MWP

# Chapter 03 Civil Engineering

## Ballinla Wind Farm

**Ballinla Wind Farm Limited**

**July 2025**

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| Project No. | Doc. No. | Rev. | Version | Date | Prepared By | Checked By | Approved By | Status |
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# 3. Civil Engineering

## 3.1 Introduction

This chapter provides additional information to Chapter 02 on the civil engineering design rationale and works for the various elements of the Proposed Development. All drawings to the appropriate scale as required by the Planning and Development Regulations 2001 to 2023 (as amended) can be found in the planning pack accompanying the planning application. The purpose of this chapter is to provide additional information in relation to construction of the following items:

- Local Access Routes.
- Site Entrances.
- Internal Wind Farm Access Tracks.
- Wind Turbine and Hardstand Infrastructure.
- Internal Wind Farm Collector Circuit.
- Substation Compound and Buildings.
- LiDAR Unit.
- Temporary Site Construction Compound.
- Spoil Deposition Area.
- Construction Material Volumes.
- Watercourse/Drainage Crossing Design.
- Site Drainage Systems Design.
- Sediment and Erosion Plan.
- Proposed Grid Connection (subject to a separate planning application).

## 3.2 Local Access Routes

The components for the seven turbines will be delivered by cargo ships from a preferred port. The components for each turbine will be delivered in separate loads, some of which are abnormal in terms of their width and length. The components will be transported a preferred port to the site along the National, Regional and Local road network.

The delivery of turbine components to the Proposed Development will require temporary works on sections of the public road network along the delivery route including hedge or tree cutting, relocation of powerlines/poles, lampposts, signage and temporary local road widening. Such works are temporary for the delivery of turbine components and are not included in the planning application boundary, however there are three nodes along the TDR where works will be required within private lands, and these are included in the planning application boundary.

## 3.3 Site Entrances

Access to the Proposed Wind Farm during the construction phase will be provided via two new permanent entrances off the L-5010 local secondary road.

- First Entrance (South Entrance): This entrance will serve the four wind turbines located to the south of the L-5010, utilising an existing forestry track that will be upgraded and widened (see **Figure 3-1**).
- Second Entrance (North Entrance): This entrance will provide access to the new onsite 110kV substation, a new LiDAR unit, and three turbines located to the north of the L-5010. These facilities will be served by newly constructed founded access tracks.

There are 800m of the L-5010 local secondary road between the north and south entrances.

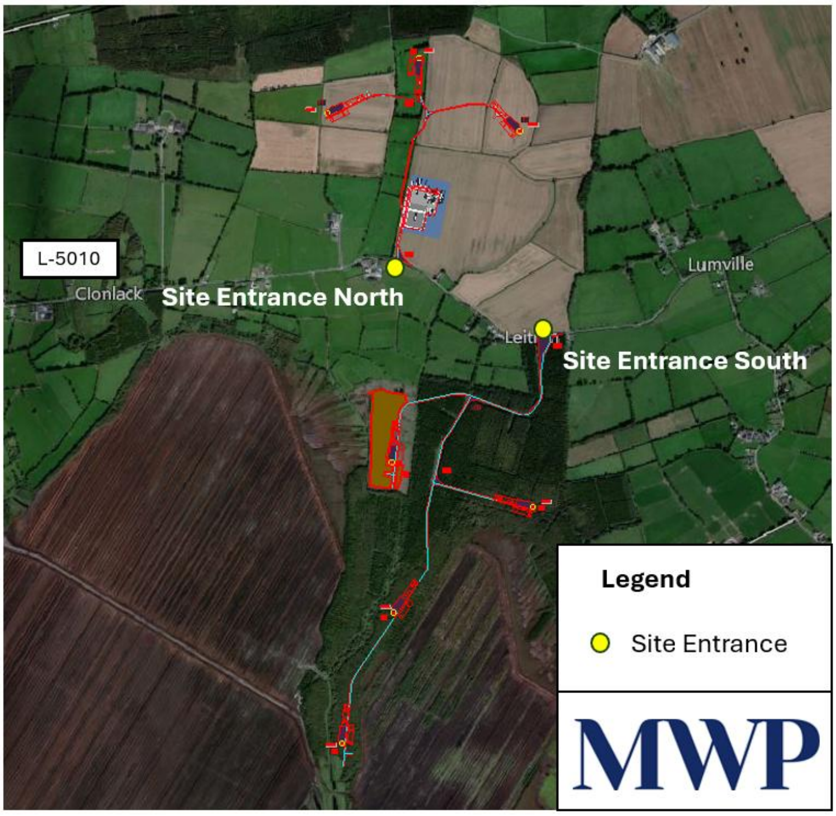


**Figure 3-1: Site Entrance Points**

The design criteria governing the north and south site entrances are set out in Transport Infrastructure Ireland (TII) '*DN-GEO-03060: Geometric Design of Junctions (priority junctions, direct accesses, roundabouts, grade separated and compact grade separated junctions)*' and *'DN-GEO-03031: Rural Road Link Design'*. The location where the required sightlines are measured from along the centre of the minor approach road is setback a distance of 3.0m from the near edge of the major road. This distance is referred to as the 'x-distance'. The required visibility distance along the major road is referred to as the 'y-distance' and is measured to the near edge of the major road in both directions. The 'y-distance' requirement is 90m for both site entrances.

Since 7$^{th}$ February 2025, the statutory speed limit on the local roads has been reduced from 80km/h to 60km/h. This applies to both proposed site entrances from the L5010 and requires a stopping sight distance of the order of 90m on the L5010. The sightline distance will be achieved by maintaining a visibility envelope free obstructions such as vegetation. The proposed visibility envelopes for the site entrances are shown in planning drawing 23882-MWP-00-00-DR-C-5004. These improvements will remain in place permanently and will benefit users of the wind farm when exiting the site onto the public road. A photograph of a typical wind farm entrance with sightlines improved is given in Figure 3-2. It is noted that the previous requirement to provide 160m clear sightlines is also possible from both site entrances.

Drainage will be provided, as appropriate to prevent water from the site entrances flowing onto the public road. The site entrance will be designed to facilitate access for all vehicles associated with the construction and subsequent maintenance of the Proposed Wind Farm.

**Figure 3-2: Typical Wind Farm Entrance**

## 3.4 Internal Wind Farm Site Tracks

The internal site access track design objectives and design rationale for the Proposed Wind Farm are outlined below. The access track drawings are presented in A1 format in the planning application pack. These include:

- Proposed Internal Access Track Layout is shown on Planning Drawing 23882-MWP-00-00-DR-C-5004 and 23882-MWP-01-00-DR-C-5005 to 23882-MWP-11-00-DR-C-5012.
- Proposed Internal Access Track Details (refer to Planning Drawing 23882-MWP-00-00-DR-C-5405).
- Proposed areas of clear fell associated with access track infrastructure (refer to **Figure 2-10** in **Chapter 02**.

Internal access tracks are required to interconnect elements of the Proposed Wind Farm and allow access to all wind turbines and wind farm infrastructure. The proposed routes were identified initially from high resolution aerial photography and site visits, where the existing tracks were assessed in terms of their width, gradient and associated drainage. The Proposed Wind Farm will use approximately 1.2km of existing tracks which are to be upgraded and 3.7km of new tracks will be constructed within the Proposed Wind Farm and either founded or floated.

The new access tracks will have a running width of generally 5m along straight sections, with localised wider areas at bends to accommodate the efficient transport of the wind turbine components. These tracks will be constructed using either excavated or floating track techniques.

The following outlines the internal access track design rationale:

- The access track design was based on the necessity to deliver wind turbines with a maximum blade length of 79.6m.
- Track gradients throughout most of the site are 8% or less which is sufficient for turbine delivery.
- The maximum camber and crossfall gradient on the access tracks is 2.5%.
- As turbines are normally grouped and linked in electrical circuits, consideration was given to cable circuit layouts in the internal access tracks route selection process. It is planned to run all cables along the internal access tracks. it is important to ensure that access tracks facilitate efficient cabling.
- Avoidance of stream crossings and water bodies, where possible.
- New sections of access tracks were selected minimising steep ground and natural drainage features.
- Access track alignments were selected to have adequate turning radii for delivery of turbine components.
- Aerial photography, Ordnance Survey Ireland (OSI) contour data and LiDAR data were used to inform the internal access track design.

The following constraints were considered in the final design of the internal access track layout within the site:

- Site topography (OSI contour data) to avoid steep slopes for turbine delivery vehicles.
- A hydrology buffer of 20m from EPA mapped watercourses as outlined in Section 4.3.1 Chapter 04 Alternatives of this EIAR and Planning Drawings 23882-MWP-00-00-DR-C-5019 to Planning Drawings 23882-MWP-00-00-DR-C-5028, except for drainage/stream crossings, associated track construction and minor works.
- Avoidance of ecologically sensitive areas, as outlined in Section 4.3.1 Identification of Environmental Sensitivities, of this EIAR.
- Avoidance of archaeological features, as outlined in Section 4.3.1 Identification of Environmental Sensitivities, of this EIAR.
- Reduction of visual impact – tracks along contours where possible.

The overall site layout is shown on Planning Drawings 23882-MWP-00-00-DR-C-5004 and 23882-MWP-00-00-DR-C-5005 to 23882-MWP-00-00-DR-C-5012.

A network of existing access tracks, which will be upgraded and widened, together with new excavated and new floating tracks will be used to access each of the turbines, the substation compound, deposition area and the LiDAR unit. Larger splays will be required at the Proposed Wind Farm access points and at spur junctions for the large turbine component delivery trucks. The splayed junctions at the windfarm access points will be coned off to 12m radii to ensure the safety of the junction for regular construction traffic. See Planning Drawings 23882-MWP-00-00-DR-C-5007 and 23882-MWP-00-00-DR-C-5008 for details of the proposed junction layouts.

The design of any length of site access track will depend on local geotechnical, topographical, and hydrological conditions. Both excavated and floating track construction methods will be employed to achieve an access track structure appropriate to the site conditions.

The stone required for the construction of the internal access tracks, hardstands and substation compound will be sourced from local quarries. A total volume of 87,795m$^3$ of stone will be required. The access tracks will be finished with a top layer of imported Unbound Granular Material (UGM-A) to give a clean hardwearing running surface for the delivery of turbines.

Overall, the internal site layout design has been optimised to minimise impact on the existing public road network in the vicinity of the site, the low risk in terms of associated environmental impacts, the use of a well-developed drainage network and good access and connectivity to the public road network.

### 3.4.1 Internal Wind Farm Access Track Construction Methods

#### 3.4.1.1 Upgrading and Widening of Existing Tracks

For the construction of the Proposed Wind Farm, it is proposed to utilise existing internal tracks where possible. These tracks will be widened by removing organic material and soft subsoil to formation level and constructing a track on a layer of geogrid or geotextile. This access track construction will be similar in build up to the excavated track construction which is outlined in detail in Section 3.4.1.2. The new width of track and the existing track surface, where required, will be capped with a 150mm layer of crushed stone of UGM-A (formerly Clause 804) or similar aggregate type material.

This access track type will have a crossfall of 2.5% from one edge to the other. The existing or new trackside drains on the lower side of the track will be used as part of the dirty water drainage system for the site. The existing or new access trackside drains on the higher side of the track will be retained as clean water drains.

Typically, the sequence for upgrading and widening existing access tracks will comprise the following:

- The appointed contractor will liaise with the wind turbine supplier prior to the commencement of the works to ensure that the design of the tracks conforms with the wind turbine supplier's specifications and no works beyond that which have received planning permission will be undertaken.
- The appointed contractor will survey the area for any unforeseen hazards prior to the commencement of works and set up warning signage as appropriate.
- The appointed contractor will mark out the line of the upgraded/widened track using a Global Positioning System (GPS)/total station.
- Drainage measures to ensure the separation of overland clean water flow from construction runoff will be implemented as outlined in Section 3.11.
- The material required for widening and upgrading the existing site tracks is proposed to be used from imported stone from the nearby quarries. All tracks will be finished with imported 150mm crushed stone of UGMA (formerly clause 804), or similar aggregate type material. Passing bays will be constructed to allow for the safe movement of site traffic along the upgraded existing tracks. Volumes of excavation and construction materials are outlined in Table 3-1.
- Widening works will begin with the use of excavators that will first remove any topsoil/vegetative layer which may be present. This material will be transported to an agreed temporary storage area (within turbine hardstand areas) and maintained for reuse during the restoration phase of construction. Topsoil/vegetative removal will be kept to a minimum to prevent any runoff of silt during heavy rainfall.
- Excavators will continue to strip and excavate the soft subsoil underneath, which will be temporarily stored adjacent to the access tracks in accordance with approved methods with the use of an articulated

dumper truck. Excavated material will only be temporarily stored on slopes under 5° and to a maximum height of under 1m until they are transported to the selected deposition area where they will be permanently stored.

- Once a section of the widened access track is exposed to suitable formation, a layer of geogrid or geotextile material may be placed along its formation depending on ground conditions.
- The stone to be used for the widening works will be delivered to the required work area and spread out locally with the use of excavators on top of the geogrid/geotextile material. This will be compacted with the use of a roller which will roll the stone aggregate in maximum 250mm layers to achieve the required design strength.
- The access track upgrading works will involve the use of a roller compacting stone aggregate in maximum 250mm layers laid over the existing track pavement. A layer of geogrid or geotextile material may be placed along the existing track pavement prior to the placement of the stone aggregate to achieve the required design strength.
- All upgraded/widened access tracks will be constructed to a minimum drivable width of 5m with a maximum crossfall of 2.5% in order that water can flow off the tracks and reduce the risk of rutting/potholes occurring.
- Trackside drains as per **Section 3.11** will be constructed to manage clean and dirty water runoff along widened and upgraded access tracks.
- The final running surface of the new widened/upgraded access tracks will be capped with a minimum 150mm layer of crushed stone UGMA (formerly clause 804) material or similar using a road grader.
- All excavations to be carried out will be battered back to a safe angle of repose (typically a max slope angle of 45°).
- Where drop offs greater than 1m in height occur alongside track edges physical edge protection will be constructed to reduce the risk of vehicles overturning. Marker posts will also be erected to delineate track edges in poor weather.
- The appointed contractor will ensure that all onsite personnel are aware of environmental constraints/sensitive areas within the Proposed Wind Farm in which works are to be avoided.

Figure 3-3: Typical Upgraded Wind Farm Track

#### 3.4.1.2 New Excavated Tracks

New excavated tracks will be constructed using stone aggregate imported from the nearby quarries. The stone aggregate will be placed over a layer of geogrid, where required, after all organic and soft subsoil material is excavated to formation level. Geotextile material, used to separate the track building material from the subsoil, will also be laid at formation level. The track will be finished with imported 150mm crushed stone of UGMA (formerly clause 804), or similar aggregate type material.

Typically, the sequence of constructing new excavated access tracks will comprise the following:

- The appointed contractor will liaise with the wind turbine supplier prior to the commencement of the works to ensure that the design of the new excavated tracks conforms with the wind turbine supplier's specifications and no works beyond that which have received planning permission will be undertaken.
- The appointed contractor will survey the area for any unforeseen hazards prior to the commencement of works and set up warning signage as appropriate.
- The appointed contractor will mark out the line of the new excavated track using a GPS/total station.
- Drainage measures to ensure the separation of overland clean water flow from construction runoff will be implemented as outlined in **Section 3.11**.
- Excavators will first remove any topsoil/vegetative layer which may be present. This material will be transported to an agreed temporary storage area and maintained for reuse during the restoration phase of the Proposed Wind Farm construction. Topsoil/vegetative removal will be kept to a minimum to prevent any runoff of silt during heavy rainfall.
- Excavators will continue to strip and excavate the soft subsoil underneath, which will be temporarily stored adjacent to the access tracks in accordance with approved methods with the use of an articulated

dumper truck. Excavated material will only be temporarily stored on slopes under 5° and to a maximum height of under 1m until they are transported to the selected deposition areas where they will be permanently stored.

- All excavations to be carried out will be battered back to a safe angle of repose (slope angle of 45°) but where excavations are in solid rock the safe angle of repose may be increased to 60°.
- Once a section of the excavated access track is exposed to suitable formation. a layer of geogrid or geotextile material may be placed along its formation depending on ground conditions which will be covered with imported aggregate stone as required compacted in maximum 250mm layers.
- The material required for the excavated access tracks is proposed to be used from either suitable excavated stone material within the Proposed Wind Farm and/or imported stone from the nearby quarries. All tracks will be finished with imported 150mm crushed stone of UGM-A (formerly clause 804), or similar aggregate type material. Passing bays will be constructed to allow for the safe movement of site traffic along the new site tracks.
- The stone will be delivered to the required work area and spread out locally with the use of excavators and compacted with the use of a roller which will roll the stone aggregate in maximum 250mm layers on top of the geogrid/geotextile material to achieve the required design strength.
- All new excavated access tracks will be constructed to a finished carriageway width of 5m with a maximum crossfall of 2.5% in order that water can flow off the tracks and reduce the risk of rutting/potholes occurring.
- Trackside drains as per **Section 3.11** will be constructed to manage clean and dirty water runoff along excavated access tracks.
- The final running surface of the new excavated access tracks will be capped with a minimum 150mm layer of crushed stone UGM-A (formerly clause 804) material or similar using a road grader.
- Any surplus spoil material generated from the excavated access track works will be transported back to the deposition area for permanent storage.
- Where drop offs greater than 1m in height occur alongside track edges physical edge protection will be constructed to reduce the risk of vehicles overturning. Marker posts will also be erected to delineate track edges in poor weather.
- The appointed contractor will ensure that onsite personnel will be aware of environmental constraints/sensitive areas within the Proposed Wind Farm in which works are to be avoided.

Figure 3-4: Typical Excavated Access Track

#### 3.4.1.3 New Floating Tracks

Floating tracks will be utilised where gradient and topographical conditions permit. The use of floating access track methods will minimize the excavation of material and reduce interference with the existing drainage regime in these areas of the site. A combination of geogrid and geotextile will be placed over the vegetation on the existing surface to be traversed with the floating track. A minimum thickness of 450mm of imported stone, will be placed over the bottom layer of geogrid/geotextile. This will be overlain with a 150mm surface layer of UGMA (formerly Clause 804) or similar material.

Where new access tracks will be constructed through forested areas, the felled trees will be used in the construction of the floating tracks as outlined in the Coford Forest Road Manual (2004, see references at end of document). This construction method involves layering the brash from the felling process on the existing ground surface and placing the felled trees perpendicular to the direction of travel to benefit from the load spread thereby provided. A combination of geogrid and geotextile will be placed on top of the felled trees and the track construction completed using the same construction method as that outlined above. Refer to Planning Drawing 23882-MWP-00-00-DR-C-5405 for further details.

Typically, the sequence of constructing floating access tracks will comprise the following as per guidance from the Scottish Natural Heritage/Forestry Commission Scotland (Forestry Civil Engineering - FCE) on the construction of floated tracks:

- The appointed contractor will liaise with the wind turbine supplier prior to the commencement of the works to ensure that the design of the tracks conforms with the wind turbine supplier's specifications and no works beyond that which have received planning permission will be undertaken.
- The appointed contractor will survey the area for any unforeseen hazards prior to the commencement of works and set up warning signage as appropriate.
- The appointed contractor will mark out the line of the proposed floated track using a GPS/total station.
- Drainage measures to ensure the separation of overland clean water flow from construction runoff will be implemented as outlined in **Section 3.11**.
- The intended floating track area is cleared of major protrusions such as rocks, trees, bushes etc. down to ground level but residual stumps and roots are left in place.
- The local surface vegetation and soils are left in place where possible as the existing vegetation and root mat may be the strongest layer in the system and care will be taken to preserve this layer if possible.
- Any local hollows and depressions are filled in with a suitable local lightweight fill such as tree brash, logs, or geogrid/geotextile material with stone aggregate.
- A formation, 7m to 8m, wide is prepared where a layer of geogrid/geotextile is laid out by hand along the line of the proposed floated track.
- The specification for geotextiles will be finalised by the design engineer at construction stage but past empirical experience on previous constructed wind farms within Ireland and Scotland has proven the suitability of floated access track construction.
- Where there is a drainage requirement, suitably sized High-Density Polyethylene (HDPE) drainage pipes shall be laid on top of the installed geogrid/geotextile prior to the placement of stone aggregate. Cross drains will be laid at appropriate intervals to maintain the existing drainage regime on the site.
- The material required for the floated access tracks is proposed to be used from either suitable excavated stone material within the Proposed Wind Farm and/or imported stone from the nearby quarries. All tracks will be finished with imported 150mm crushed stone of UGMA (formerly clause 804), or similar aggregate type material. Volumes of excavation and construction materials are outlined in **Table 3-1**.
- Wide tracked 360° excavators will be used for constructing the floated tracks by cascading a minimum 300mm thickness of stone aggregate over the geogrid/geotextile. The stone aggregate will be suitably sized to achieve a sound interlock with the geogrid/geotextile material. It is common practice for floated access track construction on wind farms that the compaction of the stone aggregate is done by the wheels and tracks of construction plant alone.
- An additional layer of geogrid/geotextile may be placed over the stone aggregate, if necessary, before a minimum capping layer of 150mm of UGMA (formerly clause 804) or similar material is laid out with excavators.
- All floated access tracks will be constructed to a minimum drivable width of 5m with a maximum crossfall of 2.5% in order that water can flow off the tracks and reduce the risk of rutting/potholes occurring.
- Trackside drains as per **Section 3.11** will be constructed to manage clean and dirty water runoff along floated tracks.
- Where drop offs greater than 1m in height occur alongside track edges. physical edge protection will be constructed to reduce the risk of vehicles overturning. Marker posts will also be erected to delineate track edges in poor visibility.
- To allow for the safe movement of site traffic during the construction of floated tracks. a site traffic management plan will be prepared by the appointed contractor in accordance with the TMP (Volume III,

Appendix 2D) submitted with this application. Care will be taken when reversing vehicles on floating tracks to ensure that they do not run along the edge of the track but stay within the delineated safe running zone.

- The appointed contractor will ensure that on site personnel will be aware of environmental constraints/sensitive areas within the Proposed Wind Farm in which works are to be avoided.

**Figure 3-5: Typical Floated Track**

## 3.5 Wind Turbines

### 3.5.1 Wind Turbine Locations

The nature of the site is relatively flat topographically. Turbine locations have been selected to allow for a balance of cut and fill of the underlying strata at each location. The turbine locations were chosen considering adjacent stakeholders, land available, ecological constraints, hydrological, spacing and other constraints.

### 3.5.2 Turbine Crane Hardstands

The layout of the crane hardstand is designed to accommodate the delivery of the turbine components prior to their erection and to support the cranes during erection. Hardstands are also used for maintenance during the operation of the turbines. The hardstands are generally rectangular in shape with additional temporary hardstand set down areas to lay the turbine blades across once delivered. The area of a single hardstand is approximately 80m long by 30m wide with depths varying depending on ground conditions and topography. Refer to **Planning**

**Drawing 23882-MWP-00-00-DR-C-5403** for further details. Due to the significant loads that will be imposed by the outriggers of the main lifting crane during the turbine erection process. it is intended that the hardstands will be constructed using excavation methods over the footprint of the hardstand area/turbine base.

The proposed works will be restricted to the turbine locations and will comprise the following:

- Each crane hardstand will be formed on competent subgrade of the underlying subsoil/rock which will comprise of stone aggregate (imported from the nearby quarries) laid on a geotextile filter membrane.
- Any existing unsuitable soil found within the footprint of the turbine hardstand will be excavated out during formation works. The excavation works will be carried out using hydraulic excavators where surplus subsoil material will be transported to the onsite deposition area via articulated dumper trucks or tractor and trailer.
- The stone aggregate for the turbine hardstands will be compacted in 250mm layers and will vary from approximately 600mm to 900mm deep depending on the gradient of the underlying subgrade.
- Temporary set down areas will be formed to facilitate the storage of the turbine components at each crane hardstand (e.g., the turbine blades, the turbine towers, and nacelle). Each temporary set down area will be constructed using compacted stone aggregate which will be fully removed and reinstated after all turbines have been erected.
- Plate bearing test results will be undertaken on the finished hardstand surface to check if ground bearing strengths are to the wind supplier's specifications. Once complete the assembly cranes will be set up on the hardstand and will erect the wind turbine into place.
- Where drop offs greater than 1m in height occur alongside hardstand edges. physical edge protection will be constructed to reduce the risk of vehicles overturning or persons falling.

**Figure 3-6: Typical Finished Hardstand**

### 3.5.3 Turbine Bases

It is proposed the seven wind turbines will have a reinforced concrete base pad foundation with a central pedestal above the base, that will in turn support the wind turbine tower. Each turbine base will bear onto rock or other such suitable bearing stratum and will be constructed utilising a spread foundation, which is wide and shallow. A typical foundation will be approximately 28m in diameter and will generally be installed to a depth of approximately 3.5m below ground level. The finished level of the top of the concrete foundation will be 150mm above finished ground level. Approximately 1200$m^3$ of concrete and 180 tonnes of steel will be used in the construction of each turbine base. Estimated material quantities required for the construction of the turbine bases are shown in Section 3.10. Refer to Planning Drawing 23882-MWP-00-00-DR-C-5402 for further details.

The proposed works will be restricted to the turbine locations and will comprise the following:

- The extent of the excavation will be marked out and will include an allowance for trimming the sides of the excavation to provide a safe working area and slope batter.
- Any existing subsoil found within the footprint of the turbine base will be excavated out during formation works at the adjacent crane hardstand area. The excavation works will be carried out using hydraulic excavators where surplus subsoil material will be transported to the onsite deposition areas via articulated dumper trucks or tractor and trailer.
- Rock breaking at turbine locations and hardstands may be necessary to enable excavation of the rock depending on the strength of the bedrock.
- Standing water in turbine base excavations is likely to contain an increased concentration of suspended solids. Dewatering of turbine base excavations can result in significant flow rates to the drainage and settlement system if high-capacity pumps are used. To avoid the need for pumping, it is proposed to provide drainage channels from the excavations to prevent a build-up of water. Where this is not feasible, temporary storage will be provided within the excavations and dewatering carried out at a flow rate that is within the capacity of the settlement ponds.
- The excavated surface will be levelled and adequate drainage measures will be put in place along with suitable set back areas to facilitate placing of stone and ultimately the erection of shuttering for the turbine base.
- If poor ground conditions are encountered during excavation and a significant depth to sub-formation is required, a piled foundation may be considered. A piled foundation requires the use of a piling machine equipped with an auger drill to rotary bore a number of holes around the area of the turbine base to the sub-formation depth determined at construction stage. Once all the holes have been bored, reinforcement steel is inserted into each with concrete poured afterwards. Piling if required, will be limited and localised.
- Suitable stone aggregate will be used to form a solid level working foundation surface. The stone will be rolled and compacted to a suitable formation level.
- Shutters and steel reinforcement will then be put in place and the foundation of the turbine will be prepared for pouring of concrete.
- A layer of concrete blinding approximately 100mm thick will be laid directly on top of the newly exposed formation, tamped and finished with a screed board to leave a flat level surface. The concrete will be protected from rainfall during curing and all surface water runoff from the curing concrete will be prevented from entering surface water drainage directly.

- High tensile steel reinforcement will be fixed in accordance with the design drawings and schedules. The foundation anchorage system will be installed, levelled and secured to the blinding using steel box section stools.
- Ductwork will be installed as required, and formwork erected around the steel cage and propped from the backside as required.
- The foundation anchorage system will be checked both for level and line prior to the concrete being installed in the base. These checks will be passed to the turbine supplier for their approval.
- Ready-mix concrete will be delivered to each turbine base by a fleet of ready-mix concrete trucks via the internal access tracks. Concrete will be placed into each base by means of a concrete pump where vibrating pokers will be used to ensure that full and proper compaction of the concrete around the reinforcement in the turbine base has been made. Upon completion of the concreting works the foundation base will be covered and allowed to cure.
- Steel shutters will be used to pour the circular chimney section.
- Following curing, the shuttering around the turbine base will be struck and removed.
- Earth wires will be placed around the base.
- The foundation will be backfilled with a cohesive material, where possible using the material arising during the excavation and landscaped using the vegetated soil set aside during the excavation. A gravel footpath will be formed from the access track to the turbine door and around the turbine for maintenance.

**Figure 3-7: Typical Wind Turbine Base**

## 3.6 Internal Site Cables – Collector Circuit

A network of underground cabling will be installed on site to convey electrical power and communications between the wind turbine generators and the onsite 110kV substation.

Cabling on site is likely to consist of single or twin cable trenches running adjacent to or within internal access tracks. A cable marker post will typically be installed on top to protect and identify the cable trench underneath. The cable ducting between T4 and the substation will run through open agricultural land and under the local L-5010 road, before it reaches the substation. The typical build up for the internal site cable trenches will consist of selected excavated backfill on top of bedding material. Where ducting is within the internal access track or public road; the cable trench will be backfilled with lean-mix concrete to protect ducting from being damaged by heavy axle loads that will pass above. The excavated material generated from the trenches will be reused as backfill where possible or alternatively it will be deposited within the proposed onsite material deposition area.

Marker tapes of non-corrodible material in bright red and yellow colour will be placed within the trench after backfilling for identification and safety purposes in accordance with ESB Networks guidelines. An earth berm will be placed over the cable trench with a marker post installed on top in a secure and robust manner to prevent the post from being damaged by animals or prevailing ground conditions. Cable marker posts will either be made of concrete, recycled plastic, or timber material. Each marker post will contain appropriately worded warning signage highlighting to persons the presence of high voltage electricity cables underneath. Details of the proposed internal collector circuit trenches marker posts and watercourse crossings are presented in Planning Drawing 23882-MWP-00-00-DR-C-5407.

### 3.6.1 Internal Collector Circuit – Open Drain and Watercourse Crossings

Where an open drain or watercourse is encountered during the installation of the internal site cable trenches; the cable trenches will cross the open drain or watercourse within the track carriageway via new or existing track crossing points to minimise the requirement for in-stream works.

Between the proposed T4 and the substation, the collector circuit ducting will run in forested or agricultural land without a new or existing track. Where this section of ducting is required to cross a drain or watercourse, it is proposed that the ducting will be installed using a dam and overpumping or temporary diversion methodology. This construction method involves the temporary pumping or diverting of the open drain or watercourse around the crossing point and the trench is excavated down to below bed level. The ducts are then installed beneath the bed of the watercourse or drain and surrounded in rapid hardening concrete. After the concrete has hardened, the watercourse bed and banks will be reinstated to their previous level and profile. This proposed construction method is shown on Planning Drawing 23882-MWP-00-00-DR-C-5407.

## 3.7 Substation Compound and Buildings

This section describes the construction methodologies that will be used for both the EirGrid and Independent Power Provider (IPP) substation buildings as well as the substation compound.

The proposed works will comprise the following:

- Prior to construction, interception drains will be installed upslope of the proposed substation compound to intercept any existing overland flows (clean water) and convey it downslope to limit the extent of surface water coming into contact with the works. The clean water conveyed will be discharged via a level spreader downslope of the works over existing vegetation.

- The area of the substation compound will be marked out using ranging rods or wooden posts and the soil stripped and removed to a temporary storage area (in development footprint) for later used in landscaping. All remaining excavated material will be brought to the spoil deposition area.
- The area will be surveyed, and all existing services will be identified. All plant operators and general operatives will be inducted and informed as to the location of any services.
- Perimeter drains will be installed or upgraded to collect surface water runoff from the substation compound which will include the installation of check dams, silt traps and level spreaders to cater for surface runoff.
- Following the installation of drainage, a cut-fill earthworks operation will be carried out to provide a level platform to facilitate the construction of the substation buildings and electrical equipment.
- All soils on the substation site will be removed and replaced with compacted crushed rock or granular fill.
- Formation of the substation compound will be achieved where the compound will be constructed with compacted layers of suitable hardcore.
- The foundations for both substation buildings will be excavated and appropriately shuttered. Reinforced concrete will be laid over it.
- The blockwork walls for each building will be built up from the footings to Damp Proof Course (DPC) level and the floor slab constructed, having first located any ducts or trenches required by the follow on mechanical and electrical contractors.
- The blockwork will then be raised to wall plate level and the gables and internal partition walls formed. Scaffold will be erected around the outside of the two buildings for this operation.
- The concrete roof slabs will be lifted into position using an adequately sized mobile crane.
- The construction and components of the substation buildings will be to EirGrid and ESB Networks specifications.
- The timber roof trusses at each building will then be lifted into position using a telescopic loader or mobile crane depending on site conditions. The roof trusses will then be felted, battened, tiled, and sealed against the weather.
- Installation of a domestic wastewater holding tank will take place to hold effluent from the toilets within the substation buildings.
- A Class 1 full retention oil separator will be installed to collect and treat oil spills within the substation compound.
- Installation of a rainwater harvesting tank will take place to collect rainwater from the roofs of the substation buildings for toilet flushing and hand washing.
- Civil works associated with the construction of the transformer bund, equipment plinths etc. within the substation compound will commence.
- Civil works associated with construction of underground cable ducts and trenches within the substation compound will commence.
- The installation of electrical equipment within the substation compound and buildings including transformers, busbars, circuit breakers, cable supports, switchgear, panels etc. and all associated cabling will occur.

- The installation of palisade fencing and associated gates to the perimeter of the substation compound will proceed.

Figure 3-8: Typical Substation Building and Compound

## 3.8 Permanent LiDAR Unit

A permanent LiDAR (Light Detection and Ranging) unit is proposed for the site to monitor the wind regime while the Proposed Wind Farm is in operation. The LiDAR unit will be located within the IPP substation compound. The LiDAR unit will be placed on a concrete slab of dimensions 4m x 4m. The LiDAR unit will be surrounded by mesh fencing, 1.2m in height. Details of the LiDAR unit are shown in Planning Drawing 23882-MWP-00-00-DR-C-5404.

Figure 3-9: Typical LiDAR Unit

## 3.9 Temporary Site Construction Compound

The temporary site construction compound will be used for the construction phase of the Proposed Wind Farm and placed in the footprint of the EirGrid future expansion area adjacent to the 110kV substation. The compound will have dimensions of 95m x 50m as shown on Planning Drawing 23882-MWP-00-00-DR-C-5411. All material excavated during the construction of the temporary compound will be temporarily stockpiled to a maximum height of 1m adjacent to the temporary site compound and 110kV substation. This material will be reinstated following construction of the proposed wind farm. Topsoil and subsoil will be separated and stored separately.

The exposed surface will be levelled out by cutting and filling and will be overlain with a layer of crushed stone from a local quarry. The finished surface will be formed with a layer of UGMA (formerly Clause 804) or similar aggregate imported from a local quarry. The site compound will be graded and compacted out before the welfare container facilities are installed.

The compound will be constructed early in the development to provide site offices and accommodation for staff and for the delivery of materials. Any surface water management, bunding, waste management measures etc. will also be put in place at the outset. Site security will be put in place adjacent to the entrance and will be maintained throughout all phases of the construction work. The compound will be in place for the duration of the construction phase and will be removed once commissioning is complete.

Areas within the compound will be constructed as access tracks and used as vehicle hardstanding during deliveries and for parking.

- A bunded containment area will be provided within the compound for the storage of lubricants, oils, and site generators etc.
- The compound will be fenced and secured with locked gates.
- During the construction phase, a self-contained port-a-loo with an integrated waste holding tank will be used onsite for toilet facilities. This will be maintained by the service contractor on a regular basis and will be removed from the site on completion of the construction phase.
- Upon completion of the construction phase, the compound will be decommissioned by backfilling the area with the material arising during excavation, landscaping with topsoil as required.

**Figure 3-10: Typical temporary site construction compound on a wind farm**

## 3.10 Soil Management and Material Volumes

### 3.10.1 Excavated Soil

Excavated soils will be reused for backfilling, landscaping and restoration around wind farm infrastructure such as turbines and hardstands. The calculated volume of excavated material is summarised in Table 3-1.

There is one proposed permanent spoil deposition area located at T4 for surplus material, as shown on Planning Drawing 23882-MWP-00-00-DR-C-5035.

Excavated soil will be placed around the turbines to a maximum height of 1m and used in track berms along sections of access tracks and hardstands that will act as a physical edge protection measure to prevent vehicles falling off where a drop off greater than 1m exists from the track/hardstand edge. Felled areas around the turbines have been identified as a potential additional area for surplus excavated soils, however, priority will be given to a dedicated spoil deposition area.

A summary of the construction material and spoil storage volumes are shown in Table 3-1.

Drainage and siltation control measures will be put in place in all areas where excavated soils are placed. This will include a dedicated drainage network, temporary silt fences and settlement ponds designed to cater for the size of each storage area. Further details of the drainage philosophy that will be applied as well as siltation control systems and attenuation systems is given in Section 3.11 of this report.

**Table 3-1: Spoil Excavation and Construction Material Volumes**

| Excavations | | |
|---|---|---|
| **Total Excavation Volume** | **$m^3$** | **84,714** |
| Excavated Material Stored or Reused Onsite | $m^3$ | 84,714 |
| Excavated Material Removed from Site | $m^3$ | 0* |
| **Imported Material** | | |
| **Total Volume of Stone Required** | **$m^3$** | **87,795** |
| Imported Stone | $m^3$ | 87,795 |
| Site Won Stone | $m^3$ | 0 |
| Concrete for bases (7 @ 1212 $m^3$ each) | $m^3$ | 8,482 |
| Concrete for substation and LiDAR unit foundations | $m^3$ | 76 |
| Concrete for cable route | $m^3$ | 4,716 |
| Reinforced steel for turbine bases (7 @ 182 tonnes each) | tonnes | 1,272 |

*This material will be reused on site as preference in trackside berms etc. It is, however, included in the table above as material to be removed from site as a precautionary measure.

### 3.10.2 Temporary Storage of Excavated Material

No permanent stockpiles will be left on site after the completion of the construction phase works with the exception of material placed in the designated permanent deposition area. After completion of the turbine base reinstatement works all surplus material will reused within the spoil deposition area or disposed of offsite at a suitably licenced disposal facility.

Any materials excavated during the construction phase which are to be used in the site reinstatement and landscaping process shall, in the first instance, be stored on site in an environmentally safe manner that will not result in the pollution of waters or the smothering of ecologically sensitive habitats.

The following principles will be adhered to when considering the temporary storage of excavated materials.

- Spoil disposal will take place within a 30m radius of each structure.

- Preparation of the spoil disposal site will involve the removal of the "top mat" which will be transplanted to a suitable area and maintained for reuse during restoration operations.
- Spoil will be deposited, in layers of 0.5m and will not exceed a total thickness of 1m.
- Spoil will only be deposited on slopes of less than 5° to the horizontal and greater than 10m from the top of a cutting. The exact location of such areas will be confirmed on consultation with the geotechnical engineer.
- Once reinstatement is complete the disposal sites will be revegetated with the "top mat" removed at the commencement of disposal operations.
- Upon commencement of the restoration phase, guidance from a suitably qualified environmental professional will be sought to confirm the methodology and programme.

It is proposed that any temporary onsite stockpiles of soil, rock and other excavated material shall be removed and utilised in the site reinstatement programme to infill any excavated areas which will then be mounded and capped with sod prior to the completion of works.

### 3.10.3 Spoil Deposition Area

The spoil deposition area will be used for the permanent storage of the excavated spoil material generated from the construction of the turbine bases, crane hardstands, substation and internal access track.

Excess cohesive material will be placed around the permitter of the spoil deposition area and will act to retain peat material stored inside the permitter. The cohesive material will be laid at a shallow batter angle of max 20° and up to a maximum height of 2m.

The area will then be enclosed with three layers of silt fencing to prevent sediment runoff. Water buildup within the spoil deposition area will not be permitted. Upon completion, the surface of the spoil deposition area will be profiled to a gradient not exceeding 5%. Following completion, it is proposed to replant the deposition area.

## 3.11 Site Drainage

### 3.11.1 Design Principles

The site drainage system was designed integrally with the Proposed Wind Farm infrastructure layout as a measure to ensure that the proposal will not change the existing flow regime across the site. It will not cause a deterioration of water quality and will safeguard existing water quality status of the catchments identified in Chapter 08 Water and as assigned by the EPA in line with the Water Framework Directive (WFD).

A fundamental principle of the drainage design is that clean water flowing in the upstream catchment, including overland flow and flow in existing drains, is allowed to bypass the works areas without being contaminated by silt from the works. This will be achieved by intercepting the clean water and conveying it to the downstream side of the works areas either by piping it or diverting it by means of new drains or earth mounds.

This process will cause the normally dispersed flow to be concentrated at specific discharge points downstream of the works. To disperse this flow, each clean water drain will be terminated in a discharge channel running parallel to the ground contours that will function as a weir to disperse the flow over a wider area of vegetation. An alternative method is to allow the water to discharge through perforated pipes running parallel to the ground contours. Both methods will prevent erosion of the ground surface and will attenuate the flow rate to the downstream receiving waters. The specific drainage measures to be used at each location are shown on the drainage drawings included with the planning application. The clean water interceptor drains, or earth mounds are all positioned upslope to prevent any mixing of the clean and dirty water. The outflow from these drains is then piped under the access track at suitable intervals and at low points depending on the site topography.

Separating the clean and dirty water will minimise the volume of water requiring treatment. The dirty water from the works areas will be collected in a separate drainage system and treated by removing the suspended solids before overland dispersal. Dirty water drains will be provided on one or both sides of the access tracks and along the periphery of the turbines, crane hardstands, substation compound, LiDAR unit, deposition area and the temporary site construction compound.

The treatment system will consist of a series of settlement ponds at designated locations throughout the site (refer to Section 3.11.4.8). The outflow from the treatment system will be dispersed over vegetation in the same manner as the clean water dispersion and will become diluted through contact with the clean water runoff in the buffer areas before eventually entering the downstream watercourses.

The clean water interceptor drains, or earth mounds are all positioned upslope to prevent any mixing of the clean and dirty water. Refer to Figure 3-11. The outflow from these drains is then piped under the track at suitable intervals and at low points depending on the site topography. In the illustration 'dirty water' drains collect all incident rainwater that falls on the infrastructure. This water then drains to settlement ponds for removal of sediment before it is discharged via overland dispersal to the downstream watercourse.

The site drainage layout is presented in Planning Drawings 23882-MWP-00-00-DR-C-5019 to 23882-MWP-11-00-DR-C-5031 with further drainage details presented in Planning Drawing 23882-MWP-00-00-DR-C-5406.

**Figure 3-11: Separation of Clean and Dirty Water Drainage on A Wind Farm Site**

### 3.11.2 Flood Attenuation

The creation of impermeable areas has the effect of increasing rates of runoff into the downstream drainage system, and this may increase flood risk and flood severity downstream. This applies particularly to urban areas that drain to closed pipe systems which do not have the capacity to cater for increased hydraulic loads. The Proposed Development is located within a large rural catchment with an open drainage system. The footprint of the impermeable areas and the associated increase in runoff rate is very small in the context of the catchment size and therefore represents a negligible increase in downstream flood risk. However, it is proposed to provide some attenuation to limit the flow rate into the settlement ponds during high intensity storm events so that they do not become overloaded. This will also attenuate the flow to the downstream watercourses.

The volume of water requiring attenuation relates to direct precipitation on the access tracks and other infrastructure footprint only. The developed surfaces have some permeability, and this reduces the attenuation requirement. Conventional attenuation systems use proprietary flow control units, but these can become blocked with debris and vegetation and require regular maintenance. They are, therefore, not appropriate for use within agriculture/forestry environments or where long-term routine maintenance would not be practical.

It is proposed to provide temporary storage within the drainage channels by creating stone dams within them at regular intervals. The spacing of the dams is typically 50m but depends on the channel slope, with steeper channels requiring shorter intervals. The dams, which are constructed with small sized aggregate held in place by large aggregate, also reduce the flow rate through the drainage system and are an effective means of providing flow control. Silt fences will also provide storage and flow control.

### 3.11.3 Drainage/Stream Channel Crossings

As part of the civil engineering works associated with the Proposed Development, four water crossings of EPA registered water courses are required. These crossings will be designed and implemented in accordance with best practice guidelines and relevant environmental regulations to minimise hydrological disruption and protect aquatic ecosystems. The construction methodology for site track crossings will prioritise the use of clear-span structures where feasible and culverts or temporary crossings will be employed only where necessary, with appropriate mitigation measures in place in accordance with the CEMP accompanying this application.

The selection criteria for crossing natural/artificial drains and streams within the Proposed Wind Farm were:

- Avoid crossing drains or streams at acute angles where possible.
- Avoid meanders at the crossing location.
- Cross where foundations could be constructed without excess excavation.
- Consider vertical alignment requirements.

All watercourse and drain crossings in the north section of the site will be made using bottomless culverts. No instream works will take place on the northern section of the site.

Clear span pre-cast concrete culverts are advantageous in several manners for this type of installation. As spans increase, the height can increase accordingly allowing significant light penetration under the culvert. The increase in height is complimentary to the vertical alignment requirements for access track design. Refer to **Planning Drawing 23882-MWP-00-00-DR-C-5415** for further details.

The design of a clear span pre-cast concrete culvert crossings will ensure that:

- The existing channel profile within the watercourse is maintained.
- Gradients within the watercourse are not altered.
- There is unrestricted passage for all size classes of fish by retaining the natural watercourse stream/riverbed.
- 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.
- The watercourse velocity is not changed.
- The clear span of a culvert will ensure that the existing stream/riverbank is maintained during construction which will in turn avoids the occurrence of in-stream works.

Construction of any clear span crossings will be supervised by the Construction Manager, a suitably qualified engineer, the project manager, and the Environmental Manager in accordance with Inland Fisheries Ireland *"Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters, 2016".*

Typically, the proposed installation works for a clear span pre-cast concrete culvert will comprise the following:

- Upon design approval, the extent of the excavations required for the culvert foundations at either side of the watercourse will be marked out. The foundations will be suitably offset from the existing watercourse so as not to impact on the riparian habitat. Health and safety measures such as lifebuoys on stakes will be installed and where appropriate life jackets will be provided to persons working near the watercourse.
- Appropriate environmental control measures such as silt curtains, silt traps, mats etc. will be erected on both sides of the watercourse. These environmental control measures will reduce the potential for sedimentation of the watercourse.
- Excavators will begin to excavate the foundations to formation level where all excavations will be battered back to a safe angle of repose (minimum slope angle of 45°) and comply with the final CEMP to be produced by the appointed contractor for the Proposed Development. All excavation works will stop in the event of heavy rainfall.
- All excavated material will be transported to the onsite deposition areas located outside of the 20m hydrology buffer zone from EPA mapped watercourses. Some of the excavated material will subsequently be reused as backfill around the culvert abutments and structure upon installation. Bare ground will be minimised.
- Once formation is reached at suitable ground conditions. steel reinforcement and shuttering will be installed. The culvert abutments will be prepared for the pouring of concrete by dewatering standing water within the excavations, which is likely to contain suspended solids, via a pump to an adequately sized settlement pond located outside of the 20m hydrology buffer zone from EPA mapped watercourses. The standing water will be treated through the settlement pond and clean filtration stone prior to outfall over vegetation away from the watercourse.
- Ready-mix concrete will be delivered to the culvert abutments by ready-mix concrete trucks and placed into each abutment by means of excavators. During the concreting works the watercourse will be temporary covered over with a tarpaulin to protect the watercourse from concrete spills. Upon completion the abutments will be covered and allowed to cure.

- Following curing, the shuttering around the abutments will be struck and removed. A small temporary hardstand will be constructed so that a lifting crane, which will install the pre-cast concrete culvert components onto the abutments, can be set up.
- Deliveries of the pre-cast concrete culvert components will arrive to site (see Figure 3-12 and Figure 3-13). These components will be individually fitted and manoeuvred into position by the lifting crane onto the concrete abutments. The components will be inspected to ensure that each unit is level and secure.
- Backfilling on either side of the culvert will commence using excavated material, in particular larger rock of a uniform size will be placed along the edge.
- The access track surface will be laid over the culvert structure using stone aggregate and compacted in maximum 250mm layers with the use of 10-20 Tonne rollers. An internal cable trench will be installed within the carriageway of the culvert so that it can cross over the watercourse.
- Vegetated soil bunds will be installed at the edge of the road over the culvert crossing to divert dirty water out of the 20m hydrological buffer zone and into the dirty water treatment system. This will ensure that dirty water will not directly enter the clean watercourse.
- Steel parapet railings and timber post and rail fencing will be installed at the sides and on the approaches to the culvert. This will prevent persons or vehicles falling into the watercourse while travelling across the culvert.

**Figure 3-12: Typical Construction of a Clear Span Pre-Cast Concrete Arch Unit**

Figure 3-13: Typical Clear Span Pre-Cast Concrete Box Culvert Construction

Alternatively precast concrete or HDPE pipes may be used for crossing existing natural or artificial drainage/stream channels. All crossings will be designed for a minimum 1 in 100-year return rainfall event. The invert of the pipe is submerged approximately one quarter of its diameter below the original drainage bed. Where natural gradients allow, a nominal back fall in the pipe will be incorporated to prevent scour and promote the settling of natural material along the invert of the pipe. An example of a permanent drain crossing is illustrated in Figure 3-14. New turbine service tracks will be required to cross several minor drains within the site.

Figure 3-14: Typical Concrete Pipe Channel Crossing

**Figure 3-15** shows a typical measure to be put in place at drainage and watercourse crossings to ensure dirty water does not enter clean watercourses. Soil bunds to be vegetated will be used to divert dirty water generated on the section of access track over the crossings to the dirty water system. Alternatively silt fencing, as shown in **Figure 3-16** will be placed along the tracks running within 20m of watercourses. These silt curtains consisting of silt fencing and a buffer strip made of clean single sized drainage stone will run parallel to watercourses to filter any potentially silted runoff. These silt curtains will also be used at temporary local road widening locations.

**Figure 3-15: Dirty Water Containment Berm**

Figure 3-16: Silt Curtain Containment Along Tracks Near Watercourses

### 3.11.4 Water Quality Management Systems

#### 3.11.4.1 General

Sediment such as clay or silt can cause pollution during the construction phase of a civil engineering project due to the erosion of exposed soil by surface water runoff. The water quality management system has been prepared in order to control erosion and prevent sediment runoff during the construction phase of the Proposed Development. The implementation of sediment and erosion control measures is essential in preventing sediment pollution. The system was designed having regard to:

- Knowledge of the site's environmental conditions.
- Previous experience of environmental constraints and issues from construction of wind farms in similar environmental conditions.
- Technical guidance and best management practice manuals (see references).

The following site-specific information was used in the design of the drainage and treatment system:

- High resolution aerial photography.
- LiDAR ground surface information.
- Wind farm infrastructure layout (turbines, access tracks and ancillary development).
- Hydrology maps (watercourses and buffer zones).
- Soil and land use maps.
- Baseline water quality assessments.
- Met Éireann extreme rainfall data.

The settlement ponds and check dams described in the following subsections provide the essential mechanism for the removal of silt from construction related runoff and the controlled return of the treated runoff to the downstream watercourses.

The drainage and treatment system will ensure that the construction and early post-construction phases of the Proposed Development will not create adverse effects on the aquatic environment. As a result, there will be no significant adverse effects.

#### 3.11.4.2 Construction Works Area

Runoff from the internal access tracks, hardstands and other wind farm infrastructure will be isolated from the clean catchment runoff by means of a series of open drains that will be constructed within the works areas. These drains will be directed to settlement ponds that will be constructed throughout the site, downhill from the works areas and as shown on the drainage layout planning drawings submitted with this application. Each drain will incorporate a series of check dams that will attenuate the flow and provide storage for the increased runoff from exceptional rainfall events. The ponds have been designed to a modular size to cater for a 1,200$m^2$ of stone hardstanding area or 240m of internal access track.

Dewatering of turbine base excavations can result in significant flow rates to the drainage and settlement system if high-capacity pumps are used. To avoid the need for pumping, drainage channels from the excavations will be provided to prevent a build-up of water. Where this is not feasible, temporary storage will be provided within the excavations and dewatering carried out at a flow rate that is within the capacity of the settlement ponds.

**Figure 3-17: Stone Check Dam (With Large Aggregate on Downstream Side)**

#### 3.11.4.3 Treatment Process

Contaminated runoff can be generated on the site access tracks, construction compound, onsite substation, spoil deposition area and turbine hard standing areas and is mainly due to excavation for the infrastructure or movement of delivery vehicles and onsite traffic.

Drains carrying construction site runoff will be diverted into settlement ponds that reduce flow velocities, allowing silt to settle and reducing the sediment loading. A modular approach has been adopted for the design of the settlement ponds which have been sized to cater for a catchment area of 1,200m$^2$ works area. This is equivalent to an access track length of 240m.

The settlement ponds have been designed as a three-stage tiered system and this has been proven to work effectively on wind farm construction sites. The three-stage system also facilitates effective cleaning with minimal contamination of water exiting the pond.

The settlement ponds have been designed with regard to the following:

- Runoff flow rate for the modular catchment area.
- Met Éireann Extreme Rainfall Data (statistical rainfall intensity/duration table).
- Character of the impermeable areas (runoff coefficients).
- Design particle size and density.

The treatment process consists of primary, secondary and tertiary treatment as follows:

- The *primary treatment* consists of a three-stage settlement pond with an over-topping weir at each stage. The first chamber will remove most of the sediment load, while the remaining two chambers will remove most of the remaining load.
- Before the water is released onto the existing ground surface, it passes through a *secondary treatment* system in the form of a graded gravel filter bed.
- The outflow from each interceptor is dispersed across a wide area of vegetation so that the velocity is minimised and the vegetation can filter out the residual sediment. This is the final or *tertiary* stage of the treatment process. Existing rills and collector drains within the tertiary treatment area are blocked off to prevent concentration of the flow.

Each sediment treatment unit has been micro-sited using the contour maps and aerial photos to avail of any locally level areas and to ensure that the outflow is spread over as much vegetation as possible before entering an aquatic buffer zone.

Settlement ponds will require inspection and cleaning when necessary. This will be carried out under low or zero flow conditions so as not to contaminate the clean effluent from the pond. The water level will first be lowered to a minimum level by pumping without disturbing the settled sediment. The sediment will then be removed by mechanical excavator and disposed of in areas designated for deposition of spoil. Settlement ponds will require perimeter fencing and signage to ensure that there are no health and safety risks.

Figure 3-18 below shows a well-constructed and maintained tiered settlement pond. This example is in an upland environment with significant ground surface slope and operates efficiently when well maintained.

Figure 3-18: Multi-tiered Settlement Pond with Stone Filter

The design of the settlement pond system for the Proposed Development is detailed in the Planning Drawing 23882-MWP-00-00-DR-C-5406. The hydraulic design of the settlement ponds is outlined in Section 3.13.4.8.

The effluent from each settlement pond will discharge to an open channel, running parallel to the ground contours. This will form a weir that will overflow on its downhill side and disperse the flow across the existing vegetation. A minimum buffer width of 20m is specified between the overflow weir and downstream watercourses. Buffer widths are designed in line with *Forests and Water, UK Forestry Standard Guidelines (Forestry Commission, 2011)* on protection of watercourses during forestry operations and management. This method buffers the larger volumes of runoff discharging from the drainage system during periods of high precipitation, further reducing suspended sediment load to surface watercourses. The outflow weirs will not be located on slopes steeper than 3:1. Existing drains within the dispersion zone will be blocked off where necessary to provide additional attenuation, disperse the flow across a larger area of ground and prevent the re-concentration to a single flow.

#### 3.11.4.4 Inspection and Maintenance

The drainage and treatment system for the Proposed Wind Farm will be managed and monitored at all times and particularly after heavy rainfall events during the construction phase. The drainage and treatment system 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. These drainage controls will be kept in place during the operational phase of the Proposed Wind Farm until the vegetation is re-established.

#### 3.11.4.5 Weather Monitoring

Weather monitoring is a key input to the successful management of the drainage and treatment system during the construction of the Proposed Wind Farm. This, at a minimum, will involve 24-hour advance meteorological forecasting (Met Éireann download) and onsite rain gauge linked to a trigger-response system. When a pre-determined rainfall trigger level is exceeded (e.g., 1 in 5-year storm event), planned responses will be undertaken. These responses will involve control measures including the cessation of construction until the storm event has passed over and flood flows have subsided. Dedicated construction personnel will be assigned to monitor weather.

#### 3.11.4.6 Water Quality Monitoring

A programme for water monitoring will be prepared prior to the commencement of the construction of the Proposed Wind Farm. The plan will include monitoring of water during the pre-construction, throughout and post construction phases. For additional details please see Chapter 08 Water.

Further baseline water quality monitoring of all streams near the development site will be undertaken prior to construction to confirm existing conditions at the time of construction. This baseline data will include the main components of a full hydrograph for the streams including both high spate flow and base flow where possible.

Water quality field testing and laboratory analysis will be undertaken prior to commencement of felling and construction at the site. The monitoring programme will be subject to agreement with OCC but will be based on the planning stage programme already outlined in the EIAR and CEMP and presented herein.

In order to ensure a comprehensive understanding of baseline water quality conditions including during low and high flow water conditions, upstream and downstream of the Proposed Development, baseline water quality measurements will be undertaken prior to commencement of construction.

Analysis will be for a range of parameters with relevant regulatory limits along with Environmental Quality Standard's (EQSs).

The analytical determinants of the monitoring programme (including limits of detection and frequency of analysis) will be as per S.I. No. 272 of 2009 European Communities Environmental Objectives (Surface Waters) Regulations, the Surface Waters (Amendment) Regulations 2015 to 2023 and European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009 to 2018. The likely suite of determinants will include:

- pH (field measured).
- Electrical Conductivity (field measured).
- Temperature (field measured).
- Dissolved Oxygen (field measured).
- Total Phosphorus.
- Chloride.
- Nitrate.
- Nitrite.
- Total Nitrogen.
- Orthophosphate.
- Ammonia N.
- Biochemical Oxygen Demand.
- Total Suspended Solids.

Continuous, in-situ, monitoring equipment will be installed at selected locations. The monitoring equipment will provide continuous readings for turbidity levels, flow rate and water depth in the watercourses.

During the construction phase of the Proposed Development, water quality in the streams and outflow from the drainage and attenuation system will be monitored, field-tested and laboratory tested on a regular basis during different weather conditions. This monitoring, together with visual monitoring will help to ensure that the mitigation measures that are in place to protect water quality are working effectively.

During the construction phase of the Proposed Development, the development areas will be monitored regularly for evidence of groundwater seepage, water ponding and wetting of previously dry spots, and visual monitoring of the effectiveness of the constructed drainage and attenuation system to ensure it does not become blocked, eroded, or damaged during the construction process.

#### 3.11.4.7 Surface Water Quality and Cementitious Material

It is important to prevent raw cement from entering waterways within and near the Proposed Development.

Cement is required as a constituent for concrete. Concrete will be used for construction of the turbine bases, the substation buildings and any culvert crossings.

The primary method of reducing the potential impact from cementitious material on the hydrology of the Proposed Development is the selection of ready-mixed concrete as opposed to site batching of concrete. Site batching requires the delivery and storage on site of significant quantities of raw cement. The chemical reactivity of cement is at its most vigorous in the early stages of its activation by water (hydrolysis, typically in the first 15 minutes). In the batching plant water is added to the cement at the correct water/cement ratio to fully activate the cement hydration process.

By removing cement in its raw state from the site the potential for a significant effect from hydrolysis of cement in the surrounding watercourses is eliminated. When ready-mixed concrete is used, the hydrolysis stage of the cement process has already been completed during the batching process and the chemical reaction undergoes a dormancy period during which it enters a plastic state. During this period the concrete is delivered and placed. After approximately 3 hours the cement in the concrete enters a third stage of the chemical process where it hardens, primarily due to the hydration of tricalcium silicate. This process increases in activity for approximately 12 hours and then decreases over the following 20 hours. After approximately 36 hours the concrete is considered to have set.

As part of the curing process the top exposed surface of poured concrete is covered in a curing blanket which eliminates the effect of rain washing down uncured cement from the top surface. Concrete placement for a truck load is typically complete within 3 hours of batching. It is normal for the truck operator to wash out the drum and chutes of the truck on site. This typically requires approximately 250l of water to complete. This concrete washout contains cement that has not fully completed the hydration process and as a result can have an elevated pH level (higher alkalinity).

Concrete truck washouts for the Proposed Development will be limited to washing down chutes only, reducing water volume to approximately 25l. The 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 Proposed Development

Washout of concrete truck drums will be carried out at the source quarry. There will be no onsite batching of concrete. Concrete requirements will be met by ready-mix suppliers.

The environmental manager will monitor the pH of the water in the chute wash out bund and will dose with carbon dioxide ($CO_2$) or acidic water from the drains until the wash out water achieves neutrality before discharge. Any overflow of water will be collected in the site compound drainage system which will be connected to a settlement pond for treatment prior to discharge to the external drainage system. The concrete sediment in the construction compound washout area will be removed at regular intervals.

#### 3.11.4.8 Sediment Pond Design

Generally, high-intensity rainfall events have a short duration and lower-intensity rainfall events tend to have a longer duration. The Met Éireann Extreme Rainfall Data for the area demonstrate that the chance of occurrence of a storm event of a given duration decreases (higher return period) as intensity increases.

**Table 3-3** shows the Point Rainfall Frequency and the total rainfall for each duration and return period in millimetres. **Table 3-2** shows the same data converted to a rainfall rate in mm/hour. For a given return period the total depth of rainfall increases with storm duration but the actual rainfall rate over that period of time decreases. For the operation of the settlement ponds, it is the rate of flow rather than the total rainfall that is relevant. The return period is a measure of the likelihood that a storm of a particular intensity will occur in a given year. However, it is important to note that the chances of occurrence of a storm event with a particular return period are the same in each year but should on average occur once in that time period. For instance, a storm event with an intensity of 33.6mm/hour and a 1-hour duration would be expected to occur once in a 100-year period (**Table 3-3**). This is more appropriately expressed as an annual exceedance probability (AEP) of 1%. that is, it has a 1% chance of being equalled or exceeded in any year.

The runoff control measures for the Proposed Development have been designed in the context of storm events of varying duration and intensity. The settlement ponds have been designed to cater for a maximum continuous flow rate associated with a medium-intensity rainfall event. Higher intensity runoff will be attenuated by the open drain collection system which provides temporary storage and limits the rate at which it enters the settlement ponds. This is achieved by the use of check dams within the open drains as described in **Section 3.11.4.14**. Longer duration storms of 24 hours or more, generally have very low intensity rainfall and are not critical in terms of the runoff rates that they generate.

The modular settlement ponds are designed to operate effectively for the runoff rate associated with a continuous high rainfall rate of 20 mm/hour. This is approximately equal to a 1-hour duration storm event with a 10-year return period (M10-60). These rates are taken from the Met Éireann Point Rainfall Frequency table for the site location.

The design runoff rate, used for the drainage design, is calculated using the Modified Rational Approach formula:

$$Q = 2.78\, C_v\, C_r\, I\, A_i$$

where $c_v$ is the volumetric coefficient which is dependent upon the catchment characteristics. It is assumed to be 0.84 for the winter profiles as stated in the Flood Studies Report,

$c_r$ is the routing coefficient, the Wallingford recommends this to be 1.3.

i is the rainfall intensity in mm/hr, and

$A_i$ is the impervious area drained surface area in ha. The percentage imperviousness (PIMP) obtained by dividing the total directly connected impervious area ($A_i$) by the total contributing area (A). PIMP is assumed to be equal to 70% for the hardcore surface. ($A_i$ =PIMP x A)

For a rainfall intensity of 20mm/hour and a total drained area of 1,200m$^2$ (equivalent to 240 linear metres of site access track) the runoff rate is:

$$Q = 2.78 \times 0.84 \times 1.3 \times 20 \times (0.70 \times 1{,}200) \text{ l/s}$$

$$= 5.10 \text{l/s } (0.0051 \text{m}^3/\text{s})$$

The main design parameter for the settlement pond is the water surface area. The required surface area is the design flow rate in m$^3$/s divided by the particle settlement velocity ($V_s$) in m/sec (Area = $Q/V_s$ m$^2$)

The particle settlement velocity is determined using the formula derived by Stokes in 1851 as follows:

$$V_s = 2 r^2 (D_p - D_f)/(9 n)$$

where $V_s$ is the particle settlement velocity (m/sec),

r is the radius of the particle (metres),

$D_p$ is the density of the particles (kg/m$^3$),

$D_f$ is the density of the fluid (kg/m$^3$), and

n is the viscosity of the fluid (0.000133 kg sec/m$^2$ @ 10°C).

For a particle density of 2,400kg/m$^3$, water density of 1,000kg/m$^3$ and particle diameter of 20 microns (radius=$1*10^{-5}$ metres) the settlement velocity, $V_s$, is:

$$V_s = 2 \times (10^{-5})^2 \times (2{,}400 - 1{,}000)/(9 \times 0.000133)$$

$$= 2 \times 10^{-10} \times 1{,}400/0.001197$$

$$= 0.000234 \text{ m/sec.}$$

The required settlement pond surface area is

$$A_p = Q/V_s$$

$$= 0.0051/0.000234$$

$$= 21.79 \text{m}^2$$

Theoretically, the pond depth is not relevant but in practice, a minimum depth is required to ensure laminar flow and to allow temporary storage of settled silt. The modular settlement pond has been designed with a surface area of 24m$^2$ (12m x 2m) and a depth of 1m. This is divided into three chambers of equal length and in practice, it has been found that most of the settlement occurs in the first chamber with very low turbidity levels being achieved in the final effluent. The design is conservative and therefore has sufficient redundancy to cater for occasional higher runoff rates or sediment loads.

#### 3.11.4.9 Attenuation Design

For rainfall intensities above the design value of 20mm/hour, the excess runoff needs to be temporarily stored. The storage can be provided in the drainage channels by installing check dams at intervals along the channel as described below.

The storage volumes required for 10-year storm events of various durations are shown in Table 3-2. The volumes are based on a catchment area of 1,200m$^2$ and a runoff coefficient of 0.70. This represents the runoff generated from 240 linear metres of site access track. The maximum storage volume required is 6.22m$^3$ for 15 minutes storm duration. This is equivalent to 20 minutes of flow through the settlement pond at the design-through flow rate of 5.1 litres/second. The stored water will drain off gradually as runoff from the works area subsides. The storage volume represents an average depth of 0.30m in a 138m long, open section of roadside drain and can therefore be easily accommodated in the drainage system.

**Table 3-2: Calculated Drainage Storage Volumes**

| Storm Event | Duration (seconds) | Rainfall rate (mm/hour) | Excess Rainfall ($m^3$) | Runoff Coefficient | Additional Storage Volume Required ($m^3$) |
|---|---|---|---|---|---|
| M10-5min | 300 | 90.0 | 70.0 | 0.70 | 4.90 |
| M10-10min | 600 | 63.0 | 43.3 | 0.70 | 6.02 |
| M10-15min | 900 | 19.6 | 29.6 | 0.70 | 6.22 |
| M10-30min | 1800 | 30.6 | 10.6 | 0.70 | 4.45 |
| M10-60min | 3600 | 19.1 | 0.0 | 0.70 | 0 |

The ability to limit flow rates is fundamental to the control of sediment during extreme storm events. It is not proposed to use any proprietary mechanical devices for this purpose but instead to rely on the check dams to effectively limit flow rates to the required values. The check dams will be constructed with gravel or other suitable material and will be of sufficient length and height to provide the required attenuation rates. The number of dams will vary depending on the gradient of the drainage channel with higher gradients requiring a greater number of dams with larger dimensions. Their ability to retain water and release it slowly can be confirmed visually.

**Table 3-3: Met Éireann Point Rainfall Frequency Table (Rainfall Depth in mm)**

| Storm Duration | Return Period (Years) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0.5 | 1 | 2 | 5 | 10 | 20 | 50 | 100 |
| 5 min | 2.6 | 3.7 | 4.2 | 6.1 | 7.5 | 9.2 | 11.8 | 14.1 |
| 10 min | 3.7 | 5.1 | 5.9 | 8.5 | 10.5 | 12.8 | 16.4 | 19.7 |
| 15 min | 4.3 | 6.0 | 7.0 | 10.0 | 12.4 | 15.0 | 19.3 | 23.2 |
| 30 min | 5.6 | 7.8 | 8.9 | 12.5 | 15.3 | 18.5 | 23.4 | 27.39 |
| 60 min | 7.4 | 10.0 | 11.3 | 15.7 | 19.1 | 22.7 | 28.4 | 33.6 |
| 2 hours | 9.6 | 12.8 | 14.5 | 19.7 | 23.7 | 28.0 | 34.6 | 40.4 |
| 3 hours | 11.3 | 14.9 | 16.7 | 22.6 | 26.9 | 31.6 | 38.7 | 45.1 |
| 4 hours | 12.6 | 16.5 | 18.5 | 24.8 | 29.4 | 34.4 | 42.0 | 48.7 |
| 6 hours | 14.7 | 19.1 | 21.4 | 28.3 | 33.4 | 38.9 | 47.1 | 54.3 |
| 9 hours | 17.2 | 22.2 | 24.7 | 32.4 | 37.9 | 43.9 | 52.8 | 60.6 |
| 12 hours | 19.3 | 24.6 | 27.3 | 35.6 | 41.5 | 47.8 | 57.3 | 65.5 |
| 18 hours | 22.6 | 28.6 | 31.6 | 40.6 | 47.1 | 54.0 | 64.2 | 73.0 |
| 24 hours | 25.3 | 31.7 | 34.9 | 44.7 | 51.6 | 58.9 | 69.7 | 78.9 |

#### 3.11.4.10 Access Track Construction

Onsite experience in wind farm construction and forestry development across the country has shown that the single most effective method of reducing the volume of sediment created by construction is the finishing of all access tracks with high quality, hard wearing crushed aggregate such as basalt, granite or limestone laid to a transverse grade. When storm water drains transverse across a track constructed from hard wearing aggregate, as opposed to low class aggregate, the level of suspended solids is reduced significantly. The internal access tracks will be finished with a hard-wearing aggregate. This can have the added benefit of contributing a balancing pH to help protect water quality from acidic runoff. The Proposed Development is serviced by a limestone quarry which can be used as a source of hard-wearing aggregate for road construction. The nearest quarry to the site is 13km from the site and has the potential to supply these materials given its proximity to the site.

#### 3.11.4.11 Wheel Washes

Wheel washes will be provided for heavy vehicles exiting the site to ensure that public roads outside of the site boundary are clean. These can take the form of dry or wet wheel wash facilities. In the case of a wet wheel wash a designated bunded and impermeable wheel wash area will be provided, and the resultant wastewater will be diverted to a settlement pond for settling out of suspended solids.

#### 3.11.4.12 Engineered Deposition Areas

Temporary engineered deposition areas will be designated where necessary at the turbine and hardstand locations to hold temporary stockpiles. These will be located away from drains and watercourses. Stockpiles that are at risk of erosion will be protected by a silt trapping apparatus such as a geo-textile silt fence to prevent contamination of runoff.

#### 3.11.4.13 Tree Felling

Felling of conifer forestry is required within and around wind farm infrastructure to accommodate the construction of foundations, hardstands, substation, grid connection and access tracks as well as to facilitate assembly of turbines. The proposed felled areas are shown on **Figure 2-10** in **Chapter 02**.

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 & Reforestation 2019"*. All conditions associated with a felling licence will be complied with.

#### 3.11.4.14 Check Dams

Check dams will be placed at regular intervals, based on gradient, along all drains to provide flow attenuation, slow down runoff to promote settlement and to reduce scour and ditch erosion. Check dams are relatively small and constructed with gravel, straw bales, or other suitable material. They will be placed at appropriate intervals and heights, depending on the drain gradient, to allow small pools to develop behind them. Examples of check dams or swales are shown below in **Figure 3-19**.


**Figure 3-19: Examples of Check Dams Along Access Track Drainage Channels**

### 3.11.4.15 Silt Fences

Silt fences placed within drains and swales are an alternative method of reducing the volume of suspended sediment. They will be placed at the end of any locally steep section of drain. They have the double benefit of effectively producing a localised swale to reduce scour effects and attenuating and filtering the discharge. An example of a typical silt fence installation is shown in Figure 3-20.


**Figure 3-20: Example of a Silt Fence in a Swale**

### 3.11.4.16 Operational Phase

The measures for control of runoff and sediment relate to the construction phase of the project when there is continuous movement of site vehicles and delivery vehicles moving around the Proposed Development site. Following construction, the amount of onsite traffic will be very low and there will be negligible risk of sediment runoff. It is therefore proposed to partly fill the sediment ponds with stone so that they will not present a long-term safety risk. Runoff from the access tracks, hard-standings, and other works areas will continue to be directed to these ponds and from there to the outfall weirs. Check dams within the drainage channels will also remain in place. The retention of this drainage infrastructure will ensure that runoff continues to be attenuated and dispersed across existing vegetation before reaching the downstream receiving waters. This infrastructure will be inspected regularly by the operational maintenance personnel. Monthly water monitoring will continue post construction and into the operational phase until the appointed Ecological Clerk of Works (ECoW) is satisfied there is no adverse impacts to the natural watercourses and that surface water quality parameters are in line with baseline levels.

The regular inspections during the operational phase will ensure culverts are free from blockages, and there is no damage or erosion of the stream crossing wing walls, particularly after storm events. Silt ponds will also be inspected and maintained before the drains and verges have vegetated.

### 3.11.5 110kV Substation Drainage

The substation compound will feature two separate underground stormwater drainage systems—one serving the IPP compound, the other the EirGrid compound. Each system will use a piped network with trapped gullies to collect surface water from roofs and impervious areas, safely conveying it away from critical electrical infrastructure. Surface water runoff from areas where a risk of a contaminant leak or spill may be present (such as transformer bunds or diesel storage tank bunds), will pass through a Class 1 full retention interceptor prior to discharging from the proposed stormwater sewer network. The interceptor is intended to separate contaminants such as light oils and silts from clean surface water runoff. All runoff collected in the underground stormwater sewer network will discharge to an above ground attenuation system. Separate parallel attenuation systems will serve the EirGrid and IPP compounds individually. The attenuation systems will each consist of detention basins providing 60m$^3$ of surface water storage capacity. The basins are sized to prevent flooding of the compounds in a 100-year storm event with an additional 20% allowance for the effects of climate change as per guidance in the Offaly County Development Plan 2021-2027. Outflow from the detention basins will be restricted to the greenfield runoff rate ($Q_{bar}$). The outfall from the detention basins will be raised above the base of the detention basins to allow for interception storage equivalent to 5mm of rainfall on the catchment area as per the Greater Dublin Strategic Drainage Strategy (GDSDS) guidance. Discharge from the detention basins will pass through outflow manholes equipped with flow controls. From there, it will outfall at precast concrete headwalls onto rip-rap aprons and disperse overland. The proposed drainage systems will be compliant with the requirements of the GDSDS in the implementation of SuDS and nature-based drainage solutions.

## 3.12 Proposed Grid Connection Route

The proposed connection of the onsite 110kV substation to the national grid does not form part of this planning application. The details in this section are included to outline the proposed construction of a grid connection for the Proposed Development. It is proposed that an underground electrical cable would be constructed to connect the onsite substation to the Philipstown 110kV substation which is located approximately 6km southeast. This proposed 110kV grid connection cable route will be approximately 8km in length and is presented below in **Figure 3-21**.

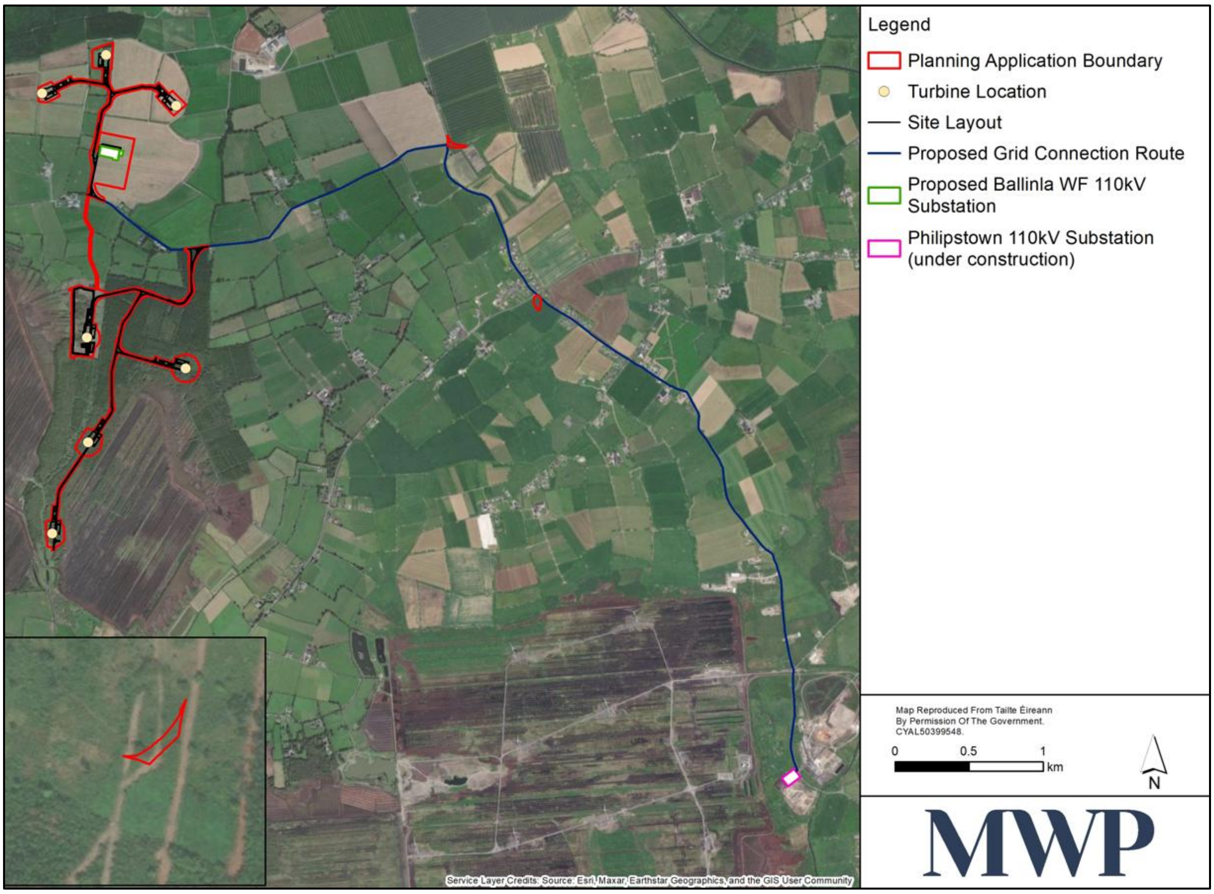


Figure 3-21: Proposed Grid Connection Route

### 3.12.1 Excavation and Duct Installation

The Proposed Grid Connection cable will be carried within a single cable trench.

The installation of the grid connection involves the following process.

- Prior to works commencing the area where excavations are planned will be surveyed and all existing services will be confirmed. All relevant bodies i.e., ESB Networks, EirGrid, Gas Networks Ireland, Eir, OCC, etc. will be contacted and drawings for all existing services sought. A road opening licence will be obtained where required from OCC for the relevant road section. All plant operators and general operatives will be inducted and informed as to the location of any services.
- Prior to works commencing a dilapidation survey will be carried out photographing and noting any existing damage or defects to road surfaces. A copy of this survey will be submitted to OCC prior to works commencing.
- Prior to works commencing the route will be inspected and marked out on the ground. Standard good practice preparatory measures are then put in place along the extent of the route. This will include any required warning notices, temporary barriers, etc.
- Prior to works commencing a traffic management plan will be prepared by the appointed contractor and agreed with OCC.

- During construction works, the trench will be excavated down through the existing stone in the road/topsoil using an excavator machine (or down through soil in the sections). As stone fill/topsoil is removed it is temporarily stockpiled adjacent to the trench for re-use in backfilling. In some instances, some soil or unsuitable material may be encountered in the trench and this is removed from site and brought to an appropriate licensed facility for disposal.
- The trench is then prepared to receive concrete bedding and surround for the ducts. The ducts are surrounded by concrete with adequate cover over the duct.
- Once the concrete is set, appropriate imported stone material is placed over the concrete surround and filled back up to the top of trench. Suitable warning tapes will also be installed in the trench. Once the trench is filled, the trenching and ducting process will move along the route in planned stages.
- Where the route is within the public road, the trench surface receives a temporary surface dressing of either spray and chip or macadam. Once the overall scheme is completed, the relevant area of the grid connection route and associated road will receive a new permanent macadam finish as agreed with OCC. A new unbound stone access track will be constructed over the route which is not within the public road.
- Joint bays will be installed where required along the grid connection route.
- The as-built location of the ducting will be surveyed using a total station/GPS. Marker posts will be installed along the grid connection route to also denote the location of ducting on the ground.
- A condition survey will be carried out on the public road impacted by the grid connection route, both pre and post construction.

### 3.12.2 Proposed Grid Connection - Watercourse Crossings

The proposed 110kV grid connection route would require the cables to cross the Leitrim watercourse at the existing L-5010 crossing between the two proposed site entrances. It is expected that Horizontal Directional Drilling (HDD), as shown in drawing 23882-MWP-00-00-DR-C-5409 for reference would be undertaken for the Proposed Grid Connection to cross under EPA mapped watercourses and under the Bord na Mona rail track adjacent to the Edenderry Power Station. The process for HDD is outlined in **Section 3.12.5**. Instream works for EPA mapped watercourses are not anticipated in the construction of the proposed grid connection route.

### 3.12.3 Proposed Grid Connection Construction - Land Drainage Ditches

Where land drains are encountered along the Proposed Grid Connection there are two scenarios, as follows:

- If there is adequate cover over the drain crossing, then the new ducts and trench will pass over the drain without interruption to the drain. No works will be required within the drain at these locations. The trench at these locations will be installed in the existing access track.
- In the event where there is insufficient cover over a drain crossing point, the new grid connection route will have to be installed underneath the existing drain crossing. To do this the following approach is adopted:
    - The drain is blocked upslope of the crossing and a sump is formed using sandbagging and stable clay soil material. This sump will accumulate water flow in the drain and will facilitate the use of a 50mm or 100mm submersible pump to over pump (fluming) the drain water across the track and back into the drain on the down flow section below the track.

- Two silt fences and filters will be put in place on the downslope of the crossing point to prevent siltation/sedimentation. Once the sump and over-pumping mechanism is in place, then the service trench excavation will progress.
- A section of drain crossing (pipe or stone culvert) is temporarily removed to allow the trench and duct to continue. The duct will pass under the drain and once in place it will be surrounded with lean mix concrete and then the trench will be backfilled with suitable stone from excavations or imported.
- The drain will then be put back in place, surrounded with stone/lean mix concrete and the track restored to its finished level. The over-pumping measure can then be removed and normal drain flow resumes. The duct/trench work can then progress over the remaining length of the access track.

### 3.12.4 Proposed Grid Connection Construction – Existing and Proposed Underground Services

All relevant bodies i.e., ESB Networks, EirGrid, Gas Networks Ireland, Eir, OCC, etc. will be contacted and drawings for all existing underground services along the grid connection route sought. Any underground services encountered will initially be surveyed for levels to determine if there is adequate cover available for ducting to pass over these services. A minimum clearance of 300mm is required from the bottom of the ducting to the top of any underground service as per ESB Networks requirements. If this clearance cannot be achieved, the ducting will pass below the service with a minimum 300mm clearance maintained from the top of the ducting to the bottom of the service.

If the required separation distances cannot be achieved by either going above or below the underground service, then a number of alternative construction options are available as outlined in the previous sections for watercourse and drain crossings.

The proposed underground grid connection route is approximately 8km long and extends from the proposed onsite 110kV substation to the connection point at Philipstown 110 kV substation.

The exact location of the underground HV ducting may be subject to minor modification following confirmatory site investigations, to be undertaken prior to construction and following consultation with OCC and all other relevant stakeholders. This will have regard to all environmental protection measures to be outlined in the relevant planning application and accompanying technical reports. Any such minor modification will be within the relevant future planning boundary.

### 3.12.5 Proposed Grid Connection Construction – Horizontal Directional Drilling

HDD is a construction method of laying a variety of underground utilities (pipelines, cables, etc.), without excavating the ground surface, with minimal impact on the surrounding area. The tools and techniques used in the HDD process have developed from the oil drilling industry and are widely used in water supply, electricity, telecommunications, natural gas, coal, oil and other fields. The method involves the construction of entrance (“Launch”) and exit (“Receiving”) pits at either side of the obstacle and using a directional drilling rig to bore a duct downwards under the obstacle and then back to the surface at the other side.

The method requires the preparation of the launch and receiving pits including the removal of any surface vegetation and levelling with the front bucket of an excavator. Typically, the width of the launch and receiving pits (per bore) are 1m to 1.5m wide and 3m to 4m in length. Their depth is typically 2m and is related with the desired entry angle to bore. A 1m x 1m x 2m steel box is placed in the ground to control drilling fluids return from the borehole. There is no need for removal of topsoil in the general area with the exception of the specific entrance and exit pit requirement. The ground around the pits is typically overlain with a suitable geotextile material and 200mm of appropriate stone for load bearing and traction. The drilling rig and fluid handling units are typically placed on bunded 0.5mm PVC to contain any fluid spills and storm water runoff.

HDD involves drilling a pilot hole from one side of the obstacle to the other side while supporting the bored hole with bentonite fluid. A minimum separation between the bottom of the obstacle (e.g. watercourse bed or rail track) will be 2.5m. The drill bit is oriented by the surveyor, and the driller pushes the drill string into the ground to maintain the bore path. The drilled cuttings are flushed back by the drilling mud flowing via nozzles in the bit, up the annulus to the surface, where they are separated from the fluid fraction for disposal. A comprehensive closed-loop drilling fluid mixing and circulation system with recycling capability is utilised to minimise the volume of fluids required on site. Constant monitoring of fluid volume, pressure, pH, weight and viscosity is undertaken. Constant attention is given to the volume of cuttings produced so that no over cutting takes place and that hole cleaning is maintained. The mud returns are pumped to the circulation system trailer by means of a bunded centrifugal pump.

A steering system, guided by tri-axial magnetometers and accelerometers that provide real time directional information to the surveyor at the driller’s console, is used to navigate the bores. After the completion of the initial pilot hole, it is reamed in a number of passes to reach the required bore size to enable the duct lining to be pulled [usually High-Density Polyethylene (HDPE)]. To ensure that the prevailing geological conditions have suitable cohesion that can maintain the bore during the drilling and reaming process close attention is paid to modelled drag forces during pullback with constant monitoring of load stress undertaken to ensure that modelled tensile stress, collapse pressures, hoop stress and buckling stress are not exceeded.

On completion of the works, the stone and geomembrane are carefully removed using an excavator and removed offsite to an appropriately permitted facility. The launch and receiving pits are then reinstated.

There are limitations in entry angle and radius of curvature for drilling. The advantage with this method is that a number of standalone cable ducts can be provided as required with suitable separation to meet the preferred requirement. Unlike other installation techniques, a key advantage of HDD is that shafts are not required but only launch and receiving pits.

### 3.12.6 Proposed Grid Connection Construction - Joint Bays and Communication Chambers

Joint bays are pre-cast concrete chambers that will be required along the grid connection route over its entire length. They are required to join cables together to form one continuous cable. They will be located at various points along the grid connection route approximately every 500m to 1,000m depending on gradients, bends, etc. It is proposed to install approximately nine joint bays and communication chambers along the Proposed Grid Connection route.

Joint bays associated with the Proposed Grid Connection will be located in public roads.

The joint bays and communication chambers will be either precast or cast *in situ*. In order to place the boxes, the area of excavation will first be marked out on the ground and any necessary preparatory protection measures put in place to avoid any runoff or loss of soil materials. These include appropriate siltation measures (silt fences, check dams, etc.).

The material excavated from the joint bay chambers will be removed from the area to the onsite deposition areas. Prior to the chamber being installed in a compacted layer of suitable stone or lean mix concrete, appropriate material will be placed in the excavation to a level surface. The boxes are then positioned *in situ* and backfilled around them with imported crushed stone material. The precast concrete joint bay chamber cover is then put in place. **Figure 3-22** shows a typical joint bay installation.

**Figure 3-22: Typical Joint Bay Construction**

## 3.13 Decommissioning and Restoration

### 3.13.1 Wind Farm

The Proposed Wind Farm has been designed to have an operational life of 35 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 35 years, the site will be decommissioned and reinstated with all wind turbines and towers removed. Upon decommissioning, all that will remain will be the access tracks. The onsite substation and Proposed Grid Connection will remain in place as part of the permanent electrical infrastructure.

When the Proposed Wind Farm 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 and LiDAR

Unit will also be removed from site. It is likely that where possible, turbine components will be reused as they have a life well in excess of the Proposed Wind Farm. Wind farm components may also be recycled.

Underground cables within the Proposed Wind Farm 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 reforestation or return to grassland by placing topsoil and grass seed. Access tracks 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 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 offsite and disposed of appropriately by a licensed waste operator.

### 3.13.2 Proposed Grid Connection

It is proposed to connect the onsite substation to the national grid via an underground cable ducting network as shown in Figure 3-21. This proposed grid connection does not form part of this planning permission submission. It is anticipated that the grid cable would 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. The ducting will not be removed if the environmental assessment of the decommissioning operation demonstrates that this would do more harm than leaving them in situ. The assessment will be carried out closer to the time to take into account environmental changes over the project life. The removal of the ducts would also cause some limited disruption to road users. Leaving the ducts in place would avoid disruption to road users without compromising the structure of the roadway.

It is also likely the substation would remain in place and would previously have been taken in charge by the system operator, after the wind farm is connected to the national electricity grid.

## 3.14 References

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