2 PROJECT DESCRIPTION

2.1 GENERAL INTRODUCTION

This chapter of the Environmental Impact Assessment Report (EIAR) presents information on the elements that constitute the entire project, which includes the proposed development, as set out in Chapter 1 of this EIAR. While the grid connection and replacement lands are not included in the proposed development and planning application, they are assessed as part of the project within this EIAR. The Project Description details the characteristics and operations involved in the project. The purpose is to provide an appropriate level of detail to provide the basis for Environmental Impact Assessment (EIA). The chapter describes the site location, the main characteristics and components of the project and details the activities and operations required to construct, commission and operate the wind farm development and to connect it to the National Grid. Decommissioning of the project is also discussed.

Details of the project are further supported by the following documents:

- EIAR Chapter 3 Civil Engineering
- Construction Environmental Management Plan (EIAR Volume III, Appendix 3-1)
- Surface Water Management Plan (EIAR Volume III, Appendix 3-2)
- Peat Stability Risk Assessment (EIAR Volume III, Appendix 9-2)
- Peat and Spoil Management Plan (EIAR Volume III, Appendix 3-3)
- Turbine Delivery Route Assessment (EIAR Volume III, Appendix 3-7)
- Planning Application Drawings

2.2 PROJECT ASSUMPTION

For purpose of the planning application and the analysis conducted in this EIAR, the Applicant has considered a wind turbine composed of a tower with a maximum height of 101 meters and a maximum rotor diameter of 136 meters resulting in an overall maximum tip height (blade in the vertical position) of 169 meters.

2.3 CHARACTERISTICS OF THE PROJECT INCLUDING THE PROPOSED DEVELOPMENT

It is being proposed by *Coillte Cuideachta Ghníomhaíochta Ainmnithe* (Coillte) (the Applicant) to develop a wind farm (named Carrownagowan Wind Farm) comprising nineteen (19) No. wind turbines in east Co. Clare. The proposed development forms a part of the entire project, as outlined in Chapter 1, and includes the following components, infrastructure and ancillary facilities and elements for construction and consideration as described below. The EIAR considers the proposed development and all additional components of the project. The following two lists include both the core wind farm elements of the project and the associated development components of the project.

Proposed Development

The development for which planning permission is sought in the planning application (the proposed development) consists of the following:

Core Wind Farm Elements:

- 19 No. Wind Turbines (blade tip height up to 169m).
- 19 No. Wind Turbine foundations and Hardstand areas.
- 1 No. Permanent Meteorological Mast (100m height) and foundation and associated hardstand areas.
- 1 No. Substation (110kV) including associated ancillary buildings (electrical building including control, switchgear and metering rooms, and the operational building including welfare facilities, workshop and office) security fencing and all associated works.
- Upgraded Site Entrance
- New and upgraded internal site service roads (8.4km of existing tracks to be upgraded and 11.4km of new service roads to be constructed)
- Provision of an on-site Visitor cabin and parking

Associated Development Components:

- Underground electrical collection and SCADA system linking each wind turbine to the on-site project substation.
- Construction of new roadways and localised widening along turbine delivery route
- 2 No. Temporary construction site compounds and additional mobile welfare units
- 3 No. Borrow pits to be used as a source of stone material during construction
- 3 No. peat /spoil deposition areas (at borrow pit locations)
- Associated surface water management systems
- Tree felling for wind farm infrastructure

Overall Project

In addition to the Proposed Development as described, the following elements are assessed as part of the overall project: Underground 110kV cable for connection to the National Electricity Grid and off-site replacement forestry lands at three sites: Ballard, Co Wicklow; Cooraclare, Co. Clare; and Trillackacurry, Co. Longford.

Details of the evolution of the site scale and design are provided in Chapter 4 of this EIAR.

2.3.1 Development Lands

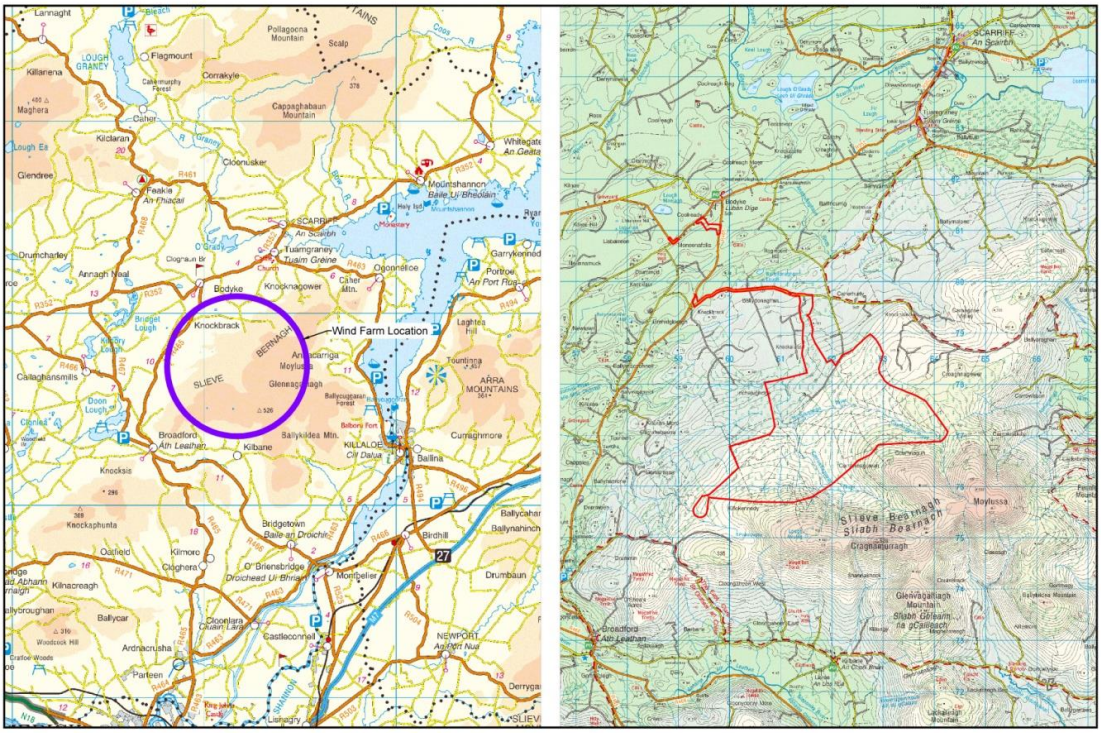
These sections describe the lands which make up the project. The lands in and around the wind farm are first described followed by a description of the lands along the grid route, the lands along the turbine delivery route, and finally, the replacement lands for afforestation.

2.3.1.1 *Wind Farm Lands*

The proposed development is a nineteen (19) No. wind turbine project. The area of the proposed Wind Farm is located within forested lands on the northern slopes of Slieve Bernagh mountain, approximately 4 km northeast of the village of Broadford, 7km north-west of Killaloe and 2.5 km south of the village of Bodyke, at its closest point. Lough Derg lies approximately 4km to the east of the proposed development area (Figure 2.1).

The wind farm site boundary (which is the planning boundary) includes a total land area of 749.69ha which principally consists of conifer plantation, bogland, cutover bogland, and improved grasslands. The townlands within the wind farm site boundary include Ballydonaghan, Caherhurley, Coumnagun, Carrownagowan, Inchalughoge, Killokennedy and Kilbane.

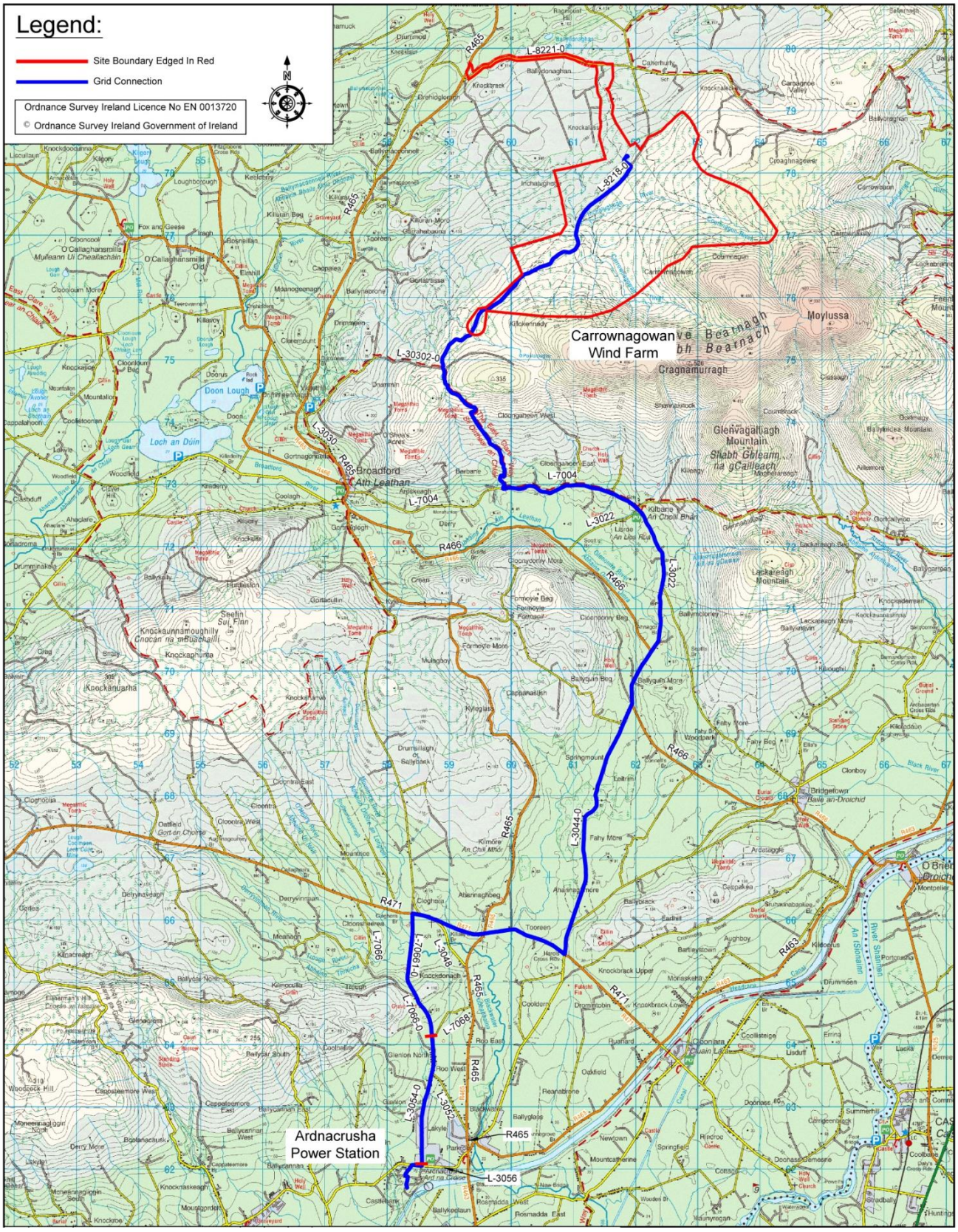
Figure 2-1 Wind Farm Development Location



2.3.1.2 *Grid Connection*

Electrical energy generated from the wind farm will be exported to the national grid via an underground grid connection cable to the existing ESB owned 110kV substation at Ardnacrusha, County Clare. Once it leaves the site, the 25km grid connection infrastructure will be installed within the body of the public road network along the route illustrated in Figure 2.2. As stated previously, the grid does not form part of the proposed development.

Figure 2-2 Underground Grid Connection Route



2.3.1.3 *Additional Lands*

2.3.1.3.1 Turbine delivery Route

Development works on private third party lands adjacent to the public road network will be required to be undertaken in order to accommodate turbine delivery. The nature and extent of works at these locations are described in Section 2.3.3.12

These development lands are as follows:

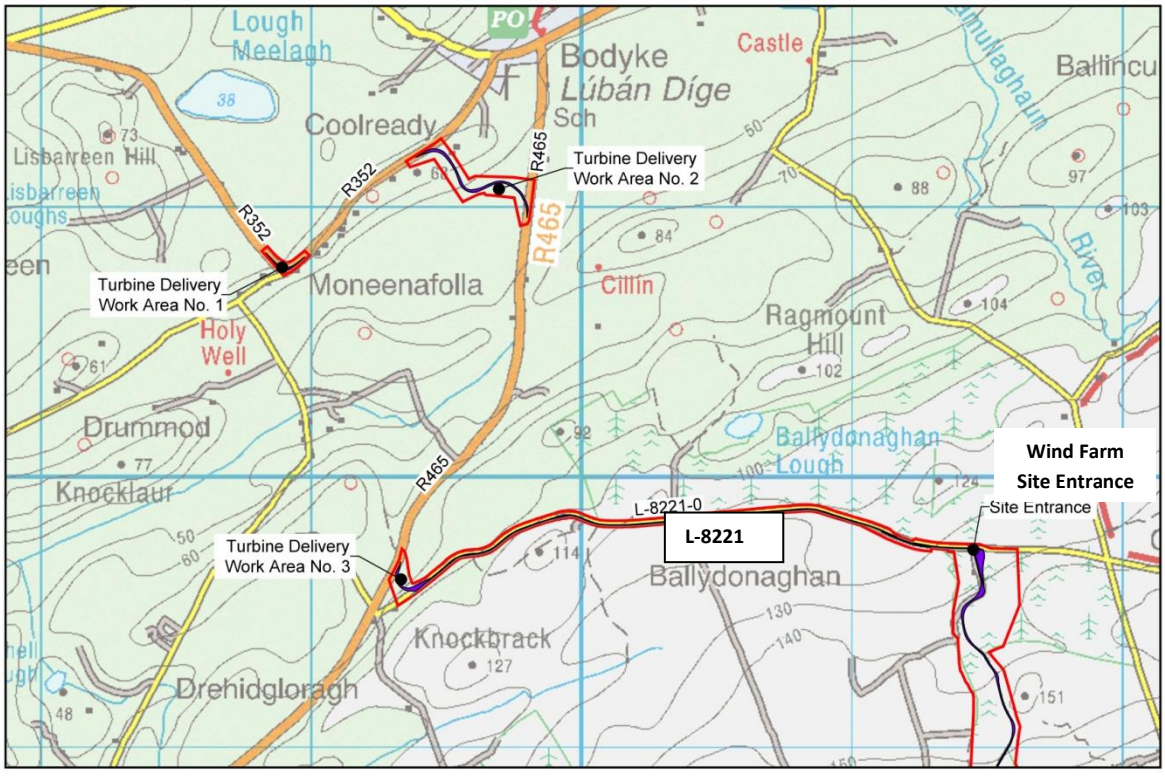
Works Area 1: 0.07ha of agricultural lands to the northern side of the R352 in the townland of Coolready, Co. Clare approximately 1.1km southwest of Bodyke village.

Works Area 2: 0.4ha of agricultural and forested lands between the R352 and R465 in the townland of Coolready, Co. Clare approximately 450m south of Bodyke village.

Works Area 3: 0.2ha of agricultural scrub lands between the R464 and the L-8221 local road in the townland of Drummod, Co. Clare approximately 2.1km south of Bodyke village.

Road widening works along a 2km section of the L-8221 local road, between the R465 and wind farm site entrance, will also be required.

Figure 2-3 Area of development lands along Turbine delivery route



2.3.1.3.2 Replacement Forestry Lands

In line with the Forest Service's published policy on granting Felling Licences for wind farm developments, areas cleared of forestry for turbine bases, access roads, and any other wind farm-related uses will have to be replaced by replanting at an alternative site (referred to in this EIAR as replacement lands). The Forest Service policy requires replanting on a hectare for hectare basis.

The off-site afforestation lands must themselves also go through an approval process before they can be granted a felling licence. This is a requirement of the Forestry Act 2014 and its consent is regulated under the Forestry Regulations 2017. Under the Regulations all applications for licences for afforestation require written approval by the Minister for Agriculture, Food and the Marine and a prior determination on the likely significant effects.

The three sites listed in the table below have received this approval. Once approval is received the lands must be planted within 3 years. These lands, and any other similarly approved lands can; either before, during or after they are planted be allocated to the future wind farm Felling Licence.

These replacement lands are included in the EIAR as part of the project. These lands, or lands approved by the Minister, will be conditioned as part of the future felling licence associated with the project.

Location	Area (ha)
Ballard in Co Wicklow	37.3
Dangananella West Cooraclare in Co. Clare	10.78
Trillackacurry, Co. Longford	24.25

Figure 2-4 Replacement lands at Ballard, Co. Wicklow

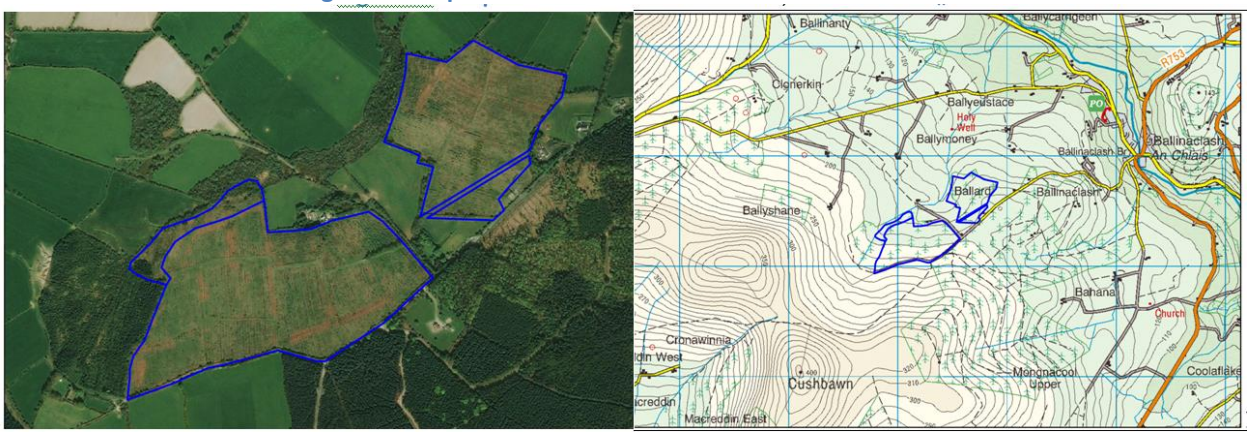


Figure 2-5 Replacement lands at Dangananella West, Cooraclare, Co. Clare

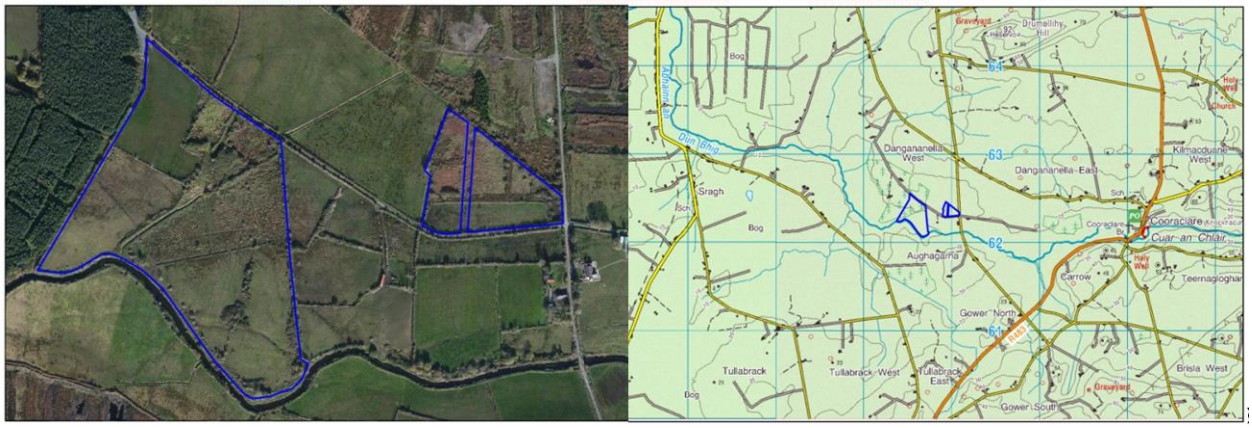


Figure 2-6 Replacement lands at Trillackacurry, Co. Longford

2.3.2 Development Lands Ownership

The proposed development lands described in the previous sections include lands under Coillte ownership along with some additional private lands. Consent letters from all the landowners are included with the planning application.

Road opening licences will also be sought from Clare County Council for development works within and along the public road network.

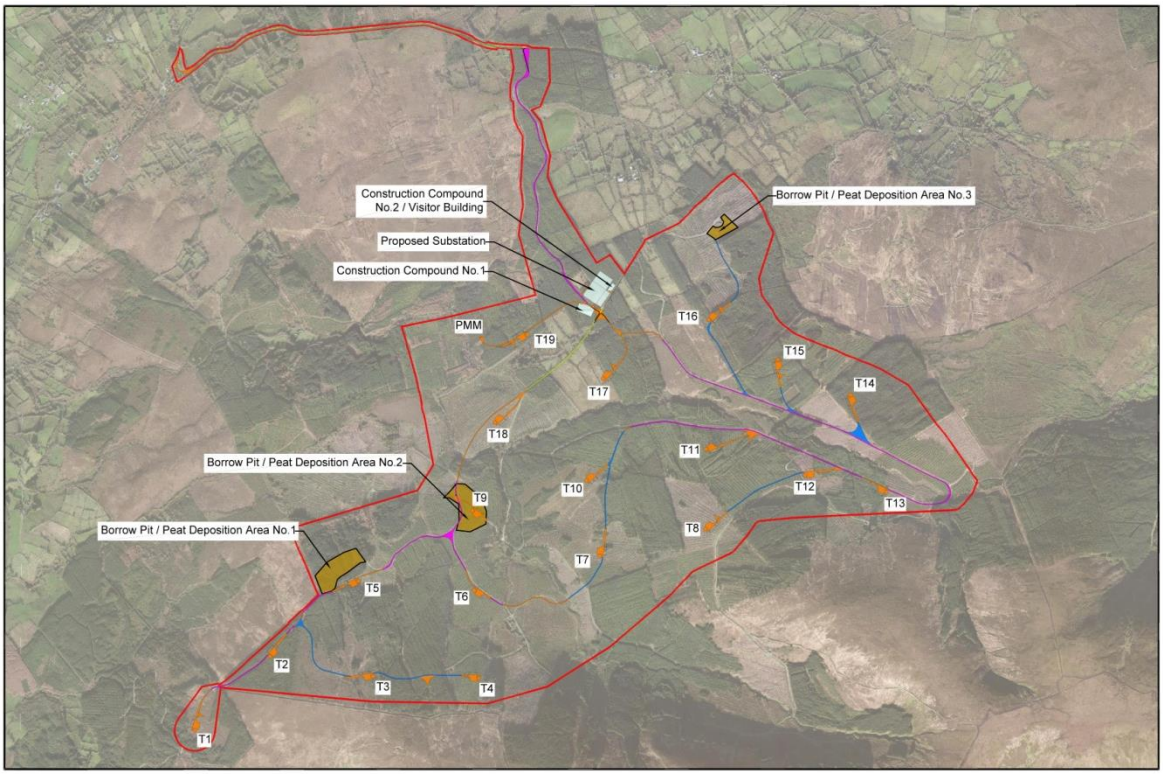
2.3.3 Size, Design and Appearance of the Proposed Project

2.3.3.1 *Wind Farm Development Layout*

The footprint area of wind farm infrastructure within the site boundary and the delivery route works areas is 30.47ha. A plan of the proposed development showing the positions of the turbines, access tracks, hard standing areas, met mast, control building/substation compound, borrow pits peat deposition areas and temporary construction compounds is shown in Figure 2.7 below.

This layout reflects the outcome of the iterative engineering and environmental analysis approach adopted during the wind farm design process which took into account a number of factors including avoidance of certain environmental features, technical wind consideration, and requirements of the DOEHLG and IWEA wind farm planning guidelines, ie. the 2006 Wind Farm Planning Guidelines *and* the 2012 Best Practice Guidelines for the Irish Wind Energy Industry, respectively. As outlined in Chapter 1, should the draft 2019 WEDG be adopted in advance of a planning decision being made on the Carrownagowan Wind Farm, the project has achieved a 1km setback distance, beyond that included in the draft 2019 WEDG. Details of the evolution of the site scale and design and how it has been tailored to this site are described in Chapter 3 Civil Engineering and Chapter 4 Alternatives Considered.

Figure 2-7 Site Layout (Refer to Planning Drawing 19107-5005-A for detail)



2.3.3.2 *Wind Turbines*

It is proposed to install 19 No. wind turbines with an overall expected installed capacity of between 90 and 110MW. The proposed turbines will be of a typical modern design, incorporating tubular towers and three blades attached to a nacelle. The colour of the proposed turbines will be an off-white or light grey colour with a matt finish. It is proposed to install lighting on the turbines in a pattern

that is acceptable to the Irish Aviation Authority for aviation visibility purposes. The dimensions and co-ordinates of the proposed turbines within the array are set out in Table 2.1.

Table 2.1 Proposed Turbine Dimensions and Co-ordinates

Turbine Ref no.	HH (m)	RD (m)	Max Blade tip height(m)	Grid Co-ordinates	
T1	101	136	169	559385	675575
T2	101	136	169	559850	676030
T3	101	136	169	560484	675908
T4	101	136	169	561137	675897
T5	101	136	169	560394	676494
T6	101	136	169	561109	676437
T7	101	136	169	561881	676649
T8	101	136	169	562533	676815
T9	101	136	169	561098	676928
T10	101	136	169	561800	677115
T11	101	136	169	562539	677308
T12	101	136	169	563149	677146
T13	101	136	169	563650	677042
T14	101	136	169	563431	677641
T15	101	136	169	562982	677858
T16	101	136	169	562556	678103
T17	101	136	169	561903	677741
T18	101	136	169	561234	677472
T19	101	136	169	561435	678011

2.3.3.3 *Wind Turbine foundations*

Each wind turbine will have a reinforced concrete base pad foundation with a central plinth above the base, which will support the tower. The foundation base will be 24m x 24m in size and installed to a depth of 3m below ground level. The above ground plinth will be approximately 38m^2 in area. See planning application Drawing No. 19107-5020-A for typical foundation details.

In the event that poor ground conditions are encountered during excavation and a significant depth to sub-formation is required, a piled foundation may be required and this has been considered in the assessment. A piled foundation requires the use of a piling machine equipped with an auger drill to bore a number of holes around the area of the turbine base to a sub-formation depth. Once all the holes have being bored, reinforcement steel is inserted into each with concrete poured afterwards. The use of piling helps reduces the extent of excavation and backfilling underneath the turbine base.

2.3.3.4 *Hardstands and lay down areas*

Turbine hardstands are required to accommodate the delivery of the turbine components prior to their erection and to support the cranes during erection. Each wind turbine will have an associated turbine hardstand area adjacent to the foundation. Each hardstand area will have a footprint of approximately 1400m^2. The hardstand areas will be excavated and bear onto rock (or other suitable bearing stratum) with a foundation of 0.5-1.5m depending on the local bedrock profile and the varying

depth of peat. The hardstand area will remain in place during the lifetime of the wind farm to facilitate maintenance during the operation of the turbine and final decommissioning. See planning application Drawing No. 19107-5020-A for hardstand details.

2.3.3.5 *Permanent Meteorological Mast*

A permanent meteorological mast will be erected within the wind farm lands described above to monitor the local wind regime while the wind farm is in operation. The permanent meteorological mast is to be located west of T19. The meteorological mast will be up to 100m in height. The mast will have a base foundation of 25m^2 and hardstanding area of 120m^2. A schematic of a typical meteorological mast is shown in Figure 2.8 below. The meteorological mast will have an antenna for internal radio communications for the SCADA (Supervisory Control and Data Acquisition) equipment on site. This is further described in Communication Links below. The meteorological mast will be surrounded by a galvanised steel palisade fence, 2.4m in height.

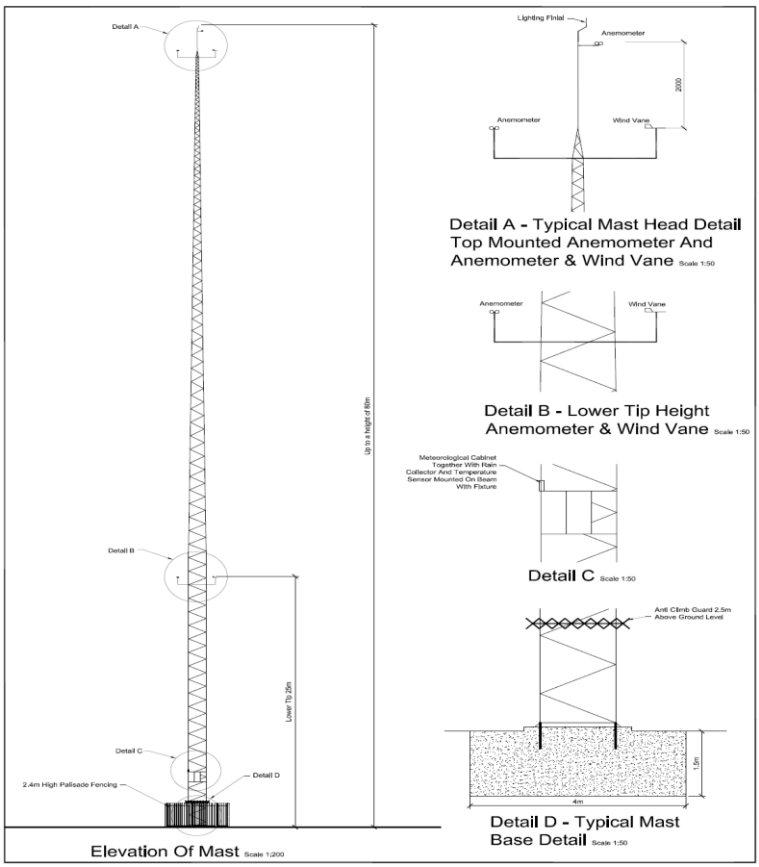


Figure 2-8 Typical Meteorological Mast

2.3.3.6 *Substation Compound*

The development includes a 110kV substation within the wind farm lands described above for exporting power from the wind farm to the national electricity grid. The substation compound is to be located in the northern section of the site, within an area currently under forestry to the northeast of T19. The electrical equipment at the substation compound and buildings will include transformers, busbars, circuit breakers, cable supports, switchgear, panels and all associated cabling.

The substation will occupy an area of approximately 2.1ha and will comprise an outdoor electrical yard and two single storey buildings (one for the system operator and one for the wind farm operator). The system operator building will be 440m² in area and contain a control room, a battery room, a store room, an office / canteen and a toilet.

The Wind Farm Control building (or IPP substation building) will be 195m² in area and contain a store room, a communications room, a control room, a staff room, an office, a switchgear room and a toilet. Both substation buildings will be approximately 6.1m in height, with pitched roofs and an external plastered blockwork finish.

There will be a very small water requirement for toilet flushing and hand washing and therefore it is proposed to harvest water from the roofs of the buildings. The discharge from the toilet within each building will go to a holding tank located within the substation compound where the effluent will be temporarily stored and removed at regular intervals. Parking for each building will be located within the compound area.

The Substation Buildings and associated compound will be contained within a 2.6m galvanised steel high palisade fence. No additional landscaping is proposed or deemed necessary.

Location and layout drawings of the proposed substation compound and buildings are provided in the planning drawings accompanying this planning application (see **Planning Drawings 19107-5048-A and 19107-5049-A**).

Figure 2-9 Typical Substation Compound

Figure 2-10 EIRGRID Substation Building

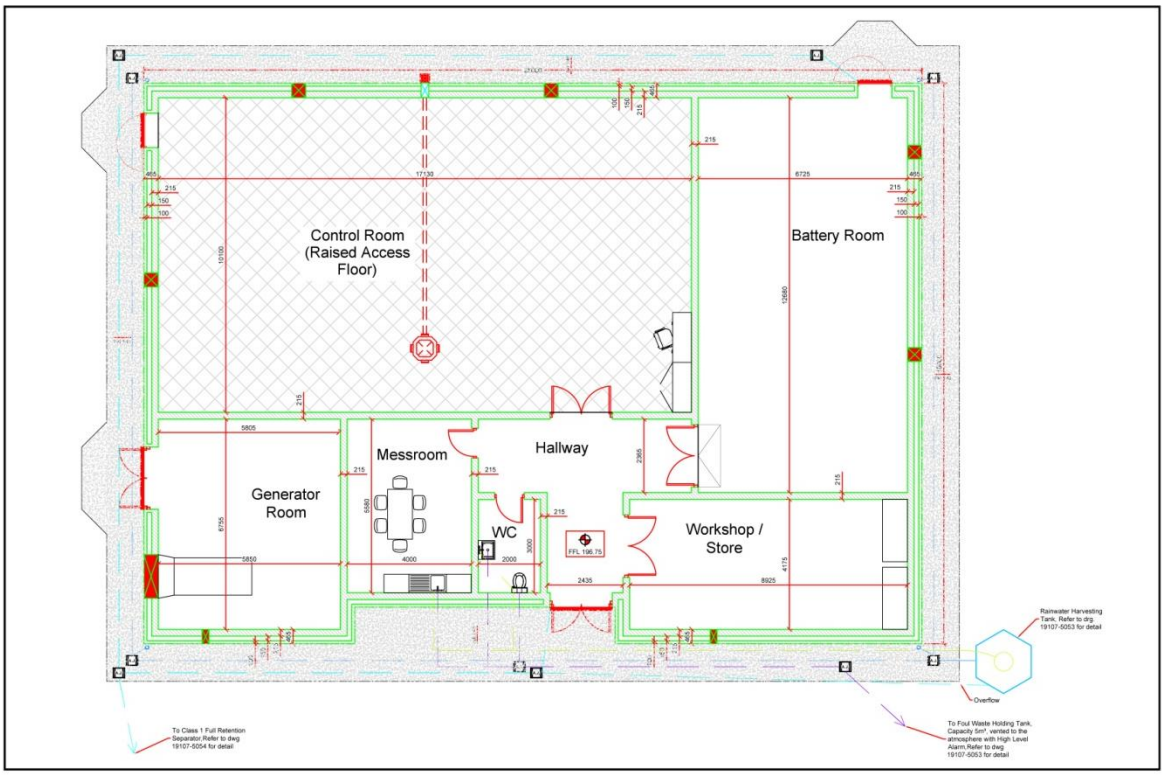
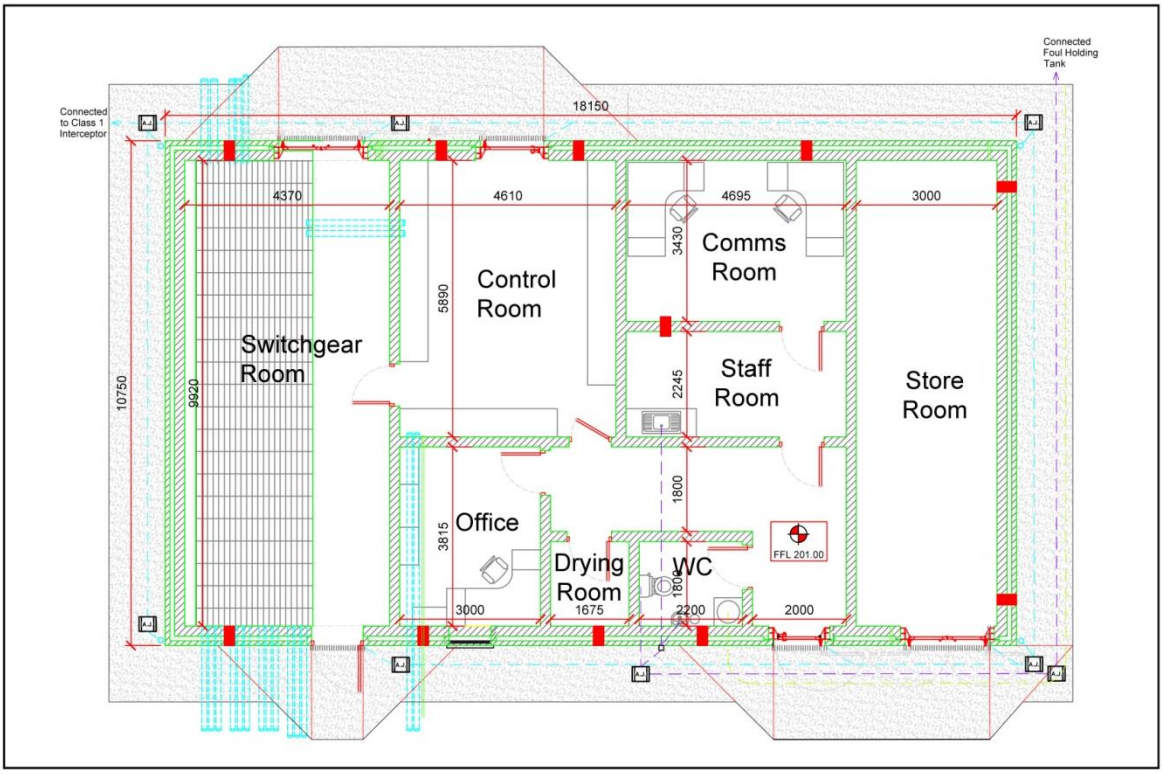


Figure 2-11 Wind Farm Control Building



2.3.3.7 *Underground Cabling within the Wind Farm Site*

A network of underground cabling serving each turbine with electrical power and signal transmission will be installed along internal service roads connecting to the sub-station compound. There will be no overhead power lines constructed on the site.

2.3.3.8 *Turbine transformers*

Each individual turbine will generate electricity at a nominal voltage. Each turbine will also have its own transformer to step-up to an on-site distribution voltage. The transformer and associated switchgear will be located either within or adjacent to the turbine tower. Where the transformer is adjacent, it is in a separate transformer box and is typically 3m (length) x 3m (width) x 2.5m (height). The location of the transformer will vary with different turbine models. Turbines will be connected together by underground cables which in turn will link back to the substation compound.

2.3.3.9 *Communication links*

There will be communication links between the wind turbines, meteorological mast and the substation. The links will use ducted fibre optic cables laid in the same trench as the network of underground electrical cables around the site. Furthermore, an antenna will be positioned on the permanent met mast at 40m height for radio communications for the SCADA equipment. This antenna is for internal site communications for the wind farm. It is not for the provision of public telecommunications services and there is no agreement with any telecommunications service providers.

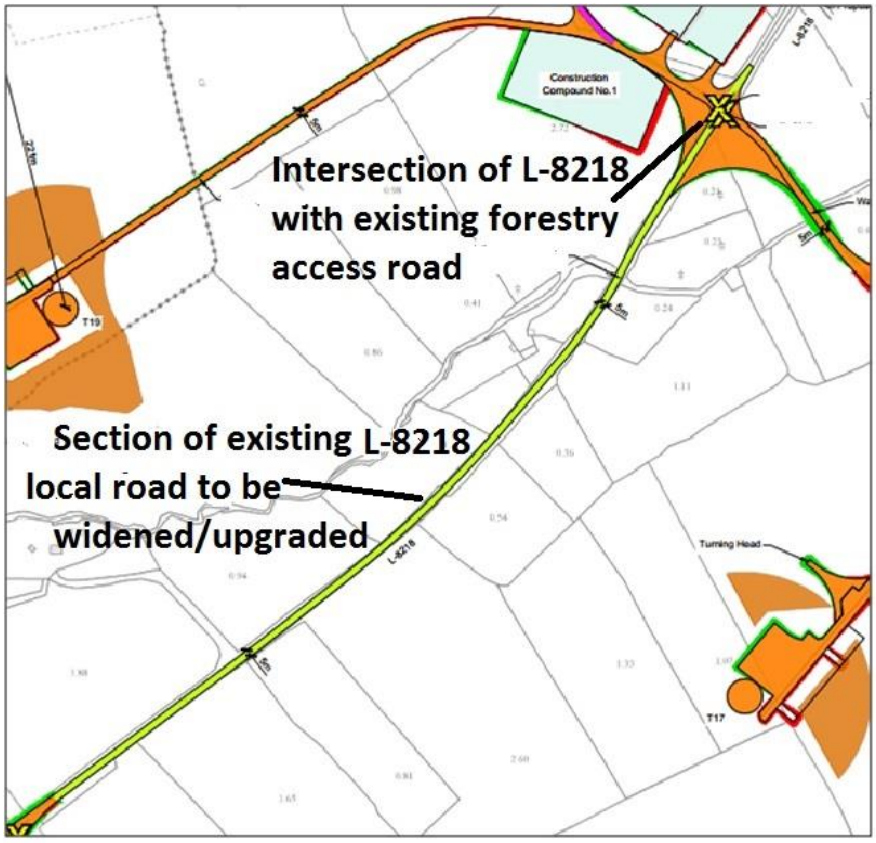
2.3.3.10 *Internal Site Service Roads*

A network of existing forestry and public roads, which will be upgraded and widened, together with new excavated and new floating roads will be used to access each of the turbines, the substation compound and the meteorological mast. The routing of internal site service roads/tracks is shown in Figure 2.3 above and Planning Drawing No. 19107-5005-A. Overall a total of 19.8km of road infrastructure will be required. This is comprised of 11.4km of new road and 8.4km of an existing road being upgraded and widened. These roads will be constructed using excavated and floating road techniques depending on the ground conditions. The methods of construction are outlined in EIAR Chapter 3.

A section of the L-8218 Local road traverses within the development site as shown in Figure 2.2. This will be strengthened and widened to a width of 5.0m over a length of 0.7km. The proposed location is shown in Figure 2.12. As this is a local road, an opening licence will also be obtained from Clare Co. Co. prior to the works being undertaken.

A cross roads junction will also be constructed within the site on the L-8218 Local road at its intersection with the existing forestry access road from the L-8221 as shown in Figure 2.12. There will be widened splays on their western side in order for turbine deliveries to turn and manoeuvre successfully. The widened splays of these junctions will be cordoned off to a radius of 12m for normal traffic and the space will only be made available specifically for turbine delivery.

Figure 2-12 Upgrading works along existing L-8218 Local Road within the wind farm site



Internal service roads will be 5m wide with surface water collection drains on either side. The road drainage system is a control measure for the collection and separation of surface water run-off from the roadways and over land surface water run-off from undisturbed areas of the site and surrounding lands. Refer to section 2.2.4.16 below.

Table 2.2 Overview of Internal Roads works

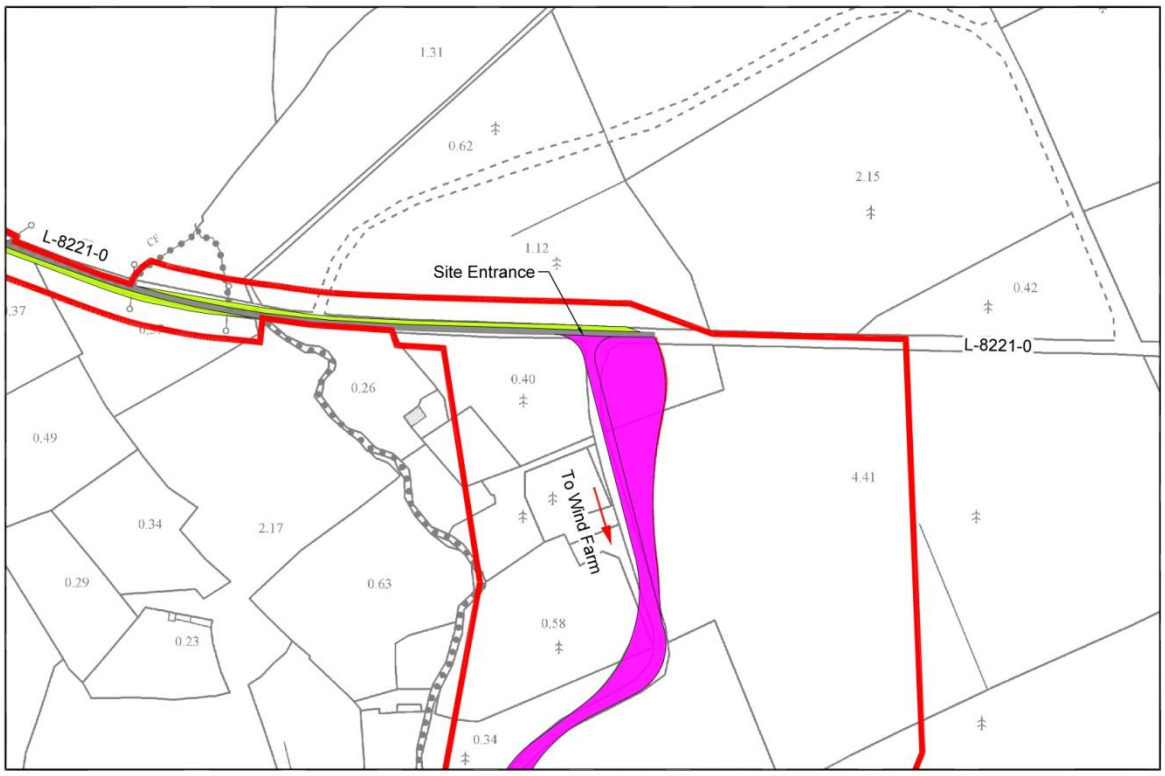
Construction of New roads	11.4km
Strengthening and widening Existing tracks (km)	8.4km
Total tracks	19.8km

2.3.3.11 *Site Entrance*

Access to the wind farm site will be gained from an existing entrance off the L-8221 Local road in the townland of Caherhurly.

The existing site entrance on the L-8221 Local road will require widening on its eastern side to allow the long turbine component loads to turn south at this point. Following completion of construction phase most of the widened area will be removed and the boundary will be restored to provide a permanent 12m junction radius.

Figure 2-13 Site Access



Permanent access to the wind farm during the operational phase will only be from this L-8221 Local road entrance. Operational access from the L-8221 Local road will be limited to cars and light goods vehicles. The L-30302 Local road to the south of the site (Figure 2.2) will not be used for access to the wind farm and does not require any widening or strengthening works.

2.3.3.12 *Turbine delivery route*

Figure 2.14 shows the turbine delivery route proposed for this project. It is anticipated that delivery of turbine components would be from either Foynes Harbour or Galway Port to Junction 18 on the M18 Motorway. From Junction 18 on the M18 Motorway the turbine delivery route will then utilise the R352 Regional road, the R465 Regional road and the L-8221 Local road to gain access to the site entrance.

The road route for starting at Galway Port, which is shown on **Planning Drawing 19107-5056-A**, is as follows:

1. Starting at Galway Port;
2. Lough Atalia Road to the R339 Regional road (Wellbrook Road);
3. Wellbrook Road to the R336 Regional road (Tuam Road);
4. Tuam Road to the N6 National Primary road (Bóthar na dTreabh);
5. Bóthar na dTreabh to the M6 Motorway;
6. M6 Motorway to the M6 / M18 Motorway interchange;
7. M6 / M18 Motorway interchange to Junction 18 on the M18 Motorway;
8. Junction 18 on the M18 Motorway to Coolready on the R352 Regional road;

9. Coolready to the Junction of the R465 Regional road / L-8221 Local road;
10. L-8221 Local road to the site entrance.

Alternatively, the road route for starting at Foynes Port, which is also shown on **Planning Drawing 19107-5056-A**, is as follows:

1. Starting at Foynes Port;
2. N69 National Secondary road to Junction 2 on the N18 National Primary road;
3. Junction 2 on the N18 National Primary road to Junction 18 on the M18 Motorway;
4. Junction 18 on the M18 Motorway to Coolready on the R352 Regional road;
5. Coolready to the Junction of the R465 Regional road / L-8221 Local road;
6. L-8221 Local road to the site entrance.

The Limerick Tunnel on the N18 National Primary road has a height clearance of 4.65m and will accommodate the turbine blades and the upper tower sections on the route above. However, it may not be high enough for the bottom tower sections or the nacelles for the turbine types envisaged on this project. Therefore, these turbine components will travel as follows:

- Starting at Foynes Port;
- N69 National Secondary road to Junction 2 on the N18 National Primary road;
- Junction 2 on the N18 National road to Shannon Bridge on the R510 Regional road;
- Shannon Bridge to the Roundabout on the R527 Regional road / R857 Regional road;
- R857 Regional road to Junction 4 on the N18 National Primary road;
- Junction 4 on the N18 National Primary road to Junction 18 on the M18 Motorway;
- Junction 18 on the M18 Motorway to Coolready on the R352 Regional road;
- Coolready to the Junction of the R465 Regional road / L-8221 Local road;
- L-8221 Local road to the site entrance.

Pre and post-construction surveys will be carried out to ensure the structural integrity of the selected haulage route are not impacted on by the project. Repairs will be carried out on the public road network, as necessary, during the construction phase, to ensure that the condition does not deteriorate below a standard that could affect the use of the site, as required. Following completion of construction, the condition of the public road network will be of at least the same standard as it was prior to commencement of construction. A permit for moving abnormal loads to the wind farm site will be sought from An Garda Síochána and the applicable local authorities on the selected haulage route with a transportation plan for the time of deliveries established at construction stage. Refer to **Appendix 3-7 of Volume III of the EIAR** for a detailed description of the proposed turbine delivery routes, from both Galway and Foynes, and the Turbine Delivery Route Assessment.

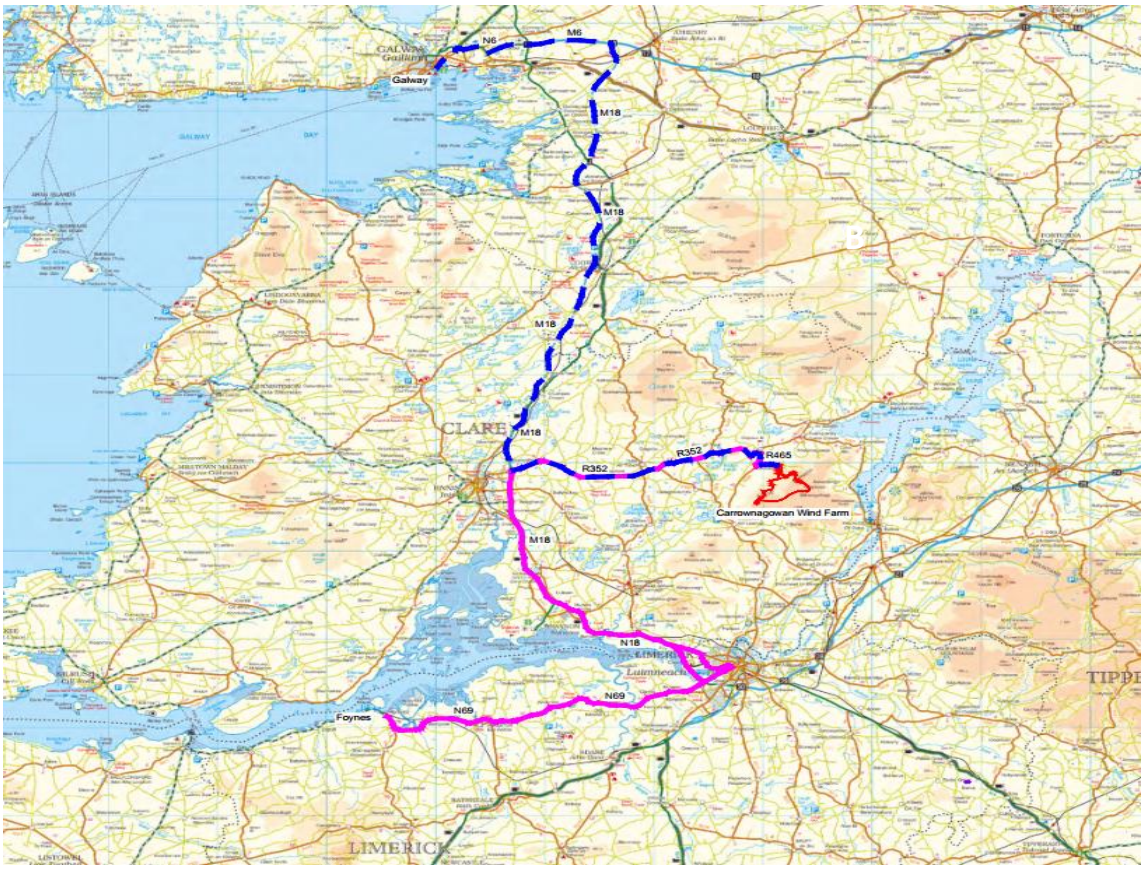
There is no requirement for any road or junction widening from either Foynes Port or Galway Port to Junction 18 on the M18 Motorway.

From Junction 18 the following temporary works are required to be undertaken in order to accommodate turbine delivery along the proposed route to the site entrance. Refer to **Planning Drawings 19107-5057-A, 19107-5058-A and 19107-5059-A.**

- Works Area 1: Road widening on a section of the R352 in the townland of Coolready, Co. Clare approximately 1.1km southwest of Bodyke village. The works will occur on third party agricultural lands to the northern side of this bend. It is intended that on completion of the widening works a temporary barrier (such as anchor blocks) will be put in place along the road verge, thus keeping the public road carriage way the same. On the day of turbine delivery, the anchor blocks will be pulled back to allow the trucks through and reinstalled again after. At the end of construction the ground will be reinstated and the boundary fence re-established at its original location.
- Works Area 2: Construction of new temporary entrances and section of roadway measuring 0.5km in length between the R352 and the R465 through third party agricultural and forested lands in the townland of Coolready, Co. Clare approximately 450m south of Bodyke village. The temporary entrance at the R352 is at the site of an existing small entrance. The entrances will be reinstated with the existing entrance at the R352 returned to its original width post turbine delivery.
- Works Area 3: Construction of new temporary entrances and section of roadway measuring 0.2km in length through third party agricultural scrub lands between the R465 and the L-8221 local road in the townland of Drummod, Co. Clare approximately 2.1km south of Bodyke village. Both entrances will be reinstated post turbine delivery.

Road widening works along the L-8221 local road from the new intersection with the R456 (Works area 3) to the wind farm development site entrance will also be required. The carriageway will be permanently widened with a verge, open drain and new boundary fence. The developer will carry out the road widening and strengthening works on the L-8221 Local road under licence from Clare County Council.

Figure 2-14 Turbine Delivery Route



2.3.3.13 *Temporary construction compounds and welfare facilities*

Two (2) no. temporary site construction compounds will be set up upon commencement of the construction phase. The locations of the temporary compounds are shown in Figure 2.15 and on Site Layout Drawing (**Planning Drawing No. 19107-5005-A**).

Construction Compound No. 1 will have a footprint of approximately 5000m^2 (0.5ha). Construction Compound No. 2 will have a footprint of approximately 1680m^2 (0.17ha).

The compounds will be used as a secure storage area for construction materials and will also contain temporary site units to provide welfare facilities for site personnel. The site units will include office space, meeting rooms, canteen area and sanitary provisions. The temporary compound will be constructed using a geotextile grid and an average of 400mm of stone.

In addition to the construction compounds, temporary mobile welfare units will be located at each of the three borrow pits.

Once the project construction phase is completed, all units from the temporary compounds and the mobile welfare units at the borrow pits will be removed.

The stone and geotextile from Construction Compound No. 1 will be removed and the area restored to its natural habitat.

The base foundation at Construction Compound No. 2 will remain in place and will be used as the sub foundation for the proposed visitor cabin (See section 2.3.3.20).

Figure 2-15 Location of Temporary Construction Compounds

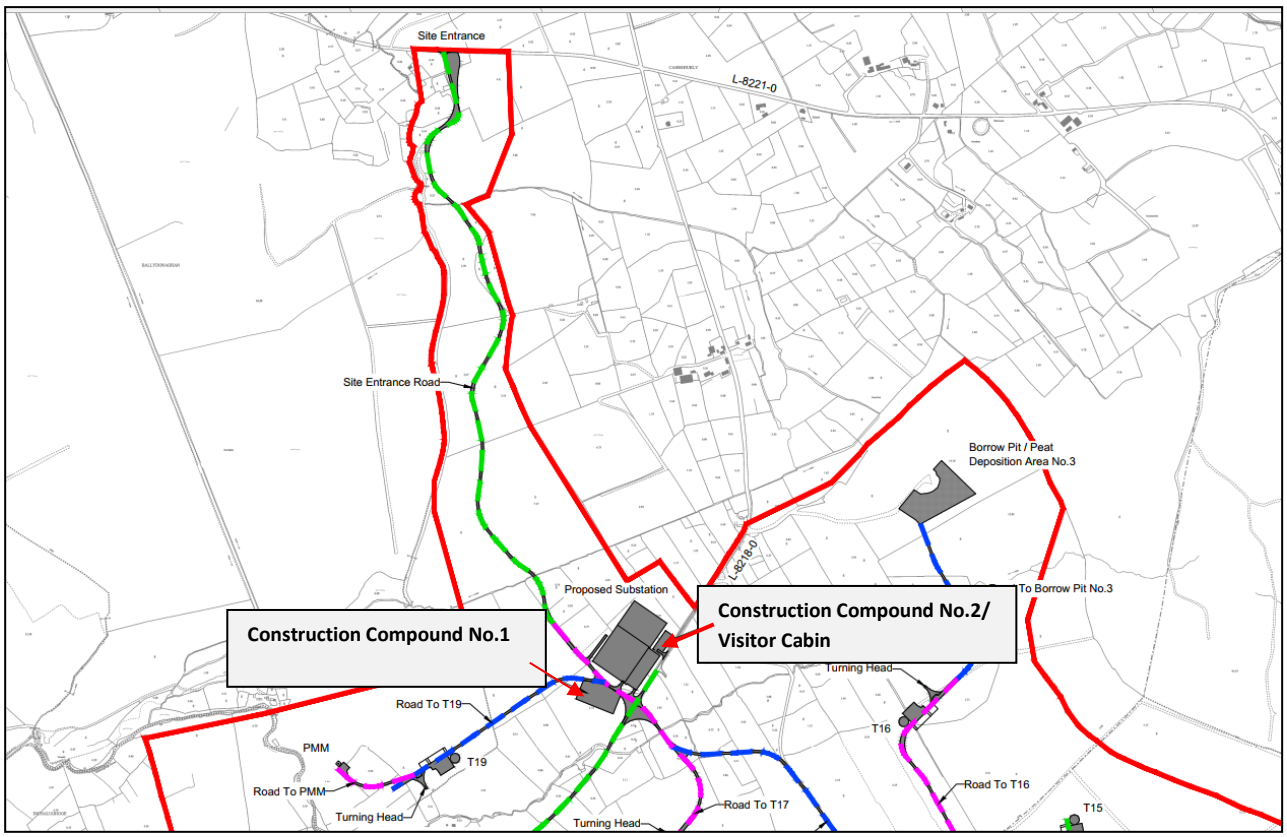
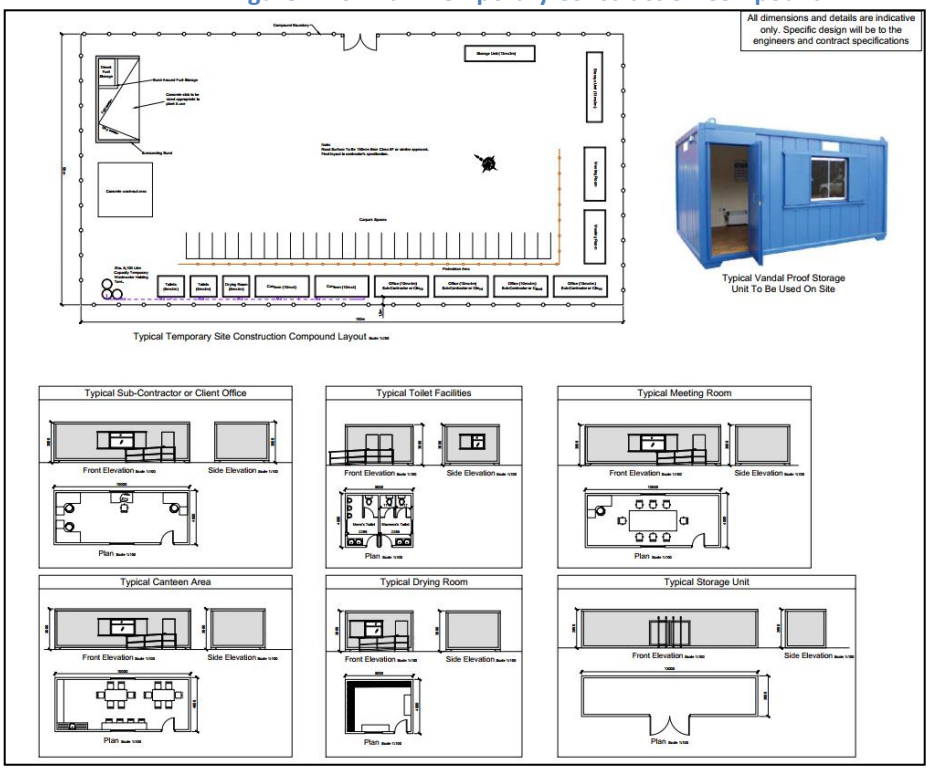


Figure 2-16 Main Temporary Construction Compound



2.3.3.14 *Borrow pits*

There are three on-site borrow pit locations which have been identified to provide the majority of the required fill material for internal roads, passing bays, hardstands, foundations and temporary compounds. It is estimated that approximately 126,627m³ of stone aggregate will be won from these borrow pits. The extraction of rock from the borrow pit will be undertaken by a combination of rock breaking and blasting.

Post-construction, the borrow pit area will be partially backfilled with overburden and excavated material from elsewhere on the site and permanently secured.

2.3.3.15 *Excavated Peat /Spoil deposition areas*

It has been calculated that there will be approximately 280,550m³ of material excavated during the construction of Carrownagowan Wind Farm. Of this, an estimated 140,775m³ will be peat and 139,775m³ will be spoil material.

Table 2.3 Peat and spoil excavation volumes

Development Type	Approx. Peat Excavation Volume (m³)	Approx. Spoil Excavation Volume (m³)
19. no Turbine Base and Hardstand Areas	63,964	59,755
Substation Compound	2,108	38,296
2 no. Site Construction Compounds	1,670	9,231
Access Roads	72,996	32,243
Permanent Meteorological Mast Hardstand	37	250
Total	**140,775**	**139,775**

It is anticipated that 68,490m^3 of the total spoil material excavated on site will be reusable as site won stone aggregate, which accounts for approximately 50% of the spoil.

Excavated peat, estimated at 68,370m^3, and spoil, estimated at 19,894m^3 will be reused for the backfilling, landscaping and restoration around wind farm infrastructure such as turbines and hardstands. Peat will be deposited only within the development areas around the turbines to a maximum height of 0.3m and will not impact on any of the constrained areas as defined at the preliminary stages of the design process in Chapter 3, Section 3.2.1. Berms will be formed along sections of floated access roads in order to store 9,713m^3 of peat which will also act as a physical edge protection in preventing vehicles falling off the raised floated road edge. This form of storage will be provided on both sides of the internal floated roads where the overall dimensions of the berms will be 1m high by 2.5m wide. The remainder of the surplus excavated peat and spoil material, estimated at 114,083m^3 will be stored within the 3 no. deposition areas at the proposed onsite borrow pits. A summary of the peat and spoil storage volumes are shown in Table 2.4.

Table 2.4 Peat and spoil storage volumes

Peat and Spoil Storage Area	Approx. Volume (m^3)
Backfilling, landscaping and restoration around Turbine Bases and Hardstands	88,264
Roadside Berms along Internal Floated Access Roads (at 1m height)	9,713
3 no. Deposition Areas at Borrow Pit Locations	114,083
Total	**212,060**

Further detail on peat deposition areas and excavated peat management are presented in EIAR Chapter 3 and (EIAR Volume III Appendix 3-3).

2.3.3.16 *Surface Water management*

A site surface water management system will be constructed on the site so as to attenuate run-off, guard against soil erosion and safeguard downstream water quality. The drainage system will be implemented along all works areas including all internal site access roads, storage areas, crane hardstand areas and site construction temporary compounds. Details of the proposed site drainage system are given in **Planning Drawings 19107-5013-A to 19107-5019-A.** The concepts and details pertaining to the drainage philosophy are described in Chapter 3 of the EIAR prepared as part of this planning application.

The following gives an outline of drainage management arrangements:

The surface water run-off drainage system will be implemented along all internal access routes, to separate and collect 'dirty water' run-off from the roadway and to intercept clean over land surface water flows from crossing internal roadways.

To achieve separation, clean water drains will be positioned on the upslope and dirty water drains positioned on the downslope of road sides, with road surfaces sloped towards dirty drains.

Clean water will be piped under both the access roads and downslope collection drains to avoid contamination. Piping the clean water under the service road allows the clean water to follow the course it would have taken before construction thus mimicking the existing surface water over land flow pattern of the site and thus not altering the natural existing hydrological regime on site.

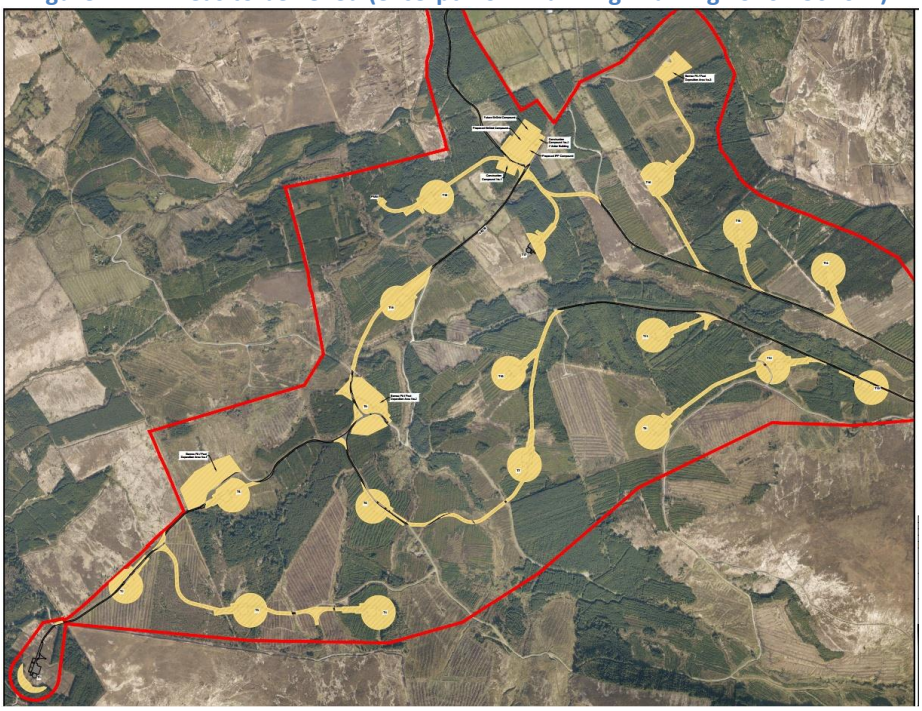
2.3.3.17 *Conifer felling and Replacement forestry*

Felling

Felling of commercial conifer forestry is required within and around wind farm infrastructure to accommodate the construction of the substation, turbine foundations, hardstands and tracks as well as to facilitate assembly of turbines. It is proposed to fell a distance of 86m (in line with the required clearance for bats) around turbines and 5m on either side of roads. Felling of a section of a private ash plantation in the townland of Coolready will also be undertaken to enable the construction of a new roadway between the R352 and R465 which is to facilitate turbine delivery to the site. Overall felling of appropriately 67.66ha of forestry will be required.

All tree felling will be undertaken in accordance with a tree felling licence, using good working practices as outlined by the Forest Service in their '*Standards for Felling and Reforestation (2019)'* and their previous guides; '*Forestry Harvesting and Environment Guidelines*' *(2000a)* and the *'Forestry and Water Quality Guidelines' (2000b)*. The latter guidelines deal with sensitive areas, erosion, buffer zone guidelines for aquatic zones, ground preparation and drainage, chemicals, fuel and machine oils. Any excess trees, brash and minor branch residues will be gathered from the site. Felling residue will be transferred to a truck for disposal via chipping or baling and removed from the site. All conditions associated with a proposed felling licence will be complied with.

Figure 2-17 Areas to be Felled (excerpt from Planning Drawing 19107-5020-A)



Replacement Forestry

To allow for all forestry removed as part of the proposed development, it is proposed that replacement forestry will occur at three off-site locations, namely Ballard in Co Wicklow, Dangananella West, Cooraclare in Co. Clare and Trillackacurry in Co. Longford as the result of a separate Coillte obligation to replant trees when permanently felling (as discussed in Section 2.3.1.3.2 of this Chapter.) These replacement forestry lands have previously been granted Technical Approval by the Forest Service for afforestation

The replacement lands in the townland of Ballard, Co. Wicklow are located approximately 1.2km south west of Ballinaclash village. The lands comprise an old Christmas tree farm that has been fully harvested and not been re-planted. The approved area for afforestation measures circa 38ha.

The replacement lands in the townland of Dangananella West, Co. Clare comprise an area of 10.78ha which are currently improved agricultural grasslands. These lands are located approximately 2.1km south west of Cooraclare village.

The Replacement lands at Trillickacurry are situated c. 3.6km to the south of Longford town and have already been replanted for commercial forestry. Prior to planting the 24.25 ha site would have had a character of an agricultural farmland used for cattle grazing and silage harvesting.

2.3.3.18 *Grid connection*

The individual turbines within the wind farm will be connected electrically by underground cables to a new 110kv substation to be constructed within the wind farm site. The Carrownagowan Wind Farm substation will in turn be connected via an underground grid connection cable to the existing ESB owned 110kV substation at Ardnacrusha, County Clare which will allow the electrical energy generated from the wind farm to be exported onto the national grid.

The underground grid cable between the Carrownagowan Wind Farm and the existing 110kV substation in Ardnacrushna is almost entirely confined to the existing road network, diverging slightly from it at water course crossings and at some joint bay locations. The full length of the Carrownagowan Wind Farm grid connection route is 25km.

The grid connection route begins at the proposed wind farm substation within the townland of Caherhurly. It will travel underground along the L-8218 Local road for a distance of 0.7km and along proposed internal wind farm roads within the townlands of Killokennedy and Cloongaheen West before emerging onto the L-30302 Local road. From here the grid connection route will travel in a southern direction along the L-30302 Local road through the townland of Cloongaheen West for a distance of 2.5km until it reaches the L-7004 Local road. At this point the route will travel east along the L-7004 Local road through the townlands of Cloongaheen East and Kilbane for a distance of 2.3km until it reaches the village of Kilbane. The route will continue past the village of Kilbane along the L-3022 Local road through the townlands of Killeagy (Goonan), Ballymoloney, Cloonygonry Beg and Ballyquin More for a distance of 2.4km until it reaches the R466 Regional road. After this point the

grid connection route will travel in a southwest direction along the R466 Regional road for a distance of 0.9km until it reaches the L-3044 Local road. From here the grid connection route will travel along the L-3044 Local road through the townlands of Springmount, Leitrim, Fahy More (South), Aharinaghmore and Ballybrack for a distance of 4.2km until it reaches Harols Cross Roads which is located on the R471 Regional road.

At Harols Cross Roads the grid connection route will travel west along the R471 Regional road through the townlands of Tooreen, Aharinaghbeg and Cloghera for a distance of 2.6km before turning south onto the L-70661 Local road. The route will travel in a southern direction along the L-70661 Local road for a distance of 1.3km through the townlands of Cloghera and Trough until it reaches the L-7066 Local road. From here the grid connection route travels along the L-7066 Local road for a distance of 0.7km through the townlands of Knockdonagh and Roo West until it reaches the L-3054 Local road. At this point the grid connection route continues to travel in a southern direction along the L-3054 Local road for a distance of 2.1km through the townlands of Lakyle and Glenlon South until it reaches the L-3056 Local road. Upon reaching this point the grid connection route will travel west for a short distance of 0.2km along the L-3056 Local road before turning south into the ESB owned Ardnacrusha 110kV Substation located within the townlands of Castlebank and Ardnacrucha.

2.3.3.19 *Visitor Cabin*

It is proposed to install a prefabricated modular unit within the compound of Temporary Site Construction Compound No. 2. The temporary site construction compound at this location will be repurposed for use as a car park and surrounded by a 2.6m high galvanised steel palisade fence.

The intended purpose of this unit is to facilitate the hosting of workshops for school groups and/or members of the public and also act as a base for guided tours of the wind farm during its operation. The building will be 86m² in area and will accommodate a meeting room and toilet facilities for up to 30 visitors.

The prefabricated building will have a flat roof with a modular external surface that may be finished to an agreed colour to minimise visual impact. The foundation of the building will consist of a concrete slab while access to the building will be made via concrete stairs or ramps. There will be a very small water requirement for toilet flushing and hand washing and therefore it is proposed to harvest water from the roof of the building. The discharge from the toilet within the building will go to a holding tank located within the compound where the effluent will be temporarily stored and removed at regular intervals by a licenced waste contractor.

Details of the visitor building and compound are shown in **Planning Drawing 19107-5047A**.

Figure 2-18 Typical prefabricated modular building

2.3.4 Cumulation with other existing and/or approved Projects

Both the grid connection and the forestry replacement lands are included in the project which is assessed throughout the EIAR, and are therefore not considered cumulatively.

The project was considered in combination with other plans and projects that could result in cumulative effects including:

- Clare County Development Plan (2017-2023) (As Varied)
- Clare Wind Energy Strategy (2017)

Any development under these plans will first have to be consented under planning and development legislation. Significant cumulative impacts are not predicted with the plans listed above, as each plan has a range of environmental and natural heritage policy safeguards in place. Furthermore, this project has been developed in view of achieving the objectives of these plans. Therefore development of this project in combination with the scope of works required to achieve the objectives of these plans will not result in cumulative effects. In terms of the Slieve Bernagh mountains, the zoning in the development plans relates to wind energy development and there is no other contradictory zoning for other project types or infrastructure. In terms of the Shannon Estuary Strategic Development locations outlined in the county development plan, the project is not located in any of these sites.

A search of Clare County Council's ePlan site was carried out during the EIA process (June 2019) with a final search in October 2020. The search focused on the areas close to Slieve Bernagh within approximately 5km of the wind farm site, along the grid route, and also looked at applications made in the nearest settlement areas including Bodyke, Broadford, Tuamgraney, Scarriff, Ogonnolloe, Killaloe and Ardnacrusha. All other wind farm developments were considered within 30km of the site. Finally, recent planning applications that are pending a decision from the planning authority, which were accompanied by an EIAR, were also considered.

The projects in the surrounding areas relate to agricultural sheds and shed extensions, dwelling houses and extensions to dwelling houses, attic conversions, domestic wastewater treatment systems, installation of photovoltaic for domestic purposes, garages, demolitions and retention permission applications. There are no applications for large-scale commercial or industrial activities near Sliabh Bernagh. Such minor domestic and agricultural development will not introduce cumulative effects. These minor projects are either under the threshold for EIA or excluded from the list of projects requiring EIA and due to the nature and scale of these applications would not introduce complex or significant issues, and are therefore not considered in the cumulative assessment. Clare County Council's ePlan site includes six planning applications which were accompanied by an EIAR. Of these six, one is relevant to the project based on location only. The application, which was granted in May 2019, is for a 10 ha extension to an existing large working quarry in Ballycar near Ardnacrusha. Considering the location of the extension adjacent to the operational quarry and that it is an existing regulated quarry, it is very unlikely to introduce significant cumulative effects. The extension is accessible from the existing quarry and is solely for the provision of additional stone, for the existing facility. These works will take place within the regulated site boundary. The quarry is located closer to the grid route than the wind farm site itself. However, it is over 2km from the grid route and served by regional and local roads. It is not considered further in the cumulative assessment and the application relates to additional rock extraction, but for processing under existing quarry activities. Also the construction of the grid connection works will only require relatively localised excavation, installation, and construction works progressing along the public road.

Land management practices in the wider area which are considered in combination with the effects of the project are agriculture, forestry and peat harvesting. However, the project will not interact with agriculture or peat harvesting as there are no active agricultural activities or peat harvesting at the site. Forestry operations at Carrownagowan are discussed below.

In terms of the replacement lands, in Co. Clare, Co. Longford and Co. Wicklow, each site has prior technical approval for forestry. There is limited potential for significant cumulative effects associated with the sites and forestry operations due to their rural location and small scale.

Existing on-site Forestry Operations

The wind farm site is on land managed for commercial forestry by Coillte. It is proposed that all on-site forestry activities will cease for the duration of the construction and commissioning phase. Forestry operations will resume again post commissioning of the wind farm.

Other wind farm developments

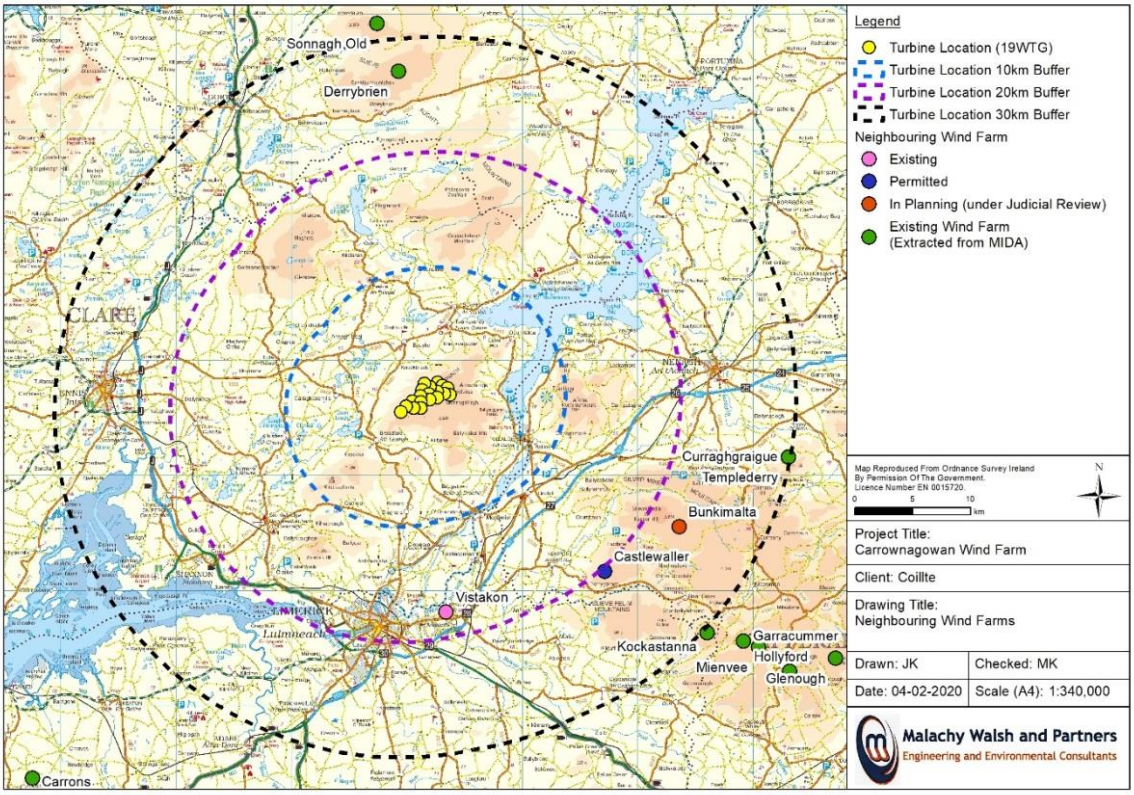
The proposed Carrownagowan wind farm development would cumulate with other wind farm developments in the region to advance in delivering local, regional and national Green Energy targets.

- Derrybrien (existing)
- Curraghgruaige (existing)
- Templederry (existing)
- Knockastanna (existing)
- Vistakon (existing)
- Castlewalter (Permitted)
- Bunkimalta (Permitted)

The potential for cumulative effects of other wind developments are considered in the relevant chapters of this EIAR. As the closest wind farm to Carrownagowan is at a distance of approximately 20km, the likelihood of cumulative noise and shadow flicker effects is low. Cumulative impacts on the Shannon catchment area are unlikely as the other wind developments are already operational.

Chapter 12, Landscape and Visual Assessment, has included these developments in the cumulative assessment.

Figure 2-19 Wind Farm developments within 30km of Carrownagowan turbines



2.4 DESCRIPTION OF CONSTRUCTION

2.4.1 The construction phase land use requirement

Land use requirements during the construction phase will be greater than that of the permanent land take area. The temporary land take required during the construction phase is set out below.

ITEM	AREA
Construction compounds	5,000m² Site Compound No. 1 only
Wind Turbine Construction	16,920m² (890m² per hardstand) WTG construction requires temporary workspaces during the erection of the different turbine components. These workspaces include storage areas for the turbine blades and temporary areas for the assembly of the auxiliary cranes and parking.
Temporary Turning Heads	7,500m² 8 no. temporary turning heads (two of these turning heads will be for fully laden deliveries) will be temporarily constructed to allow for the turning of construction and turbine deliveries vehicles during construction.

2.4.2 Proposed works

The construction of Carrownagowan Wind Farm project will principally comprise the following works:

- Felling of any areas of coniferous forestry plantation necessary to facilitate the construction of the works;
- Construction of site entrances and any sections of internal access roads necessary to facilitate access to the temporary site construction compounds and proposed on-site borrow pit locations;
- Establish temporary site construction compounds including fencing, site offices, parking, material laydown and storage areas, wheel wash facilities;
- Establish on-site borrow pits and associated repositories for temporary storage of stockpiled overburden and surplus excavated materials;
- Earthworks and drainage infrastructure associated with construction of new and upgraded internal access roads, crane hardstand areas and substation compound;
- Construction of new watercourse crossings along internal access roads;
- Excavation of turbine bases, blinding of bearing strata, fixing of shuttering and steel reinforcement, placing of concrete and backfilling around turbine foundations;
- Reinstatement of areas around turbine bases / crane hardstand areas, along edges of access tracks;

- Installation of sections of underground cabling between turbines and the wind farm substation compound which are located alongside existing / new internal access roads within the site;
- Construction of the substation compound, EirGrid substation building, IPP substation building, equipment plinths, etc.
- Works to the local public road network required to facilitate access for turbine component deliveries to the wind farm;
- Installation of ducting and joint bays along the grid connection route running under public roads from the wind farm to the ESB owned 110kV substation at Ardnacrusha, County Clare;
- Cable installation of the grid connection route under public roads;
- Installation and commissioning of electrical equipment in the EirGrid and IPP substation buildings;
- Turbine delivery, installation and commissioning; and
- Meteorological mast delivery, installation and commissioning.

2.4.3 Construction methods

Details on the construction methods are fully set out in EIAR Chapter 3 and EIAR Volume III Appendix 3-1 Construction Environmental Management Plan. The following provides a summary of the types of proposed construction techniques for the main project components.

Element	Construction technique
Wind turbine foundations and hardstands	Wind turbine locations will be cleared, graded, and foundations will be either excavated or piled by rotary core technique. Blasting may be required at wind turbine locations where bedrock is present near the ground surface. An engineered concrete foundation will be installed in the excavated/piled structure location. Backfill will be provided, and grading will be performed in a manner to allow for immediate drainage away from each tower. Construction activities include tree removal, vegetation clearing, topsoil and/or peat stripping, excavation and or piling, grading, foundation construction, final grading and landscaping of temporary works areas.
Met mast	Construction includes tree removal, topsoil and peat stripping, excavation, grading, foundation construction, final grading and landscaping of temporary works area
Turbine delivery route	Modifications along the turbine delivery haul route will be required. Modifications including widening, strengthening and construction of new road sections. Construction activities include vegetation clearing, topsoil and/subsoil stripping, aggregate placement and grading, and landscaping of temporary works areas.
Site Access	Widening of the existing site access junction will be required. Construction activities include vegetation clearing, topsoil and/subsoil stripping, aggregate placement and grading, and landscaping of temporary works areas.
Internal roadways	**Upgrading, widening and new excavated roadways:** Construction activities will include vegetation clearing, topsoil and/or peat stripping, excavation, placement of geogrid/ geotextile layer and aggregate, compaction, grading , berm placement and landscaping.

Element	Construction technique
	Floating Roads: Construction activities will include removal of major protrusions, placement of geogrid/ geotextile layer and aggregate, compaction, grading , berm placement and landscaping.
Internal underground site electrical cables	Underground electrical collector cables will be co-located within access roads in order to minimize the area of construction disturbance.
Substation Compound	Construction includes tree removal, topsoil stripping, excavation, grading, foundation construction, final grading and landscaping of temporary works area.
Construction compounds	Construction includes tree removal, topsoil stripping, excavation, grading, aggregate placement, compaction and landscaping.
Borrow pits	Construction includes topsoil stripping, excavation and/or blasting.
Water crossings	**Wind Farm Site:** Existing crossings: widening using pre-cast piping. New crossings: Clear span crossings.
	Grid Connection Route: Techniques include directional drilling; Standard trefoil formation; Flatbed formation.
Grid connection cable (other than at water crossings)	Construction activities include excavation, backfilling, resurfacing.

2.4.4 Duration and Timing

2.4.4.1 *Wind Farm*

It is envisaged that the project will commence in Quarter 3 of 2022 with an 18 month construction period followed by a 4-6 month commissioning period. The start date is dependent on planning being granted and funding and all permits being in place.

A typical programme of works is outlined in Table 2.5 below. It is dependent on how the above works are scheduled to coincide with each other and relates directly to existing environmental and user constraints. Construction works will be carried out in a phased manner in order to:

- Minimise disruption to the local community;
- Minimise environmental impact
- Create the safest working conditions possible.

It is anticipated that the construction work will be phased as outlined in Table 2.5 below. A number of these phases will however run concurrently as outlined as follows.

- As the internal site access roads are constructed up to each turbine, hardstanding areas for the crane, turbine foundations and building foundations will be prepared.

- Before the final road surface is completed, the trenching and laying of underground cables in the roads will begin.
- Construction of the site sub-station and control houses will commence so that they will be ready to export power as turbines are commissioned.

Table 2.5. Development sequences

Phase	Activity	Duration
Phase 1	Clearfelling (to be complete ahead of construction site mobilisation)	2 – 3 month (post planning consent, prior to construction)
Phase 2	Prepare site, Pre-construction activities, Site entrance, temporary Compound	1 month
Phase 3	Access road construction + Drainage plan implementation	3 months
Phase 4	Hard standing construction for turbines	2 months
Phase 5	Turbine Foundation construction	4 months
Phase 5A	Trenching and ducting (underground electrical collection system)	2 months
Phase 6	Substation construction	4 months
Phase 7	Permanent meteorological mast erection	1 month
Phase 8	Turbine delivery	4 months
Phase 9	Turbine erection	4 months
Phase 10	Wind Farm Commissioning	4 months (approx)

2.4.4.2 *Grid Connection Construction*

The Grid connection will be subject to a separate planning application. The active construction area will generally be only along a 100-200m stretch of any roadway at any one time. The works for the grid connection route are estimated to take approximately 10 months and will overlap with the wind farm works. During the first 5 months the cable trenches will be constructed. The second 5 months will involve sequentially opening up all joint bays (these are pre-cast concrete chambers that will be required along the grid connection route over its entire length) and pulling electrical cables pulled through ducts and then joining each cable together. There is anticipated to be 35 joint bays with 2-3 days' work involved at each. Construction activities along the proposed grid connection route would operate between the hours 7:00 a.m. and 7:00 p.m., Monday to Saturday (if required). Any deviations to these times will be agreed in advance with Clare County Council. It is expected that the civil works for the grid connection route will require at least 10 personnel to complete the works. The electrical works will require less heavy machinery but more labour personnel.

2.4.5 Major temporary features: cranes, stockpiles etc

Temporary features on site include the compound facilities, plant and equipment along with safety fencing and building materials. Large excavators and turbine erection cranes are also a temporary feature on site during the construction phase. Stockpiling of peat or soils will be avoided on site. Any surplus peat material will be placed within the peat deposition areas (refer to **Planning Drawings 19107-5028-A to 19107-5031-A**).

2.4.6 List of plant

Mechanical machinery and electrical equipment typically used for construction projects will be required to facilitate the project. The following is a non-exhaustive list of plant that is typically used for wind farm and heavy civil engineering work.

- 30-50T Excavators;
- 15-30T Excavator;
- Rubber Tired 15-20T Excavator;
- 3-10T Mini Diggers;
- Low Ground Pressure Excavators (Bogmaster);
- Mobile Crane for construction;
- Rebar/shuttering/precast units/conc pipes/box culverts etc 60t to 120t;
- Cranes (1 main, 1 assist) Erection 120t to 1000t;
- Telescopic Handler;
- Tractors and trailers;
- Road grader;
- Double contained fuel bowsers;
- 12T Rollers;
- Diesel powered generators; and
- Water bowsers.

2.4.7 Working Hours

2.4.7.1 *Wind Farm Site*

Construction will typically occur within the hours: 07.00am – 7.00pm, Monday to Saturday inclusive. During summer periods the working day may extend at times when critical elements of work need to be advanced. Longer working days can also occur when there is a phased construction programme with some elements such as commissioning overlapping with final site construction activity. Working hours will be confirmed at the outset of the project and any changes in hours will be agreed with the Local Authority.

A permit for moving abnormal loads will be sought from An Garda Siochana and a transportation plan for the timing of deliveries will be established.

No work on Sunday unless preapproved with the relevant bodies.

2.4.7.2 *Grid Connection Cable*

The works for the grid connection route are estimated to take approximately 10 months within the overall project works schedule. During the first 5 months the cable trenches will be constructed. Construction activities along the proposed grid connection route will operate between the hours 7:00 a.m. and 7:00 p.m., Monday to Saturday or as otherwise conditioned as part of the consent.

2.4.8 Construction Personnel

During the construction phase, the number of on-site construction personnel will vary for each phase of the development. Overall, it is envisaged that the proposed development would generate

employment for up to 100 persons during the construction phase to include site contractors, on-site vehicle and plant operators, engineers, materials delivery personnel, environmental personnel, health and safety personnel.

It is expected that the civil works for the grid connection route will require at least 10 personnel to complete the works. The electrical works will require less heavy machinery but more labour personnel, with typically 25 personnel to complete the works.

2.4.9 Construction Environmental Management Plan (CEMP)

A construction environmental management plan is provided in EIAR Volume III Appendix 3-1. This plan outlines the requirements and constraints which must be followed by the appointed contractor in preparing the detailed CEMP in order to construct the works in an appropriate manner. The CEMP will include all mitigation measures in this EIAR (relevant to the construction phase) and all of the conditions of planning should a consent be granted.

2.5 DESCRIPTION OF COMMISSIONING

Wind farm commissioning can take approximately 4 months to complete from the erection of the final turbine to exporting of power. It involves approximately ten commissioning engineers working through an entire schedule of SCADA (Supervisory Control and Data Acquisition) and electrical testing and control measures to ensure the wind farm will perform and export power to the national grid as designed.

2.6 DESCRIPTION OF OPERATION

2.6.1 Land use requirement

The permanent land take will be limited to the wind turbine hardstands, access tracks, permanent crane hardstand areas, visitor compound area, control building and substation hardstandings which account collectively for about 4% of the total area within the wind farm planning boundary.

2.6.2 Operating Hours and Operational Conditions

2.6.2.1 *Operating Conditions*

The proposed wind farm development will have a lifespan of 30 years. The Project is designed to operate when wind speeds at the hub height are within the operating range of the wind turbines. The final selected turbine model will likely have a cut in wind speed of 3m/s with optimum generation at approximately 12.5m/s. The turbines are expected to have a cut out wind speed of 25m/s.

Each wind turbine will be computerised to control critical functions, monitor wind conditions and report data back to a Supervisory Control And Data Acquisition (SCADA) system. An anemometer mounted on the top of the wind turbine nacelle provides wind speed information used to automatically set blade pitch and control the wind turbine. A wind vane mounted on top of the nacelle

provides information needed to yaw the wind turbine into the wind. The SCADA system monitors problems and diagnoses failures. If a problem causes a wind turbine to shut down, the wind turbine will either be restarted by the SCADA system operator, or service personnel will perform the necessary repairs and then manually restart the wind turbines.

In addition, the wind turbine can also be controlled manually at the nacelle, from a panel inside the base of the tower, or from a remote computer via the SCADA system. Using the tower top control panel, the wind turbine can be stopped, started, and turned out of the wind.

2.6.2.2 *Maintenance*

During the operation of the wind farm, the turbine manufacturer, the Developer or a service company will carry out regular maintenance of the turbines. During the life of the project, it is envisaged that at least two permanent jobs will be created locally in the form of an operator or maintenance personnel. In addition, operation and monitoring activities may be carried out remotely with the aid of computers connected via a telephone broadband link. However, routine inspection and preventive maintenance visits will be necessary to ensure the smooth and efficient running of the wind farm and require a minimal presence.

2.7 DECOMMISSIONING AND RESTORATION

2.7.1 Wind Farm

The wind farm has been designed to have an operational life of 30 years and any further proposals for wind farm development at the site after this time will be subject to a new planning permission application. If planning permission is not sought after 30 years, the site will be decommissioned and reinstated with all wind turbines and towers removed. Upon decommissioning, all that will remain will be the roads. The substation will likely remain in place as part of the permanent electrical infrastructure.

When the site is to be decommissioned, cranes of similar size to those used for construction will disassemble each turbine. The towers, blades and all components will then be removed. The turbines, cabin and monitoring masts will also be removed from site. It is likely that any turbine component will be reused as they have a life well in excess of the wind farm proposal i.e. greater than 30 years. Wind farm components may also be recycled.

Underground cables will likely be cut back and left underground as removal may do more harm than leaving them *in situ*.

Hardstand areas will be remediated to match the existing landscape thus requiring peatland restoration or reforestation. Access roads will be left for use by the landowner. The current view is that the disturbance associated with the removal and disposal of the elements (hard core and sediment) would be more deleterious than leaving them in place.

Any structural materials suitable for recycling will be disposed of in an appropriate manner.

Prior to wind turbine removal, due consideration will be given to any potential impacts arising from these operations. Some of the potential issues include:

- Potential disturbance by the presence of a crane, heavy goods vehicles and personnel on-site;
- On-site temporary compound would need to be located appropriately;
- Time of year and time-scale (to be outside sensitive periods); and
- Roads (site tracks may remain in use for the benefit of the landowner).

Prior to the decommissioning work, a plan will be drawn up to ensure the safety of the public and workforce and the use of best available techniques at the time.

Prior to the decommissioning work, a comprehensive reinstatement proposal, including the implementation of a program that details the removal of all structures and landscaping, will be submitted to the planning authority for approval.

Wastes generated during the decommissioning phase will be taken off site and disposed of appropriately by a licensed waste operator.

2.7.2 Grid Connection

The grid cable will remain a permanent part of the national grid and therefore decommissioning is not foreseen. In the event of decommissioning, it will involve removing the cable from the ducting but leaving the ducting and associated supporting structure in place. It is also likely the substation will remain in place and will previously have been taken in charge by the system operator, after the wind farm is connected to the national electricity grid.

2.8 THE USE OF NATURAL RESOURCES

2.8.1 Aggregate

Large amounts of aggregates (rock, stone, gravel, sand), concrete, and steel will be used during construction phase. The majority of aggregate materials required for the construction of the roads, crane hardstands and the substation compound will come from aggregate (rock, stone, gravel, sand) extracted from three proposed on-site borrow pits. Concrete and additional aggregate materials will be sourced from approved facilities. There are two quarry facilities in the areas which are capable of supplying these construction materials, McGraths quarry in Tulla and O'Connell Quarries in Ballycar, Ardnacrusha. The closest is McGraths in Tulla. The Traffic Management Plan (Appendix 3-4, Volume III) has considered transport of quarry material closest quarry but the aggregate source will be finalised at a later date.

Table 2.6 Summary of Approximate Aggregate Quantities

Item	Site Won Aggregate m^3	Imported Materials m^3		Concrete m^3
		Aggregate	Capping	
Turbine delivery areas and L-8221 Local Road Widening	0	2,564	769	0
Internal access roads	107,089		15,734	
Turbine bases				13,300
Turbine hardstands	45,957		6,686	
Substation compound, infrastructure and buildings	25,865		3,141	500
Temporary site compounds	6,682		1,040	

2.8.2 Water

Water needs for construction activities will be low and limited to truck washing, wheel wash, dust suppression and sanitary facilities. It is proposed that this water requirement will be sourced from on-site rainwater collection systems and settlement ponds.

It is estimated that up to approximately 3,000 litres per day of potable water will be required during peak construction for construction employees. It is proposed that this water requirement will be imported in bulk water tanks.

Potable water for the operational and maintenance phase is estimated to be approximately 60 litres per day. This water will be supplied as bottled water.

2.9 PRODUCTION OF WASTE

2.9.1 Excavated soils, subsoils and peat

All soils and subsoils generated from excavation works will be retained on site and reused in bunding, landscaping and localised earthworks. Excess peat and spoil material, estimated to be approximately 114,083m^3, will be stored on site in designated peat deposition areas. All spoil excavated from the grid cable route trench, estimated to be approximately 19,725m^3 will be removed offsite to a suitable inert soil facility. Available facilities include Clare Waste & Recycling at Tuamgraney, Inagh Central Waste Management Facility in Ballyduff Beg, Inagh and Enva, located at Smithstown Industrial Estate in Shannon, Co. Clare.

Table 2.7 Summary of surplus excavated soil, subsoils, peat

Material	Volumes m^3
Peat and spoil (onsite deposition)	114,083
Spoil from grid connection cable route (to be removed to an offsite facility)	19,725
TOTAL	**133,808**

2.9.2 Domestic Waste-Water Effluent

Wastewater from welfare facilities on site will drain to integrated wastewater holding tanks associated with the toilet units. The stored effluent will then be collected on a regular basis from site by a permitted waste contractor and removed to a licenced waste facility for treatment and disposal. There are licensed, operational wastewater treatment plants at Quin and Shannon.

During the construction time period, wastewater production is estimated to be 3,000 litres per day.

Although primarily controlled remotely, during the operational phase, maintenance personnel will visit the substation building on a regular basis. The daily average wastewater production during the operational phase is estimated from the average number of workers on site, which is expected to be 2 workers, resulting in a typical wastewater production rate of 60 litres per day. The wastewater generated during the operational phase will be managed by a holding tank which is of twin-hull design and fitted with an alarm to indicate levels and when it is due for empty. The holding tank will be emptied by a permitted contractor only.

2.9.3 General Wastes

Construction phase waste may consist of hardcore, concrete, spare steel reinforcement, shuttering timber and unused oil, diesel and building materials. This waste will be stored in the construction compound and collected at the end of the construction phase and taken off site to be reused, recycled and disposed of in accordance with best practice procedures at an approved facility. Plastic waste will be taken for recycling by an approved contractor and disposed or recycled at an approved facility. Domestic type waste generated by contractors will be collected on site, stored in an enclosed skip at the construction compounds and disposed of at a licensed landfill facility.

The power generation aspect of the proposed development would not produce any waste emissions or pollutants. The general operation and maintenance of the proposed development has the potential to produce a minimal amount of waste. Wastes arising during the operation phase of the project include but are not limited to lubricating oils, cooling oils, and packaging from spare parts. The containment and disposal of such oils will be carried out by an approved contractor. Such operations will be carried out in accordance with the Waste Management (Hazardous Waste) Regulations, 1998. The remaining wastes will all be removed from site and reused, recycled or disposed of in an authorised facility in accordance with best practice.

2.10 EMISSIONS AND NUISANCES

2.10.1 Construction Phase

The potential sources of pollution from the project will be emissions to air, water, and noise pollution during the construction phase primarily. This will be managed through established construction management practices during consented working hours. Table 2.8 provides a summary of the anticipated residues and emissions and nuisances (traffic) likely to be generated during the construction phase.

Table 2.8 EMISSIONS/NUISANCES

Aspect	Emission/Nuisance
Air (Ch 14)	The main emissions to atmosphere during the construction stage of the project is from fugitive dust associated with the following activities: • Groundworks associated with the construction of the site infrastructure • Transportation and unloading of crushed stone around the site; • Vehicular movement over potentially hard dusty surfaces such as freshly excavated and constructed access tracks and crane hardstanding areas; • Vehicular movement over material potentially carried off site and deposited on public roads. The movement of machinery, construction vehicles and the use of generators during the construction phase will also generate exhaust fumes containing predominantly carbon dioxide (CO_2), sulphur dioxide (SO_2), nitrogen oxides (NO_x), carbon monoxide (CO), and particulate matter (PM_{10}).
Noise (Ch 10)	Traffic flows, mechanical machinery and electrical equipment typically used for construction projects will generate noise emissions.
Water (Ch 8)	Surface water runoff and discharges from construction working areas are likely during construction, although overall the quantity of surface runoff would not change overall as a result of the construction work. Occasional and low quantity discharges could arise from pumping in order to dewater foundation excavations. Pollution sources could arise as a result of soil erosion or from oil/ fuel or chemical storage and use. Proposals for management of water quality and quantity from the proposed development are presented in EIAR Volume III: Technical Appendix 3-1: CEMP.
Traffic (Ch 15)	The additional traffic, especially heavy goods vehicles associated with the construction phase, has the potential to cause nuisance to those using the local road networks

2.10.2 Operational Phase

Table 2.9 provides a summary of the anticipated residues and emissions during the operational phase of the project.

Table 2.9 Operational Phase Emissions, Pollution and Nuisance

Aspect/Emission	Operation
Air (Ch 14)	Due to the nature of the project no significant point source or diffuse air emissions would be produced during its operation.
Noise (Ch 10)	The wind turbines would generate noise during operation, and the noise levels would vary according to the wind speed.
Water (Ch 8)	No water emissions or pollution sources have been identified for the operational phase.
Soils (Ch 9)	No requirement for soil or subsoil excavation or handling during the operation phase has been identified. No pollution sources have been identified for the operational phase.
Light	It is proposed to install lighting on the turbines in a pattern that would be acceptable to the Irish Aviation Authority for aviation visibility purposes.
Shadow Flicker (Ch 11)	In certain conditions, the movement of wind turbine blades could give rise to shadow flicker nuisance.

2.11 ENVIRONMENTAL PROTECTION MEASURES

The key to avoiding environmental impacts during the works is down to design mitigation, good site management practices, tight controls, regular inspections and ongoing vigilance with staff and employees on site. The following outlines the considerations included in the project design and measures to be implemented to safeguard the environment:

2.11.1 DESIGN MITIATION

2.11.1.1 *Avoidance*

The design was influenced by *mitigation by avoidance*:

1. Hydrological buffers of 75m were applied to streams. **With the exception of the water crossings, the siting of infrastructure within 75m of streams or rivers has been avoided**.

2. A 150m buffer was placed between the development footprint (of turbines and hardstands) and the nearest designated nature conservation site. **The nearest infrastructure to the SAC is Turbine 13 at 164m.**

3. A detailed habitat constraint map was generated to ensure avoidance of valuable blanket bog habitat and the placement of maximum infrastructure adjacent to existing roads and on low value habitats.

4. Intensive site investigations were undertaken to ascertain a detailed understanding of the peat site profile to inform the optimum wind farm design by avoiding peat risk areas. **The siting of infrastructure on identified peat risk zones has been avoided**.

2.11.1.2 *Surface Water Management System*

A site drainage system will be constructed on the site so as to attenuate run-off, guard against soil erosion and safeguard downstream water quality. The measures are outlined in Chapter 3 Civil Engineering and in the Surface Water Management Plan (Volume III, Appendix 3-2). Measures addressed in the drainage design include:

- Check dams will be placed at regular intervals, based on slope gradient, along all drains to slow down runoff and to encourage settlement and to reduce scour and ditch erosion.
- Consideration will be given to the use of check dams constructed in accordance with best practice utilising clean stone at points along the drainage channel during the construction phase to further mitigate against any sediment escaping to nearby watercourses.
- Low gradient drains will be provided. These reduce the velocity of flow in the drains, thus reducing soil and subsoil erosion and reducing hydraulic loading to watercourses.
- Where possible existing drains will remain untouched.
- Regular buffered outfalls that consist of numerous small drains off the main drain which end by fanning out into the surrounding vegetation by tapering drains. The drain will contain hard-core material to entrap suspended sediment.
- Drains carrying construction site runoff will be diverted into settlement ponds, which will promote sediment deposition and reduce hydraulic loading by slowing flow velocities allowing

sediment to settle. Settlement ponds have been designed in the form of a three stage tiered pond system. The design of the settling pond system for the site is detailed in the **Planning Drawing 19107-5024-A**. These will be maintained by the contractor to the satisfaction of the client's engineers and IFI for the entire construction period.

- Flow from the settlement ponds will enter the sediment traps where runoff will be cleaned further by a series of graded gravel filters. Silt traps will require regular inspection and cleaning and removed material will be disposed of at an appropriate location.
- Drainage ditch outfalls from silt traps will discharge at regular intervals to mimic the natural hydrology by encouraging percolation and by decreasing individual hydraulic loadings from discharge points. The drainage ditches will flow onto the existing ground by fanning out onto the surrounding vegetation via tapering drains.
- The access roads will be graded so that all runoff is directed to the dirty water drains. A low mound will be constructed between the road and the clean water drain to ensure that runoff from the road cannot flow into the clean water system.
  No disturbance will be permitted to the natural vegetative buffer. They will be fenced where necessary.

2.11.1.3 *Watercourse Crossings*

Within the Wind Farm Site

On the proposed site, a number of watercourse crossings will be required, detailed as follows:

- 4 No. of New Clear Span Arch Watercourse Crossings
- 3 No. of New Piped Culvert Crossings
- 6 No. of Existing Piped Culvert Widenings

It proposed that new watercourse crossings will use clear span pre-cast concrete crossings such as a bottomless arch or similar. The design of a clear span pre-cast concrete arch crossing will ensure that:

1. The existing channel profile within the watercourse is maintained;
2. Gradients within the watercourse are not altered;
3. There is unrestricted passage for all size classes of fish by retaining the natural watercourse stream / river bed;
4. There are no blockages within the watercourse. The large size of a clear span culvert allows for the passage of debris in the event of flood flow conditions;
5. The watercourse velocity is not changed;
6. The clear span of a culvert will ensure that the existing stream / river bank is maintained during construction which will in turn avoid the occurrence of in-stream works;

Where the crossing of an existing natural or artificial drainage / stream channel is unavoidable, a suitable crossing will be in the form of precast concrete or HDPE pipes.

Refer to Chapter 3 Civil Engineering for the details on watercourse crossings.

Grid Connection Route

There are a total of 9 no. major watercourse crossings along the proposed grid connection route. The preferred construction methodologies for the provision of the grid connection route at these locations are set out in Table 2.10. No in-stream works will be required at these watercourses.

Table 2.10 Water Crossing Techniques along grid connection route

Crossing No.		Construction Technique
1	Trough Bridge, located on the L-70661	Directional drilling.
2	Single span concrete bridge located on the R471 regional road	Directional drilling.
3	Two span stone arch bridge on the R471 regional road	Directional drilling.
4	Ahnagor Bridge, located on the L-3022 local road	Standard trefoil formation over Ahnagor Bridge,
5	Single span stone arch bridge located on the L-3022 local road	Directional drilling
6	Single span stone arch bridge located on the L-7004 local road	Directional drilling
7	Single span stone arch bridge located on the L-7004 local road	Flatbed formation over bridge,
8	Single span stone bridge located on the L-7004 local road	Directional drilling
9	Single span stone arch bridge located on the L-7004 local road	Directional drilling

2.11.2 SITE MANAGEMENT CONTROLS

a) Temporary Construction Compounds

- Drainage within the temporary site compound will be directed to an oil interceptor to prevent pollution if any spillage occur.
- No domestic wastewater discharges to the environment. Temporary toilet facilities will include an integrated wastewater holding tank and be emptied routinely by a licence waste contractor.
- A bunded containment area will be provided within the compound for the storage of fuels, lubricants, oils etc.
- The compounds will be in place for the duration of the construction phase and will be removed once commissioning is complete. The hardcore area at compound No. 2 will be repurposed for a car park and visitor cabin, as outlined.

b) Soil Stripping

- The timing of the construction phase soil stripping and excavation works will take account of predicted weather, particularly rainfall.
- Soil stripping activities will be suspended during periods of prolonged rainfall events.
- The area of exposed ground will be kept to a minimum by maintaining where possible existing vegetation that would otherwise be subject to erosion in the vicinity of the wind farm infrastructure. The clearing of peat will be delayed until just before construction begins rather than stripping the entire site months in advance particularly during road construction.

c) Excavation Works

- Earth movement activities will be suspended during periods of prolonged rainfall events
- The earthworks material will be placed and compacted in layers to prevent water ingress and degradation of the material.
- Drainage and associated pollution control measures (set out in 2.11.1.2 above) will be implemented on site before the main body of construction activity commences.
- Best practice for excavation in peat is that the acrotelm (top 50cm of peat), which contains the seed bank, is stored and maintained separately from the catotelm (i.e. peat below the acrotelm layer). Wherever good quality acrotelm is identified, it will be stored for re-use in accordance with best practice. Once works are complete, the acrotelm can be used to cover exposed areas of peat. Exposed areas of the site that are slow to re-vegetate may need to be replanted with suitable vegetation. This can be by natural regeneration or by reseeding. Natural regeneration relies on colonisation of bare ground by native species from adjacent habitats. For this method, a roughened surface will be provided that can trap seeds and soil to provide initial regeneration areas.

d) Dewatering

- Where dewatering is required for construction activities, any pumped waters will be directed to the surface water management system.

e) Storage and Stockpiles

- Temporary stockpiles of excavated spoil, stored in the footprint of the excavation areas, will then be directed for use in backfilling, landscaping and restoration or placed in the deposition areas at the borrow pits.
- Stockpiles of stripped topsoil will be in locations with minimum trafficking to prevent damage and dusting
- Reusable excavated sub-soils and aggregate will be temporary stockpiled at suitably sheltered areas to prevent erosion or weathering and shall be shaped to ensure rainfall does not degrade the stored material
- Where unsuitable material is encountered this will be removed to the borrow pit for permanent storage.
- Stockpiled materials will be located away from drainage systems and silt retaining measures (silt fence, / silt curtain or other suitable materials) to reduce risk of silt run-off shall be installed along the downgradient edges of stockpiled earth materials.

f) Refuelling of Construction Plant On-Site

- Refuelling will be carried out using 110% capacity double bunded mobile bowsers. The refuelling bowser will be operated by trained personnel. The bowser will have spill containment equipment which the operators will be fully trained in using.
- Plant nappies or absorbent mats to be placed under refuelling point during all refuelling to absorb drips.
- Mobile bowsers, tanks and drums should be stored in secure, impermeable storage area, away from drains and open water.

- To reduce the potential for oil leaks, only vehicles and machinery will be allowed onto the site that are mechanically sound. An up to date service record will be required from the main contractor.
- Should there be an oil leak or spill, the leak or spill will be contained immediately using oil spill kits, all oil and any contaminated material will be removed and properly disposed of in a licensed facility.
- Immediate action will be facilitated by easy access to oil spill kits. An oil spill kit that includes absorbing pads and socks will be kept at the site compound and also in site vehicles and machinery.
- Correct action in the event of a leak or spill will be facilitated by training all vehicle/machinery operators in the use of the spill kits and the correct containment and cleaning up of oil spills or leaks. This training will be provided by the Environmental Manager at site induction.
- In the event of a major oil spill, a company who provide a rapid response emergency service for major fuel spills will be immediately called for assistance, their contact details will be kept in the site office and in the spill kits kept in site vehicles and machinery.

g) Materials Handling, Fuels and Oil Storage

- Fuel containers will be stored within a secondary containment system e.g. bund for static tanks or a drip tray for mobile stores.
- Collision with oil stores will be prevented by locating oils within a steel container in a designated area of the site compound away from vehicle movements.
- Leakages of fuel/ oil from stores will be prevented by storing these materials in bunded tanks which have a capacity of 110% of the total volume of the stored oil. Ancillary equipment such as hoses and pipes will be contained within the bunded storage container. Taps, nozzles or valves will be fitted with a lock system.
- Long term storage of waste oils will not be allowed on site. These waste oils will be collected in leak-proof containers and removed from the site for disposal or re-cycling by an approved service provider.
- On-site washing of concrete truck barrels will not be allowed. The washing of the chutes at the rear of the trucks may be permitted. A designated chute wash down area, which will retain the washout water, will be located within the construction compound and there will be no other chute wash down activity on any other part of the wind farm site.

h) Road maintenance

The road surface can become contaminated with clay or other silty material during construction. Road cleaning will, therefore, need to be undertaken regularly during wet weather to reduce the volume of sediment runoff to the treatment system. This is normally achieved by scraping the road surface with the front bucket of an excavator and disposing of the material at designated locations within the site which may include the proposed borrow pits.

i) Construction Wheel Wash

A Construction Wheel Wash will be used to wash Truck tyres leaving the construction site. Water residue from the wheel wash will be fed through a settlement pond, interceptor and then discharge to the surface drainage network.

j) Inspection and maintenance

The drainage and treatment system will be managed and monitored and particularly after heavy rainfall events during the construction phase. Controls will be regularly inspected and maintained to ensure that any failures are quickly identified and repaired so as to prevent water pollution. A programme of inspection and maintenance will be designed and dedicated construction personnel assigned to manage this programme. A checklist of the inspection and maintenance control measures will be developed and records kept of inspections and maintenance works.

2.12 RISK OF ACCIDENTS (DUE TO SUBSTANCES OR TECHNOLOGIES USED)

2.12.1.1 *Construction Issues*

As in all construction activities, there is a wide range of potential risks of accidents and hazards associated with wind farm construction. While many risks are similar in nature to those for other industries, wind farm construction works take place in exposed windy locations and involve transport of heavy equipment, heavy cranage and specialised electrical installation.

All work on site will be carried out in compliance with the Health, Safety and Welfare at Work Act 2005, the Health and Safety (Construction) Regulations 2013 and all relevant Legislation and Work Practices to ensure that the construction areas, site environs and public roads remain safe for all users. The Construction and Environmental Management Plan (CEMP), (refer to Appendix 4.1 of the EIAR) outlines the safety procedures that will be implemented during the construction phase. The effective implementation of the CEMP will help to reduce the risks associated with the construction phase of the Proposed Project.

2.12.1.2 *Operational Issues*

Fire/ Fuels

The presence of electrical generating equipment and electrical cables along with the storage and use of various oils (diesel fuels, lubricating oils, hydraulic fluids) can create the potential for fire and/or ground contamination. This potential exists within the turbine tower, nacelle, substation, electrical transmission structures and operations maintenance buildings. Modern wind farm design will minimise the use of combustible materials. Lightning and surge protection will cover the nacelle and rotor blades, as well as electrical equipment, including cables. Each element of equipment has strict and exact operational protocols that provide for the elimination of risk. The protocols set out the flammability or chemical properties of each of the oils, lubricants and fuels that may be used within equipment on site. The Carrownagowan Wind Farm will be operated to the specifications of the chosen turbines and in accordance with all electrical standard operating procedures.

Lightning Strikes

A lightning strike could cause a fire or could cause severe damage to blades which may lead to blade failure. To protect wind turbines from damage caused by a lightning strike and to provide grounding each turbine will be equipped with an electrical grounding system.

Turbine Structural Failure

Turbine structural failure includes tower collapse, blade failure or separation. Risk may arise due to stress, wear and tear.

Rigorous safety checks are conducted on the turbines during operation to ensure the risks posed to staff, landowners and general public are negligible. These checks are specified particular to the turbine model purchased for the project.

The separation distances of turbines from public roads and residences are well beyond fall over distances that would present a risk of significant accidents.