emissions. In this instance a 'worst case' potential turbine has been used in the assessment as appropriate. A typical turbine elevation is shown in **Figure 4.2 Typical Wind Turbine.**

11. The proposed final locations of the turbines have been defined in order to enable the EIA to describe fully the Proposed Development for which permission is being sought and are illustrated on **Figure 4.1 Site Layout Plan**. The British National Grid coordinates for the location of each turbine are listed in **Table 4.1.**

Turbine	Easting	Northing
1	300147	592473
2	300726	592539
3	301280	592104
4	301841	593217
5	302348	592685
6	302440	593352
7	302667	593967
8	303049	593567

Table 4.1: Wind Turbine Coordinates (British National Grid)

12. Each of the turbines is comprised of the following components:

- blades;
- towers
- nacelle; and
- hub.

13. Each turbine would be mounted on a tapered tubular steel tower and would consist of a nacelle to which are attached a hub and rotor assembly including three blades. The turbines would be of a typical modern, three-blade, horizontal axis design in semi-matt white or light grey with no external advertising or lettering except for statutory notices, to be agreed with Dumfries and Galloway Council.

4.2.4 Turbine Foundations

14. Turbine foundations would be designed to accommodate the final choice of turbine and to suit site conditions. The final design would be informed by the detailed ground investigation at each turbine location. An illustration of a typical turbine foundation is provided **Figure 4.3 Typical Turbine Foundation**.

15. The turbines would have gravity foundations approximately 30m in diameter and would be constructed using reinforced concrete. Foundation excavations would be approximately 3.5m deep, dependent on ground conditions. The sides of the excavation would be graded back, from the foundation to an approximate 37m excavation diameter to ensure that they remain stable during construction.

4.2.5 Turbine Transformers

16. Each turbine would be served by an electrical transformer/switchgear unit that would either be located within the turbine tower or located externally adjacent to the turbine base. The transformer housing would measure approximately 10m long by 5m wide and 4m high and would be mounted on a concrete plinth. The external finishes would typically be metal or glass reinforced or moulded plastic. An indicative external transformer is shown on **Figure 4.3 Typical Turbine Foundation**.

4.2.6 Crane Hardstandings

17. The turbines would be erected using cranes brought on to the Site temporarily for the construction phase. To enable the construction of the turbines, a crane hardstanding area and turning area at each turbine location would be required to accommodate assembly cranes and construction vehicles. This would comprise a crushed stone hardstanding area measuring approximately 94m long by 34m wide, with a typical thickness of approximately 1m, but subject to the specifications required by the selected turbine manufacturer and crane operator and following detailed ground investigations prior to construction. Adjacent to the crane hardstanding would be laydown areas for the blades comprising a disturbance area of approximately 78m long by 28m wide.

18. Additional hardstanding areas would be required to accommodate auxiliary cranes needed to lift and assemble the crane boom sections. These areas would measure approximately 12m by 12m, be comprised of crushed stone and would be positioned along the access tracks. The assembly areas are typically required to be constructed to the same level as the main crane hardstanding.

19. The crane hardstandings and laydown areas would remain a permanent feature of the Proposed Development to facilitate maintenance. **Figure 4.4 Typical Crane Hardstanding** illustrates a crane hardstanding.

4.2.7 Access Tracks

20. Approximately 12,000m of the proposed access tracks for the Proposed Development would use existing infrastructure, whether upgraded forestry tracks or tracks used for the operational Harestanes Windfarm. The existing site access track is in good condition. It was previously widened for the construction of the operational Harestanes Windfarm and is generally suitable for very large turbine component deliveries. At the site entrance, further track upgrade works are required to facilitate entry and are illustrated in **Figure 4.5 Site Entrance Upgrade**. Otherwise, significant engineering works along this route into the Site are not anticipated although there may be small sections which require very minor upgrades or limited repair works within the existing road corridor. Some new passing places will be required outwith this corridor to allow the passage of abnormal loads carrying a longer length blade.

21. All new access tracks have been designed to avoid sensitive environmental receptors. They would be made of locally sourced stone (from the onsite borrow pits or imported from local quarries) and have a typical running width of approximately 5.5m, with an average stone thickness of 500mm. Access tracks would widen on bends and junctions and at the new passing places which would be placed approximately every 500m. Existing passing places on the operational windfarm tracks would be able to be reused. The construction traffic passing places would be 70m by 5m to accommodate the largest turbine component delivery vehicles. Indicative cross sections of the proposed access tracks and plan of the passing places is provided in **Figure 4.6 Typical Access Road Construction.**

22. Turning heads, to enable unloaded vehicles to turn, have been proposed to avoid significant distances of reversing. Typically these are on tracks longer than 200m or where there is a significant slope gradient between the hardstanding and turning area. The turning heads measure approximately 35m in length with a 25m bend radius. The location and specification of turning heads are subject to turbine manufacturer and site health and safety requirements.

23. The total length of roads for the Proposed Development is approximately 15,140m and can be sub-divided into the categories detailed in **Table 4.2** and as represented on **Figure 4.1 Site Layout Plan**.

Type	Description	Length (m)	Percentage of Total
Existing Windfarm	Existing tracks, part of the operational Harestanes Windfarm, to be upgraded where necessary	8600	56.8
Existing forestry tracks	Existing tracks used for forestry access	3400	22.5
New cut tracks	Spurs to individual turbines	3140	20.7

Table 4.2: Access Track Composition

24. Where there is a benefit, the construction of floating access tracks would be considered. Floating access tracks require the placing of a geotextile membrane on existing topsoil and vegetation followed by aggregate layers. Depending on ground conditions two or more layers of geotextile would be placed in layers of 300mm to 500mm. The access tracks would be capped with layers of Type 1 aggregate or similar material. Type 1 is unbound aggregate mixture specified under Clause 803 of the Specification for Highway Works (2016) as suitable for vital load bearing foundation in road construction. For this EIA Report the use of cut tracks has been assumed throughout the Site.

4.2.8 Watercourse Crossings

25. Watercourse and ditch crossings have been avoided in the design of the access track layout as far as possible. There would be ten crossings of watercouses showing on the 1:50,000 scale ordnance survey map, which are all existing track upgrades. Coordinates for each are provided in **Table 4.3**. There are no new watercourse crossings at this scale. Further discussion on the water crossings proposed as part of the Proposed Development is provided in **Chapter 6: Hydrology, Hydrogeology, Geology and Soils**.

Crossing	Easting	Northing	Description
WC01	302926	590995	Black Linn (Garrel Water tributary), Water of Ae Catchment
WC02	302162	593969	Glenkiln Burn tributary, Water of Ae Catchment
WC03	301660	593821	Ox Cleuch (Glenkiln Burn tributary, Water of Ae Catchment
WC04	301004	594116	Auchendowal Sike (Glenkiln Burn tributary), Water of Ae Catchment
WC05	300481	593384	Rough Cleuch (Glenkiln Burn tributary), Water of Ae Catchment
WC06	300076	593011	Clachanbirnie Burn (Glenkiln Burn tributary), Water of Ae Catchment
WC07	303225	593362	Yellowtree Grain (Garrel Water tributary), Water of Ae Catchment
WC08	302115	594317	Auchencaigroch Burn (Glenkiln Burn Tributary), Water of Ae Catchment
WC09	300819	596590	Deer Burn, Tributary of Water of Ae
WC10	300366	597297	Unnamed Tributary of the Water of Ae

Table 4.3: Watercourse Crossings

4.2.9 Meteorological Monitoring Masts and Lidar Compound

26. A 105m lattice structure anemometer mast may be installed onsite at national grid reference 303320, 593378 (as shown on **Figure 4.1 Site Layout Plan**). The purpose of this is to provide operations and performance monitoring data and the mast height would be dependent on the final turbine selection.

27. The mast would be delivered to Site in sections and would be bolted to a concrete pedestal, the foundations for which would typically measure 10m x 10m. During construction, the crane would be supported using a stone pad and hardstanding measuring approximately 20m x 20m and the depth dependant on the localised ground conditions A 3m high anti-climb fence would also be installed around the base of the mast to restrict access.

28. One 105m temporary power performance mast (PPM), may be erected dependant on the final turbine selected. If required, the temporary mast would be erected early in the construction programme and would record data for several months before turbine erection. Prior to the turbines being constructed, the temporary masts may be decommissioned and removed, or remain in place for a period of up to two years following turbine commissioning.

29. Furthermore, a LIDAR station would be located adjacent to the control building, which would comprise a 3m x 3m fenced compound with a Lidar on a raised 2m platform. The Lidar station would provide operations and performance monitoring data alongside the anemometer mast.

4.2.10 Control Building

30. The control building would be single storey, built on a concrete base and would measure approximately 23m x 14m and 7m high. The operations building would also host solar panels on the roof to produce power for the control building and thus reduce the carbon footprint of the building. Other sustainable measures would likely include rain water harvesting for flushing of toilets. The building would be used to contain the supervisory control and data acquisition (SCADA) facilities as well as office space. The control building would be located within a compound which would measure approximately 25m x 25m in total. The compound would include approximately four car parking spaces.

31. The proposed location of the control building is provided in **Figure 4.1 Site Layout Plan** and an indicative layout for the operations building is provided in **Figure 4.7 Typical Control Building**.

4.2.11 Temporary Construction Compound

32. A construction compound would be required as the centre for all construction activities and to provide facilities for the day-to-day needs of the project and the workforce. There would be two locations which would serve this purpose, both of which would be using existing hardstanding areas which were constructed for the operational Harestanes Windfarm. They comprise the previous construction compound situated on the main access track and the main construction compound area within the operational site as illustrated on **Figure 4.1 Site Layout Plan**. An indicative layout of a typical construction compound is provided in **Figure 4.8 Typical Construction Compound**, although the arrangement would differ to fit the irregular site area. The detailed size and engineering properties of the construction compound would be confirmed prior to the start of construction, after the turbine supplier and model have been confirmed.

33. The compound area would house temporary portable cabin structures to be used as the main construction office and welfare facilities, including toilets, clothes drying and kitchen, with the provision for sealed waste storage and removal. It would also be used for the storage and assembly of certain components, containerised storage for tools and small parts, and oil and fuel storage. Adequate parking would be provided for cars and light vehicles. A portable cabin would be located at the entrance to the compound and used by staff responsible for controlling access to the construction compound, which would also house the mandatory signing in and out procedure.

34. A concrete batching plant would be located within the construction compound and would comprise aggregate and cement hoppers, water bowsers/tanks, a mixer and a control cubicle. Aggregates and sand would be stockpiled and contained adjacent to the plant. It would be necessary to provide a limited private water supply and foul drainage; this is considered further in **Chapter 6: Hydrology, Hydrogeology, Geology and Soils**.

35. On completion of construction works, it is proposed that all temporary structures be removed and the existing hardstanding left in place.

4.2.12 Borrow Pits

36. To minimise the volume of imported material brought onto the Site and any associated environmental impact, borrow pits located within the Site would be used to source aggregate for construction of the Proposed Development, where suitable material is found to be present. A borrow pit is an area where material has been excavated for use at another location.

37. Three borrow pit search areas have been identified, as illustrated on **Figure 4.1 Site Layout Plan,** in order to provide a total of approximately 36,220m^3 of material required to construct the Proposed Development. This includes base material for roads, hardstandings and foundations and Type 1 surface material. It is proposed that the actual borrow pit(s) would be located within these search areas, however, the actual area utilised may only be a portion of the search areas. **Table 4.4** provides information on the location and potential extraction volumes per borrow pit should material be extracted evenly across all three sites; in practice it is likely that some borrow pits would be used more than others depending on the quality of the extracted material and the location relative to the construction works. As there has been no detailed ground investigations carried out, a contingency of 25% has been added to the volume of material required, resulting in a required borrow pit volume of 45,275m^3; **Appendix 6.5 Initial Borrow Pit Assessment** provides more detail.

Borrow Pit	Easting	Northing	Est. of Volume (m^3)
1	302437	593874	15092
2	301446	592335	15092
3	300629	592257	15092

Table 4.4: Borrow Pit Information

38. Detailed site investigations prior to construction would be carried out to further confirm the rock type, rock characteristics and suitability, as well as potential volumes to be extracted from the search area. The final borrow pit(s) identified during the geotechnical evaluation would be defined within the Construction Environmental Management Plan (CEMP) (refer to **Section 4.3.5**). The pollution control measures to be implemented during usage of the borrow pit(s) and its reinstatement would also be covered within this document.

39. The borrow pit(s) would require the use of plant to both win and crush the resulting rock to the required characteristics. It is anticipated that rock would be extracted by breakers or other relevant methods that may be required, such as blasting. Noise associated with stone extraction is discussed in **Chapter 9: Noise**.

40. Environmental considerations have influenced the location of the borrow pit search area to minimise the effect on ecology, cultural heritage and hydrology, and to allow successful reinstatement measures to be put in place as appropriate. Following construction, the borrow pit(s) would be restored and reinstated to agreed profiles.

41. If there is insufficient suitable material available from the borrow pits, stone would be sourced from local quarries and imported. The transport assessment in **Chapter 11: Traffic, Transport and Access** assumes a worst case scenario of 100% imported material.

4.3 Construction

42. The onsite construction period for the Proposed Development is expected to be approximately 12 months (refer to **Table 4.5**). Normal construction hours would be between 07:00 and 19:00 Monday to Friday and 07:00 to 16:00 on weekends, or as agreed with the Dumfries and Galloway Council's Environmental Health Officer (EHO). These times have been chosen to minimise disturbance to local residents. It should be noted that out of necessity due to weather conditions and health and safety requirements, some generally quiet activities, for example abnormal load deliveries (which are controlled by Police Scotland) and also the lifting of the turbine components, may occur outside the specified hours stated. **Table 4.5** provides an indicative programme for the main activities to be carried out.

Task	Month					
	2	4	6	8	10	12
Mobilisation						
Forest Felling						
Access and Site Tracks						
Foundations						
Crane Hardstands						
Onsite Cabling						
Turbine Delivery						
Turbine Erection						
Commissioning and Testing						
Site Reinstatement/Restoration						

Table 4.5: Indicative Construction Programme

43. **Table 4.6** below summarises the approximate volume of aggregate material required for each of the main infrastructure elements described in **Section 4.2**. The transport assessment has been prepared on a "worst-case" basis by assuming that a capping layer of construction aggregate would be imported to Site and no concrete batching would take place on Site. However, if all base aggregate materials are sourced from the borrow pit(s) and concrete batching takes place on Site, then this would result in a reduction in delivery volumes/traffic. Further detail on traffic volumes associated with the importation of construction materials is provided in **Chapter 11: Access, Traffic & Transportation**.

Infrastructure	Approximate Volume of Aggregate(m^3)
New and upgraded Tracks	15,780
Crane Hardstanding and Laydown Areas	20,000
Control Building	440

Table 4.6: Volume of Aggregate per Infrastructure Type

4.3.1 Construction Materials

44. The main materials likely to be required in part or total for the construction of the track, turbine, turbine transformers and control building foundations, hardstanding areas and cable trenches are described below:

- crushed stone;
- geotextile;
- cement;
- sand;
- concrete;
- steel reinforcement; and
- electrical cable.

45. Necessary excavations would be made after stripping back the soil from the area to be excavated. This soil would typically be stored separately either adjacent to the excavation area for backfill, or stored at a designated area on Site for further use or reinstatement of temporary works areas. The handling of soils would be undertaken in accordance with best practice techniques.

46. Measures will be taken to help prevent surface water entering excavations during construction of the turbine foundations. Should surface water run-off or groundwater enter the excavation appropriate pumping measures away from watercourses would be implemented to ensure the works are safely carried out and the excavation is sufficiently dry to allow concrete placement. Once the concrete is cast, the excavated material would be used for backfill and compacted to the required design density. Once this backfill is completed, the crane hardstanding areas would be constructed.

47. The turbines would be erected using two cranes, positioned on the hardstanding adjacent to the turbine base.

4.3.2 Site Restoration

48. As soon as practical once installation is complete, the immediate construction area would be restored to a profile to be agreed with Dumfries and Galloway Council. Crane hardstandings would be retained for future maintenance. The soil would be replaced where appropriate and as advised by an onsite Environmental Clerk of Works (ECoW). Any surplus soil would be used to restore track edges after construction. This progressive reinstatement has been found to assist with re-establishment of the local habitats, as it minimises the time soil is stored.

49. The upper vegetated turfs would be used to dress infrastructure edges and to reinstate the surface of restoration areas. It is anticipated that most of the soil resources within areas directly affected by construction activities would be able to be stored and reinstated as close as possible to where they were excavated in accordance with good practice; so that the Site would be restored with minimal movement of material from its original location. It is not anticipated that any excavated material would leave the Site.

50. Further detail on restoration would be provided within the Construction Environmental Management Plan (CEMP), an outline of which is provided in **Appendix 4.1 Outline CEMP.**

4.3.3 Micrositing

51. During the construction process there may be a requirement to microsite elements of the Proposed Development infrastructure (e.g. due to unsuitable ground conditions or environmental constraints). A 50m micrositing tolerance of turbines and all other infrastructure is proposed for to the Proposed Development. Within this micrositing distance any changes from the consented locations would be subject to approval of the ECoW as required and in consideration of other known constraints.

4.3.4 Traffic and Transportation

52. Construction traffic associated with the construction and maintenance of the Proposed Development falls into two main categories, namely Abnormal Indivisible Loads (AIL) and construction/maintenance loads. AILs would require an escort, either by private contractor or by the police. Construction/maintenance loads do not require any special escort or permissions and are subject to normal traffic regulations.

53. The Applicant would ensure that the construction vehicles would be routed as agreed with the Dumfries and Galloway Council, Transport Scotland, Police Scotland and other relevant consultees, to minimise disruption and disturbance to local residents and road users. Further details regarding transport and access can be found in **Chapter 11: Access, Traffic & Transport** of this EIA Report.

4.3.5 Construction Environmental Management Plan (CEMP)

54. As part of the construction contract, the Principal Contractor responsible for undertaking the construction works would produce a CEMP. The CEMP would be developed in accordance with the joint Scottish Renewables, Scottish Natural Heritage, Scottish Environment Protection Agency (SEPA), and Forestry Commission Scotland guidance on Good Practice During Wind Farm Construction (Scottish Natural Heritage, 2019). The Principal Contractor would consult with the Scottish Ministers, NatureScot, SEPA, Historic Environment Scotland and Dumfries and Galloway Council on the production of the CEMP. The mitigation measures proposed in this EIA Report which would be applied during construction of the Proposed Development are outlined in the Outline CEMP provided in **Appendix 4.1 Outline CEMP**.

55. The CEMP would describe how the Principal Contractor would ensure suitable management of, but not limited to, the following environmental issues during construction of the Proposed Development:

- noise and vibration;
- dust and air pollution;
- surface and groundwater;
- ecology and ornithology (including protection of habitats and species);
- agriculture (including protection of livestock and land);
- cultural heritage;
- waste (construction and domestic);

- details of the size, location and volumes to be extracted from borrow pits;
- pollution incidence response (for both land and water); and
- Site operations (including maintenance of the construction compound, working hours and safety of the public).

56. The Applicant would engage an ECoW onsite during the construction phase. The services of other specialist environmental advisors, such as an Archaeological Advisor, would be procured to support on specific environmental issues as required. The ECoW would ensure that the construction activities undertaken by PC are carried out in accordance with the mitigation measures contained within the CEMP and any planning conditions relating to environmental matters, and this would be monitored by the Applicant.

57. To ensure all construction mitigation measures outlined within this EIA Report are carried out onsite, the CEMP would form an overarching document for all Site management requirements, including:

- Traffic Management Plan;
- Construction Methodology Statement;
- Pollution Prevention Plan (including monitoring, as appropriate);
- Site Waste Management Plan;
- Peat Management Plan;
- Water Management Plan; and
- Access Management Plan.

58. The construction mitigation measures proposed by each of the environmental topics assessed in the EIA are provided in the relevant EIA Report chapters.

4.3.6 Temporary peat storage

59. Where possible, progressive restoration techniques would be used to place excavated peat material in its final destination rather than in temporary stockpiles. In some circumstances this may not be possible and there may be a requirement to temporarily store excavated peat onsite. It is important both for the peat itself and for the surrounding environment that the peat is not allowed to substantially erode or become dry while it is stored. Procedures to control the hydrology of stored peat would be covered by the CEMP and are outlined in the Soil and Peat Management Plan (**Technical Appendix 6.2**).

60. The full details for peat storage areas and dimensions would be determined following detailed design, and the peat condition and requirements are better known.

4.3.7 Drainage

61. Surface or sub-surface water flow within the vicinity of the access tracks and hardstanding areas would be routed into drainage channels. The drainage channels would be situated on the upstream side of the infrastructure and run in parallel with them. These channels would pass under the hard areas, via small diameter carrier drains, to the downstream side where the run-off would percolate to the riparian zone.

62. Where ground conditions permit, channels may connect with infiltration trenches on the downhill side of the hard areas, with a small sump at the inlet to collect silt and treat run-off prior to infiltration to the surrounding soils. Silt traps would also be located along trenches to further facilitate the collection of silts. These would be cleaned out periodically, as required.

63. The edges of the access tracks would be flush to allow the surface water from the road to route directly into the collection channels or infiltration trenches. On steeper sections of track, regular cross drains, connected to infiltration trenches, would be installed to collect surface run-off and ensure longitudinal flow is intercepted, thus avoiding rutting and subsequent breakup of the track surface. Trenches would maintain linear flows to downstream areas avoiding point discharge of large flows.

64. Where the access tracks follow contours, earthworks may be required. Where earthworks are required a collection ditch would be installed at the head of the cutting, with appropriate dams and sumps, to collect silt and prevent sediment transfer to watercourses.

65. A detailed drainage design would be undertaken and submitted to the Scottish Ministers, in consultation with the SEPA, for approval prior to construction.

4.4 Forestry

4.4.1 Felling

66. The Proposed Development would use a 'keyhole' approach to the siting of turbines within the forest, to retain as much forestry as possible. It is anticipated that construction of the Proposed Development would require approximately 82.23 hectares (ha) of woodland to be felled to facilitate construction works and installation of permanent features such as the turbines and access tracks; some of which would be subsequently restocked. The requirements and undertaking of felling would be in close consultation with Forestry and Land Scotland, Scottish Forestry and documented in the Forestry Report which is contained in **Appendix 13.1 Forestry**. **Figure 4.9 Forestry Felling Plan** and **Figure 4.10 Forestry Restocking Plan** illustrate the proposed tree felling and restocking required for the construction of the Proposed Development.

4.4.2 Compensatory Planting

67. As a result of the construction of the Proposed Development, there would be a net loss of woodland area. The area of stocked woodland in the study area would decrease by approximately 61.23ha. In order to comply with the criteria of the Scottish Government's Control of Woodland Removal Policy offsite compensation planting would be required. The Applicant is committed to providing appropriate compensatory planting. The extent, location and composition of such planting would be agreed with Scottish Forestry[1], and would take into consideration any revision to the felling and restocking plans prior to the commencement of operation of the Proposed Development.

4.5 Operation and Maintenance

4.5.1 Operational Lifespan

68. There is no proposal to limit the lifetime of the Proposed Development. Therefore, the assessment of all technical areas considers the effects of the operational phase of the Proposed Development without time limitations. Should decommissioning of any of the Proposed Development be required it is considered that the environmental effects of decommissioning would be similar to, or less than, those during construction.

4.5.2 Lighting

69. Civil Aviation Authority (CAA) Policy Statement on Lighting of Onshore Wind Turbine Generators in the United Kingdom with a Maximum Blade Tip Height at or In Excess of 150m Above Ground Level (AGL) (CAA, June 2017) modifies the strict application of Article 222 to require only the hub to be lit by 2000 candela steady red lights, with a single set of intermediate steady red lights halfway down the tower at a reduced intensity of 32 candela. Aviation lighting would be installed as soon as practicable on erected turbines.

70. The turbines would be lit as described above, and as such, during hours of darkness may have a visual impact. The night time visual effect of lighting the turbines is assessed within **Chapter 5: Landscape and Visual**.

71. It is proposed that visibility sensors are installed on the Proposed Development turbines in line with the 2017 CAA Policy Statement so that where visibility is restricted to 5km or less from all the turbines in the Proposed Development, the lights would operate at 2000 candela and where visibility is greater than 5km from all the turbines,

[1] With regard to ancient woodland compensation, NatureScot would also be consulted.

the nacelle obstruction lights would be dimmed to 200 candela. Further information can be found in **Chapter 13: Other Issues**.

72. In addition, the Applicant proposes to explore the possibility of installing an aircraft detection lighting system whereby the lights would only be switched on when aircraft enter the volume around the turbines bounded by 4km (horizontal distance) from the perimeter turbines of the Proposed Development and between 150m AGL of the lowest turbine and 300m above the highest tip height of the Proposed Development. Given the lights are only required for aircraft flying at night in the vicinity of the Site at altitudes of up to 2900ft above mean sea level, it is anticipated that the lights would be rarely on in this quiet airspace. Further detail is provided in **Appendix 13.3 Indicative Aviation Lighting Landscape and Visual Impact Mitigation Plan (IALLVIMP)** on this proposal and how it is being taken forward.

4.5.3 Maintenance

73. The Proposed Development would be maintained throughout its operational life by a service team comprising up to three to five full time equivalents made up of operation management, operations technicians and support functions. Additionally, the technicians may be required to undertake unscheduled maintenance throughout the year. The maintenance team would either be employed directly by the Applicant or by the turbine manufacturer. Management of the Proposed Development would typically include turbine/array maintenance, health and safety inspections and civil maintenance of tracks, drainage and buildings.

74. Maintenance activities would typically include, but not limited to, the following:

- civil maintenance of tracks and drainage;
- scheduled routine maintenance and servicing;
- unplanned maintenance or call outs;
- electrical maintenance;
- blade inspections;
- fencing; and
- snow clearing.

4.6 Climate Change and Carbon Considerations

75. Whilst the Proposed Development would reduce carbon emissions by replacing the need to burn fossil fuels to generate electrical energy, carbon emissions would result from the component manufacturing, transportation and installation processes associated with the Proposed Development. There is also the potential for carbon fixers and sinks to be lost through the clearing of vegetation during construction, such as peat. There must, therefore, be a sufficient balance between the carbon reduction associated with the generation of renewable energy and that which is produced through construction/fabrication processes and lost through Site preparation.

76. The electrical energy generating capacity of the Proposed Development would be approximately 45MW, with the exact capacity depending on the model and type of turbine selected. It would be expected that the Site would generate around 121.4GWh per year (depending on the turbine selected).

77. The average electricity consumption per household in the UK quoted by the Department of Business, Energy and Industrial Strategy is 3,729 kWh (BEIS, 2019). Assuming generation of around 121.4GWh annually, the Proposed Development would generate enough power to supply over 32,550 average UK households.

78. **Chapter 13: Other Issues** provides details of the assessment undertaken to calculate the carbon emissions which would be generated during the construction and operation of the Proposed Development as well as the carbon payback period resulting from the operation of the Proposed Development. The Proposed Development is expected to take around 2.1 years to repay the carbon exchange to the atmosphere (the CO_2 debt) through construction of the windfarm; the Site would in effect be in a net gain situation following this time period and can then claim to contribute to national objectives of reducing greenhouse gas emissions and meeting the 'net zero' carbon targets by 2050.

4.7 Public Access

79. Within the site is located one core path (Ae Forest Large Circular) and Romans and Reivers Long Distance Walking Route, which is part of Scotland's Great Trails and runs north-south through the western part of the Site following the existing forest tracks. More information on recreational and tourism use of the Site is discussed in **Chapter 12: Socio-economic, Tourism and Recreation**.

80. In the interests of health and safety, and if required, a temporary diversion may be put in place for the construction period for affected path sections, with suitable alternatives clearly signposted. Details of temporary path diversions would be set out in the Access Management Plan which would form part of the CEMP and subject to approval by Dumfries and Galloway Council.

81. Once construction is completed, any upgrades or new tracks associated with the Proposed Development would provide improved access and increased opportunities for informal recreation (walking / biking / horse riding) throughout the operational life of the Proposed Development.

4.8 References

BEIS. Sub-national Electricity and Gas Consumption (2019). Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/853760/sub-national-electricity-and-gas-consumption-summary-report-2018.pdf

CAA (2017). Policy Statement on Lighting of Onshore Wind Turbine Generators in the United Kingdom with a Maximum Blade Tip Height at or In Excess of 150m Above Ground Level

Forestry Commission Scotland (2009). The Scottish Government's Policy on Control of Woodland Removal. Edinburgh

Highways Agency (2016). Specification for Highway Works. Available at http://origin.standardsforhighways.co.uk/ha/standards/mchw/vol1/

Scottish Renewables, Scottish Natural Heritage, SEPA, and Forestry Commission Scotland (2019). Good Practice During Wind Farm Construction.

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