4. DESCRIPTION OF THE PROPOSED DEVELOPMENT

4.1 Introduction

This section of the Environmental Impact Assessment Report (EIAR) describes the development and its component parts (the 'Proposed Development') including the works subject of a proposed application for planning permission to Cork County Council. The Proposed Development comprises:

1. *Up to 7 no. wind turbines with an overall blade tip height of up to 178.5 metres and all associated foundations and hard-standing areas;*
2. *2 No. borrow pits;*
3. *1 No. permanent meteorological mast with a maximum height of up to 112 metres;*
4. *Upgrade of existing and provision of new site access roads;*
5. *Upgrade to existing access junction;*
6. *A 38kV electricity substation, including 4 no. battery storage containers, 1 no. control building with welfare facilities, associated electrical plant and equipment, security fencing, wastewater holding tank,*
7. *Forestry Felling;*
8. *A temporary construction compound;*
9. *Site Drainage;*
10. *All associated internal underground cabling, including underground grid connection cabling to the existing overhead line; and*
11. *All associated site development and ancillary works.*

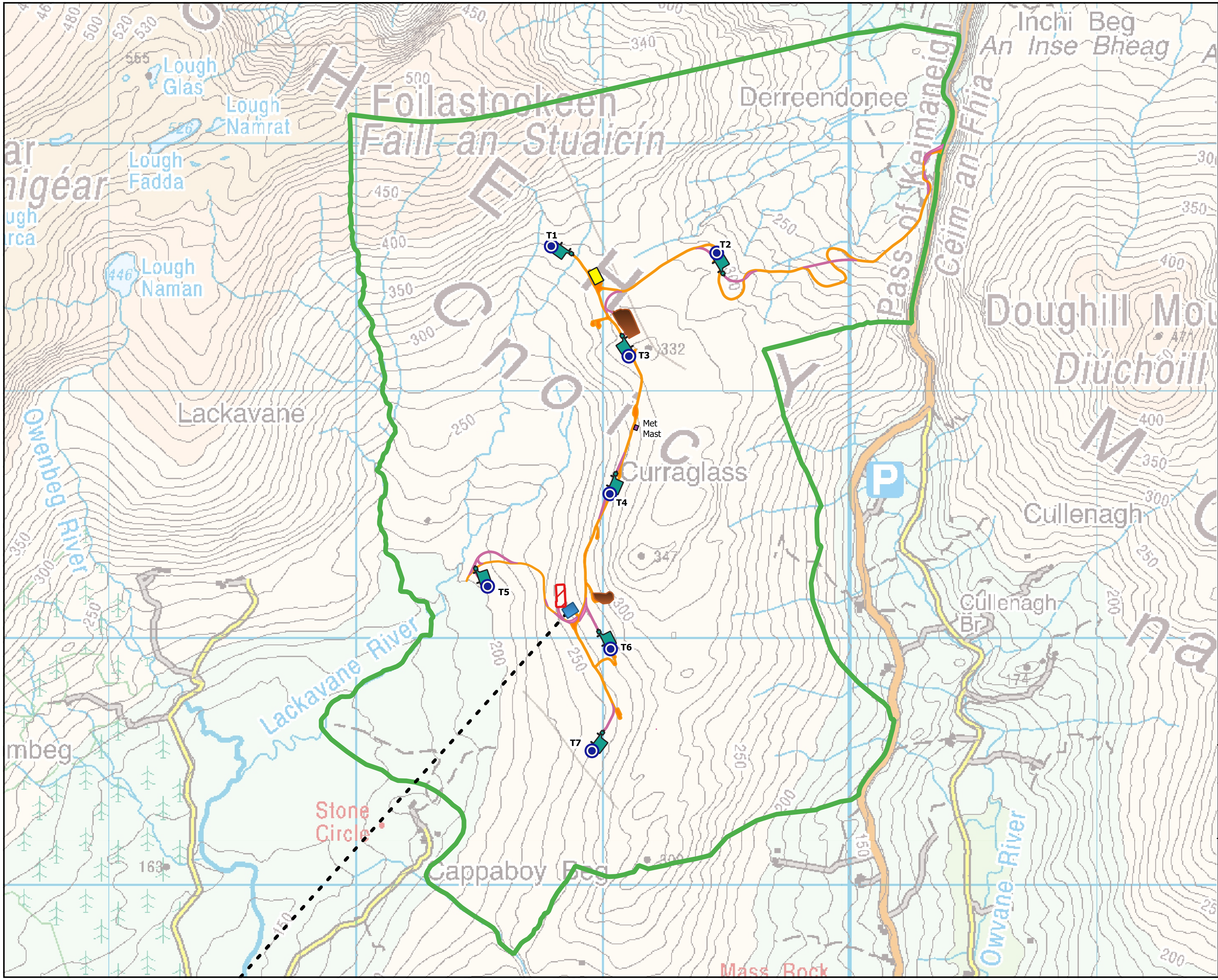
The Proposed Development will have an operational life of 30 years from the date of commissioning of the development and the application seeks a ten-year planning permission.

All elements of the Proposed Development, including the wind turbines, substation and associated battery storage, underground cabling, forestry felling and replanting, have been assessed as part of this EIAR.

4.2 Development Layout

The layout of the Proposed Development has been designed to minimise the potential environmental effects of the development, while at the same time maximising the energy yield from the site. A constraints study, as described in Section 3.3.6 of this EIAR, has been carried out to ensure that turbines and ancillary infrastructure are located in the most appropriate areas of the site. The Proposed Development layout makes maximum use of the existing access tracks within the site.

The overall layout of the Proposed Development is shown on Figure 4-1. This figure shows the proposed locations of the wind turbines and associated hardstand areas, electricity substation and associated battery storage compound, underground cabling, borrow pits, construction compound and access roads. Detailed site layout drawings of the Proposed Development are included in Appendix 4-1 to this EIAR.



Map Legend

- EIAR Site Boundary
- Proposed Turbine Locations
- Existing Roads - Upgrade Proposed
- Proposed New Site Roads
- Current Substation Location
- Existing Overhead Line to Ballylickey
- Proposed Temporary Construction Compound
- Proposed Hardstanding
- Proposed Substation
- Proposed Borrow Pits
- Proposed Met Mast Location

N

Drawing Title: Proposed Site Layout	
Project Title: Curraglass Renewable Energy Development, Co. Cork	
Drawn By: Órla Murphy	Checked By: Michael Watson
Project No.: 190301	Drawing No.: 4-1
Scale: 1:20000	Date: 19.06.2020

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4.3 Development Components

4.3.1 Wind Turbines

4.3.1.1 Turbine Locations

The proposed wind turbine layout has been optimised using wind farm design software (WindPro by ReSoft) to maximise the energy yield from the site, while maintaining sufficient distances between the proposed turbines to ensure turbulence and wake effects do not compromise turbine performance. The Grid Reference coordinates of the proposed turbine locations are listed in Table 4-1 below. The final ground level of the turbine foundations will be determined by the actual ground conditions at each proposed turbine location and may differ slightly from those levels listed in Table 4-1. Also, in accordance with the '*Wind Energy Development Guidelines for Planning Authorities*' (Department of the Environment, Heritage and Local Government (DOEHLG), 2006) micro-siting of the turbine positions may be required within the criteria set out in the guidelines.

Table 4-1 Proposed Wind Turbine Locations and Elevations

Turbine	ITM Coordinates		Top of Foundation Elevation (m OD)
	Easting	Northing	
1	508763	563650	319
2	509433	563623	302
3	509077	563204	328
4	509000	562646	296
5	508505	562272	206
6	509003	562019	273
7	508927	561606	251

4.3.1.2 Turbine Type

Wind turbines use the energy from the wind to generate electricity. A wind turbine, as shown in Plate 4-1 below, consists of four main components:

- Foundation unit
- Tower
- Nacelle (turbine housing)
- Rotor

Plate 4-1 Wind turbine components

The proposed wind turbines will have a tip height of up to 178.5 metres. Within this size envelope, various configurations of hub height, rotor diameter and ground to blade tip height may be used. The exact make and model of the turbine will be dictated by a competitive tender process, but it will not exceed a tip height of up to 178.5 metres. Modern wind turbines from the main turbine manufacturers have evolved to share a common appearance and other major characteristics, with only minor cosmetic differences differentiating one from another. The wind turbines that will be installed on the site will be conventional three-blade turbines, that will be geared to ensure the rotors of all turbines rotate in the same direction at all times. The turbines will be grey matt in colour (RAL7035 or similar).

Turbine design parameters have a bearing on the assessment of shadow flicker, noise, visual impact, traffic and transport and ecology (specifically birds), as addressed elsewhere in this EIAR. In each EIAR section that requires the consideration of turbine parameters as part of the impact assessment, the turbine design parameters that have been used in the impact assessment are specified.

At the turbine selection stage of the project, pre-construction, new turbines models or variants may be available that were not on the market at the pre-planning and EIAR preparation stage, which would better suit the site and fit within the proposed size envelope. Should this circumstance arise, the specific parameters of the new turbines will be assessed for their compliance with the criteria set out and considered in this EIAR, the relevant guidance in place at the time and any conditions that may be attached to any grant of planning permission that might issue.

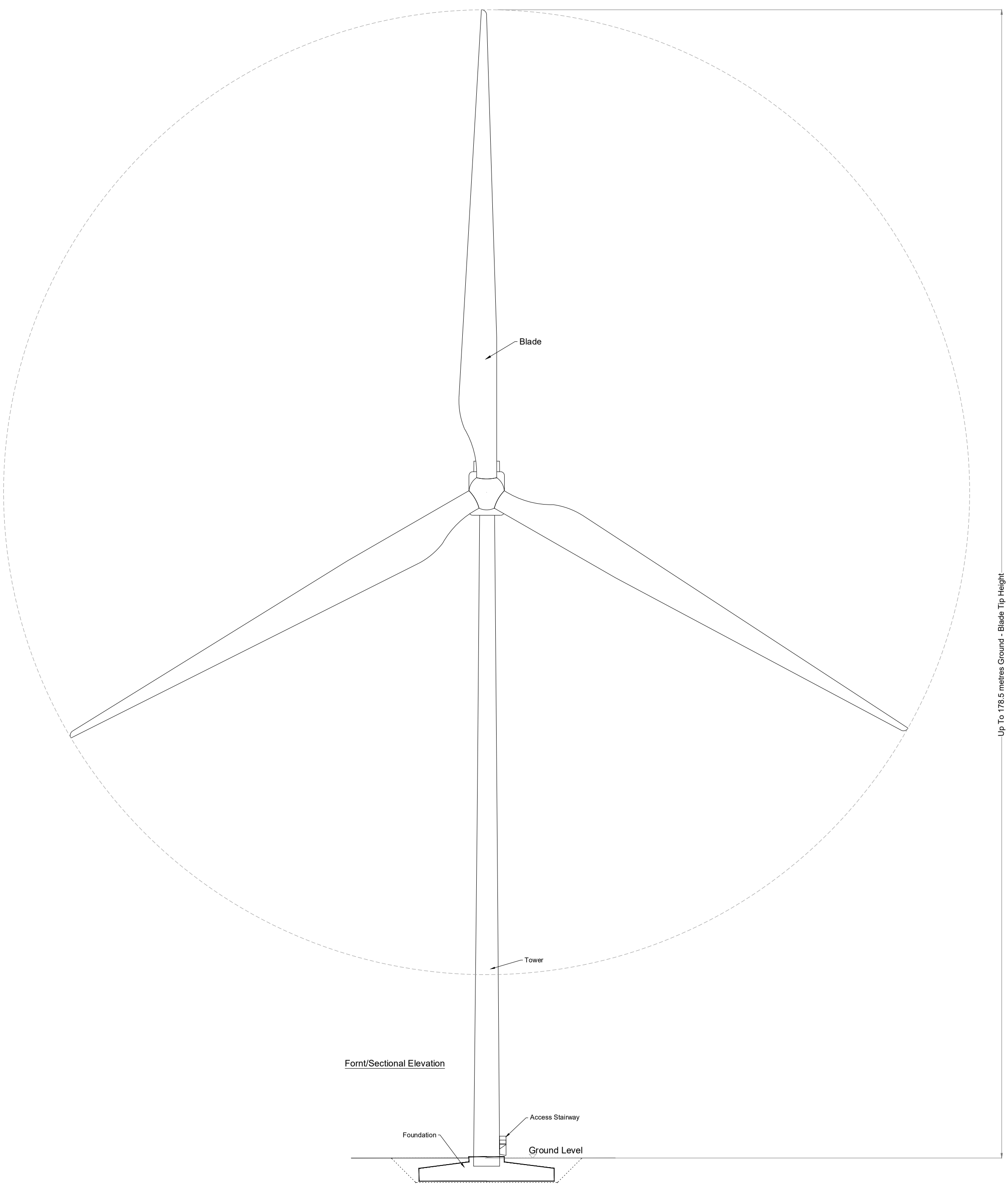
A drawing of the proposed wind turbine is shown in Figure 4-2. The individual components of a typical geared wind turbine nacelle and hub are shown in Figure 4-3 below.

Drawing Notes

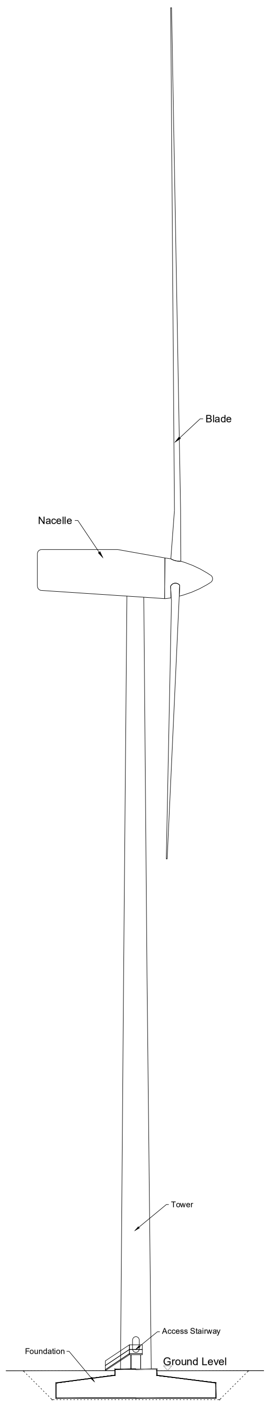
1. Proposed wind turbines to have a maximum ground to blade tip height of up to 178.5m.

2. Exact make and model of the turbine to be dictated by a competitive tender process.

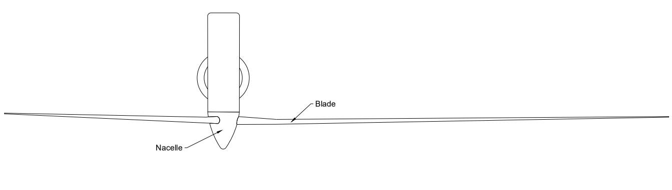
3. Installed wind turbine not to exceed maximum size envelope set out above in any blade length and hub-height configuration.



Front/Sectional Elevation



Side/Sectional Elevation



Plan

Figure 4-2

DRAWING TITLE:
Wind Turbine Elevation & Plan

PROJECT TITLE: Curraglass Renewable Energy Development, Co. Cork

DRAWING BY: **Joseph O Brien**	CHECKED BY: **Orla Murphy**
PROJECT No.: **190301**	DRAWING No.: **190301 - 20**
SCALE: **1:500 @A2**	DATE: **30.06.2020**

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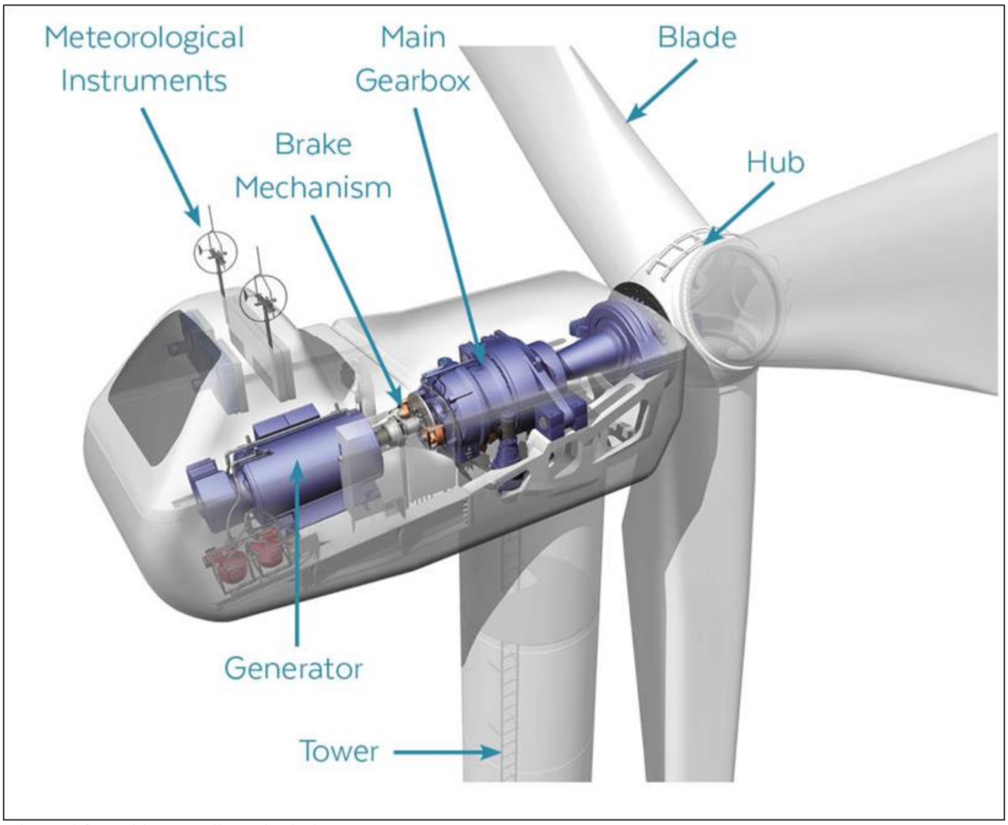

Figure 4-3 Turbine nacelle and-5 hub components

Figure 4-4 shows a typical turbine base layout, including turbine foundation, hard standing area, assembly area, access road and surrounding works area.

Drawing Notes

1. Typical Layout, final dimensions and configuration will be based on manufacturer's specifications

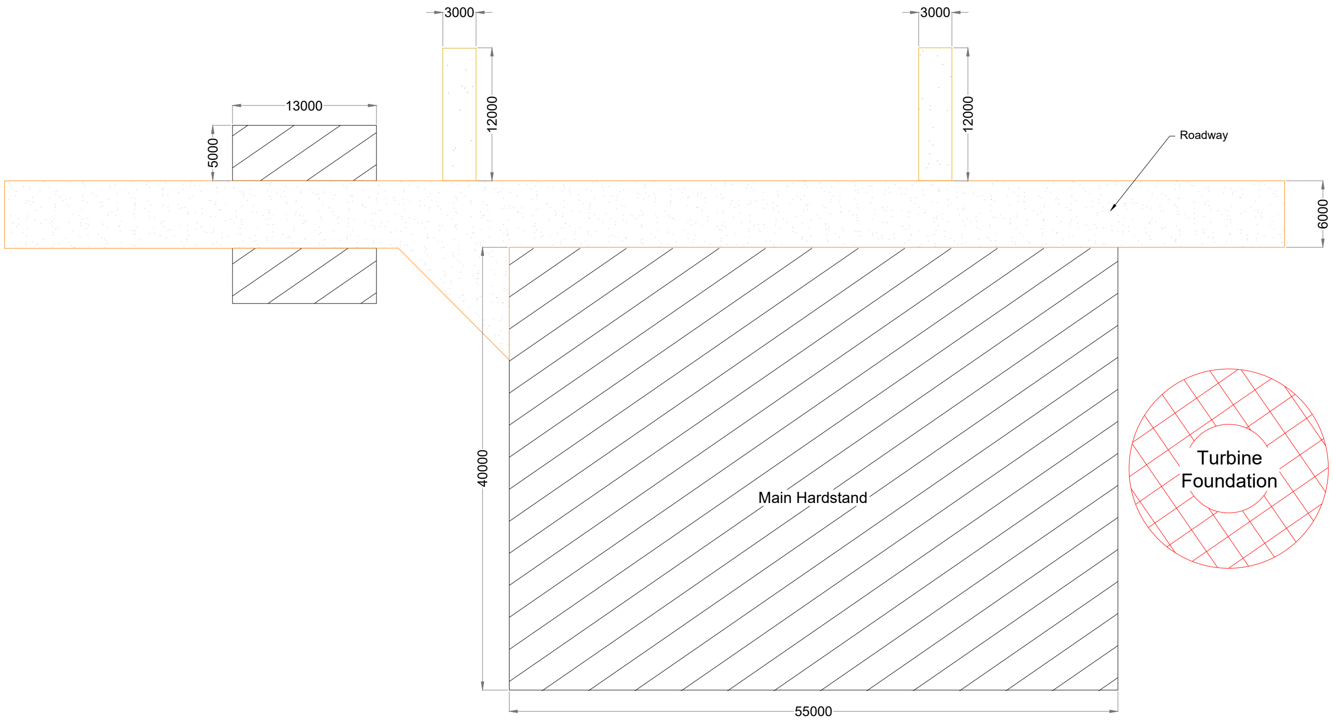

Figure 4-4

DRAWING TITLE:
Typical Turbine Hardstand Layout Standard Detail

PROJECT TITLE: Curraglass Renewable Energy Development, Co. Cork

DRAWING BY: **Joseph O Brien**	CHECKED BY: **Orla Murphy**
PROJECT No.: **190301**	DRAWING No.: **190301 - 19**
SCALE: **1:500 @A3**	DATE: **30.06.2020**

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4.3.1.3 Turbine Foundations

Each wind turbine is secured to a reinforced concrete foundation that is installed below the finished ground level. The size of the foundation will be dictated by the turbine manufacturer, and the final turbine selection will be the subject of a competitive tender process. Different turbine manufacturers use different shaped turbines foundations, ranging from circular to hexagonal and square, depending on the requirements of the final turbine supplier. The turbine foundation transmits any load on the wind turbine into the ground. The typical horizontal and vertical extent of a turbine's foundation is shown in Figure 4-2.

After the foundation level of each turbine has been formed using piling methods or on competent strata, the bottom section of the turbine tower "Anchor Cage" is levelled and reinforcing steel is then built up around and through the anchor cage (Plate 4-2 below). The outside of the foundation is shuttered with demountable formwork to allow the pouring of concrete and is backfilled accordingly with appropriate granular fill to finished surface level (Plate 4-3 below).

Plate 4-2 Turbine Base 'Anchor Cage'

Plate 4-3 Finished turbine base

4.3.1.4 Hard Standing Areas

Hard standing areas consisting of levelled and compacted hardcore are required around each turbine base to facilitate access, turbine assembly and turbine erection. The hard-standing areas are typically used to accommodate cranes used in the assembly and erection of the turbine, offloading and storage of turbine components, and generally provide a safe, level working area around each turbine position. The hard-standing areas are extended to cover the turbine foundations once the turbine foundation is in place. The sizes, arrangement and positioning of hard standing areas are dictated by turbine suppliers. The hard-standing area is intended to accommodate a crane during turbine assembly and erection. The proposed hard standing areas shown on the detailed layout drawings included in Appendix 4-1 to this report are indicative of the sizes required, but the extent of the required areas at each turbine location may be optimised on-site depending on topography, position of the site access road, the proposed turbine position and the turbine supplier's exact requirements.

4.3.1.5 Assembly Area

Levelled assembly areas will be located on either side of the hardstanding area as shown on Figure 4-4. These assembly areas are required for offloading turbine blades, tower sections and hub from trucks until such time as they are ready to be lifted into position by cranes and to assist the main crane during turbine assembly. The exact location and number of assembly areas will be determined by the selected turbine manufacturer.

4.3.1.6 Power Output

The wind turbines available within the proposed size envelope will have a potential generating capacity in the 3 to 5 Megawatts (MW) range. Turbines of the exact same make, model and dimensions can have different power outputs depending on the capacity of the electrical generator installed in the turbine nacelle. The exact power rating of the installed turbine will be designed to match the wind regime on the site and will be determined by the selected manufacturer.

A rated output of 4.3 MW has been assumed throughout this document for various calculations, the exact output of the installed turbine may be less than or greater than this figure, however 4.3 MW represents a reasonable average output for modern turbines within the proposed size envelope. This results in an estimated installed capacity of 30 MW. Assuming an installed capacity of 30 MW, the Proposed Development therefore has the potential to produce up to 91,980 MWh (megawatt hours) of electricity per year, based on the following calculation:

A x B x C = Megawatt Hours of electricity produced per year

where: A = …… The number of hours in a year: 8,760 hours

B = …… The capacity factor, which takes into account the intermittent nature of the wind, the availability of wind turbines and array losses etc. A capacity factor of 35% is applied here

C = …… Rated output of the wind turbines: 30 MW

The 91,980 MWh of electricity produced by the Proposed Development would be sufficient to supply approximately 21,900 Irish households with electricity per year, based on the average Irish household using 4.2 MWh of electricity[1] (this latest figure is available from the March 2017 CER Review of Typical Consumption Figures Decision).

The 2016 Census of Ireland recorded a total of 209,558 occupied households in Co. Cork. Per annum, the Proposed Development would therefore produce sufficient electricity for the equivalent of approximately 10.5% of all households in Co. Cork.

4.3.2 Site Roads

4.3.2.1 Road Construction Types

To provide access within the site of the Proposed Development and to connect the wind turbines and associated infrastructure existing tracks will need to be upgraded and new access roads will need to be constructed. The road construction preliminary design has taken into account the following key factors:

1. *Buildability considerations*
2. *Serviceability requirements for construction and wind turbine delivery and maintenance vehicles*
3. *Minimise excavation arisings*
4. *Requirement to minimise disruption to peat hydrology*

Whilst the above key factors are used to determine the road design the actual construction technique employed for a particular length of road will be determined on the prevailing ground conditions encountered along that length of road.

4.3.2.1.1 *Construction of New Excavated Roads*

The general methodology to construct new founded roads (i.e. See Detail A of the typical road construction detail drawings presented in Appendix 4-4) is presented below.

1. *Excavation of the new access road to competent strata (see Section 5 of Appendix 4-4 for guidance on the correct handling and storage the different peat layers).*

[1] *March 2017 CER (CRU) Review of Typical Consumption Figures Decision* https://www.cru.ie/document_group/review-of-typical-consumption-figures-decision-paper/

a. *For excavations in overburden and peat, side slopes shall not generally be greater than 1(V): 2 or 3(H), respectively. Slacker slopes may be required if localised areas of weaker peat are encountered.*
b. *Drainage shall be installed to divert surface and groundwater from the construction areas.*
    2. *Placement of granular fill in layers following the designer's specification (typically 200mm, but which will be subject to detailed design).*
    3. *Access roads to be finished with a layer of capping across the full width of the road.*
a. *A layer of geogrid/geotextile may be required at the surface of the existing access road following the designer's specification.*

The presence of excavations can destabilise the road. Temporary excavations, where required, should be excavated in short lengths and backfilled as soon as practicable.

Spoil materials can be side-cast on the upslope side of roads only, where slope and ground conditions allow. Side cast materials should be placed to heights of typically 1m and widths of 2 to 3m unless specific site-specific designs allow larger volumes of to be placed. Large stockpiles of materials shall not be placed on or adjacent to floated access roads. This is to avoid bearing failure of the underlying peat.

Particular buffer areas have been highlighted in the peat stability risk assessment report prepared by GDG (2020) for this development (Ref: 19162-002) and are shown presented in Appendix A.

These consist of:

- Safety buffer 01 and 02 – areas which will be construction buffer zones
- Peat stockpile restriction 01, 02 and 03 – areas that shall not be used for stockpiling of peat or any overburden materials.

4.3.2.1.2 Upgrade of Existing Access Roads or Tracks

The general methodology to upgrade existing founded roads (i.e. See Detail B of the typical road construction detail drawings presented in Appendix B) is presented below.

    1. *Excavation on one or both sides of the existing access road to competent strata.*
a. *For excavations in peat and overburden, side slopes shall not generally be greater than 1(V): 2 or 3(H), respectively. Slacker slopes will be required where areas of weaker peat are encountered.*

    2. *Benching of existing road and placement of granular fill in layers, following the designer's specification.*

    3. *Overlay of the existing access road with selected granular fill following the designer's specification.*
a. *Where coarse granular fill has been used in the existing floated access road make-up, a layer of geogrid should be placed on top of the existing floated access road.*

    4. *Access roads to be finished with a layer of capping across the full width of the road.*
a. *A layer of geogrid/geotextile may be required at the surface of the existing access road following the designer's specification.*

The general methodology to upgrade existing floating roads (i.e. See Detail C of the typical road construction detail drawings presented in Appendix B) is presented below. As noted, it is not anticipated that this will be necessary on site, but is included to account for the unlikely case that this construction is found to be necessary during detailed design or construction.

1. *Placement of tree brash and/or a geotextile onto on one or both sides of the existing access road directly onto the peat surface, following the designer's specification.*

2. *Benching of existing road and placement of granular fill and reinforcing geogrids in layers following the designer's specification, with due regard to any settlement of peat anticipated for the widened area.*
   a. *It may be necessary to stage the widening to maintain peat stability – i.e. to reduce rate of placement of fill to allow the peat layers to consolidate and increase in strength.*
   b. *It may be necessary to anchor the geogrids into the existing roads which would require significant benching of existing roads.*

3. *Overlay of the existing access road with selected granular fill following the designer's specification.*
   a. *Where coarse granular fill has been used in the existing floated access road make-up, a layer of geogrid should be placed on top of the existing floated access road.*
   b. *The surface of the existing access road should be graded/levelled before the placement of any geogrid/geotextile, where necessary (to prevent damaging the geogrid/geotextile).*

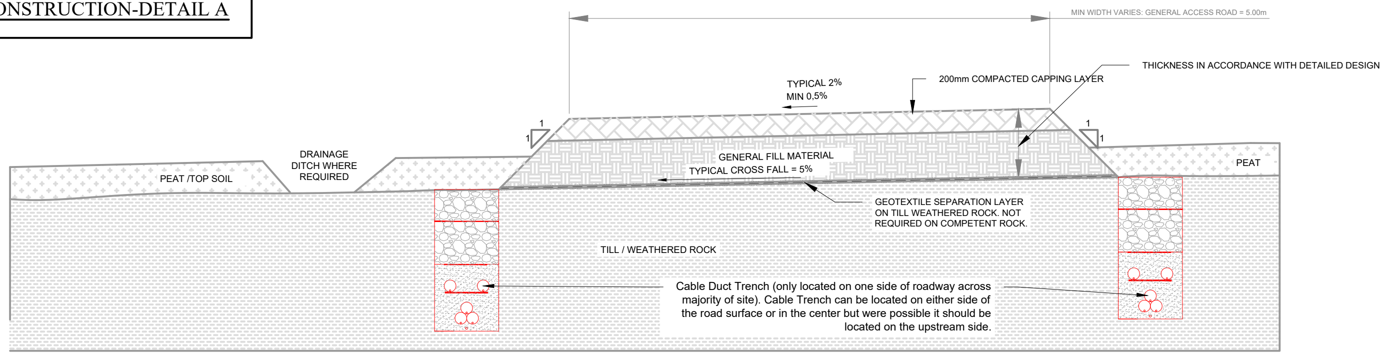
4. *Access roads to be finished with a layer of capping across the full width of the road.*
   a. *A layer of geogrid/geotextile may be required at the surface of the existing access road following the designer's specification.*

Where there are cross slopes, any road widening works required should be carried out on the upslope side of the existing access road, where possible. Particular design details will be required at detailed design at the transitions between floating and founded roads to smooth out differentials settlements between the two construction types.

Typical sections of existing excavated and floated road for upgrade are shown in Figure 4-5.

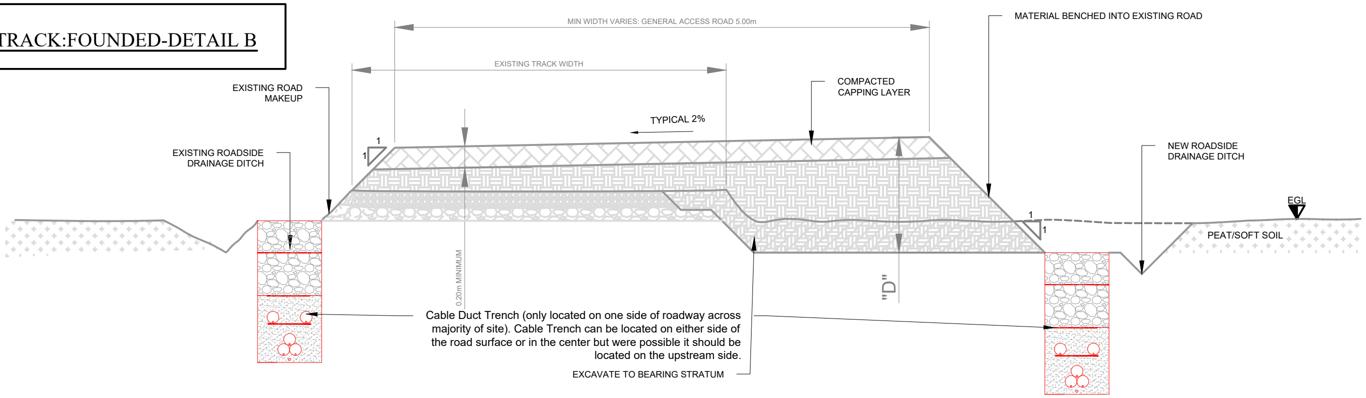
TYPICAL SECTON THROUGH ACCESS ROADS NEW CONSTRUCTION-DETAIL A

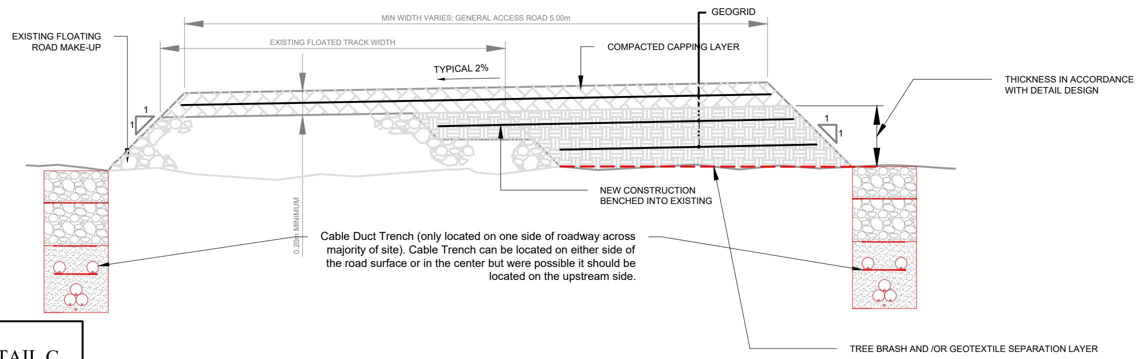
SCALE 1:50



TYPICAL CROSS SECTON WIDENING OF EXISTING TRACK:FOUNDED-DETAIL B

SCALE 1:50





TYPICAL CROSS SECTON WIDENING OF EXISTING TRACK:FLOATED-DETAIL C

SCALE 1:50

NOTES:

1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED
2. USE DIMENSIONS ON DRAWINGS (DO NOT SCALE FROM DRAWINGS).
3. THE STRENGTH OF THE SUBFORMATION SOILS MUST BE ASSESSED BY A SUITABLY QUALIFIED GEOTECHNICAL ENGINEER PRIOR TO PLACEMENT OF FILL.
4. DRAINAGE TO BE PROVIDED TO PREVENT WATER DEGRADATION OF THE SUBFORMATION SOILS.

HEALTH & SAFETY:

1. NO OPERATIVES TO ACCESS ANY UNSUPPORTED TRENCHES. TRENCHES TO BE ADEQUATELY BATTERED BACK OR SUPPORTED WHERE NECESSARY. SAFE TEMPORARY BATTER ANGLES TO BE ASSESSED IN ACCORDANCE WITH CIRIA REPORT 97 "TRENCHING PRACTICE".

Figure 4-5

REV: FI -01	DATE: 29/05/20	DRAWN BY: CJM	CHECKED BY: LB
DESCRIPTION:	ISSUED FOR INFORMATION		
REV: FI -00	DATE: 15.04.20	DRAWN BY: CJM	CHECKED BY: LB
DESCRIPTION:	ISSUED FOR INFORMATION		

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ISSUED AS: FOR INFORMATION

CLIENT: MKO

PROJECT TITLE: CURRAGLASS RENEWABLE ENERGY DEVELOPMENT

DRAWING No: 19162-GDG-XX-XX-DR-G-0002

DWG No.190301 - 21 | Revision: -FI -01

DRAWING TITLE: TYPICAL SECTION THROUGH GENERAL ACCESS TRACK DETAILS

SCALE: SHOWN	SHEET SIZE: A3	DATE: 24/06/2020
DRAWN BY: CJM	CHECKED BY: L.B	APPROVED BY: P.Q.

4.3.3 Borrow Pit

4.3.3.1 Description

It is proposed to develop 2 No. on-site borrow pit as part of the Proposed Development. It is proposed to obtain the majority of all rock and hardcore material that will be required during the construction of the Proposed Development from the on-site borrow pits. Usable rock may also be won from other infrastructure construction including the substation and the turbine base excavations.

The location of the borrow pits are shown on Figure 4-1 and on the detailed site layout drawings included as Appendix 4-1 to this EIAR. Borrow Pit 1 is located approximately 70 metres northeast of Turbine No. 3 and measures approximately 7,254 square meters in area. Borrow Pit 2 is located further south within the site, approximately 180 metres north of Turbine No. 6 and measures approximately 2828 square meters in area. It is intended that all hardcore materials required for the construction of the Proposed Development will be won on-site.

Figure 4-6 below shows detailed sections through the proposed borrow pits. The borrow pits will, on removal of all necessary and useful rock, be reinstated with any surplus excavated peat and subsoils as described in Section 4.3.4 below.

Post-construction, should the borrow pit areas not be completely backfilled it will be permanently secured and a stock-proof fence will be erected around the borrow pit area to prevent access. Appropriate health and safety signage will also be erected on this fencing and at locations around the fenced area.

Hardcore materials will be extracted from the borrow pits (and other infrastructure locations, if necessary), principally by means of rock breaking. Depending on the hardcore volume requirements, blasting may also be used as a more effective rock extraction method, capable of producing significant volumes of rock in a matter of milliseconds. Blasting will only be carried out after notifying all relevant parties/bodies and agreed with the Planning Authority. The potential noise and vibration impact on sensitive receptors associated with the rock extraction measures, detailed below, are assessed in Chapter 11 of this EIAR.

The two proposed extraction methods are detailed below.

4.3.3.2 Rock Extraction Methods

The extraction of rock from the borrow pits are a workstage of the Proposed Development which will be a temporary operation run over a short period of time relative to the duration of the entire project. Where there is a layer of overburden present within the borrow pit areas, it will be stripped back and stockpiled using standard track mounted excavators. Two extraction methods have been assessed for breaking out the useful rock below; rock breaking and blasting.

4.3.3.2.1 *Rock Breaking*

Weathered or brittle rock can be extracted by means of a hydraulic excavator and a ripper attachment. This is a common extraction methodology where fragmented rock is encountered as it can be carefully excavated in layers by a competent operator. In areas where rock of a much higher strength is encountered and cannot be removed by means of excavating then a rock breaking methodology may be used. Where rock breaking is required, a large hydraulic 360-degree excavator with a rock breaker attachment is typically used. Given the power required to break out tight and compact stone at depth, the machines are generally large and in the 40-60 tonne size range. Even where rock might appear weathered or brittle at the surface, the extent of weathering can quickly diminish with depth resulting in strong rock requiring significant force to extract it at depths of only a few metres.

A large rock breaking excavator progressively breaks out the solid rock from the ground in the borrow pit area. The large rock breaker is typically supported by a smaller rock breaker which can often be in the 30-40 tonne size range, and works to break the rocks down to a size that they can be fed into a crusher.

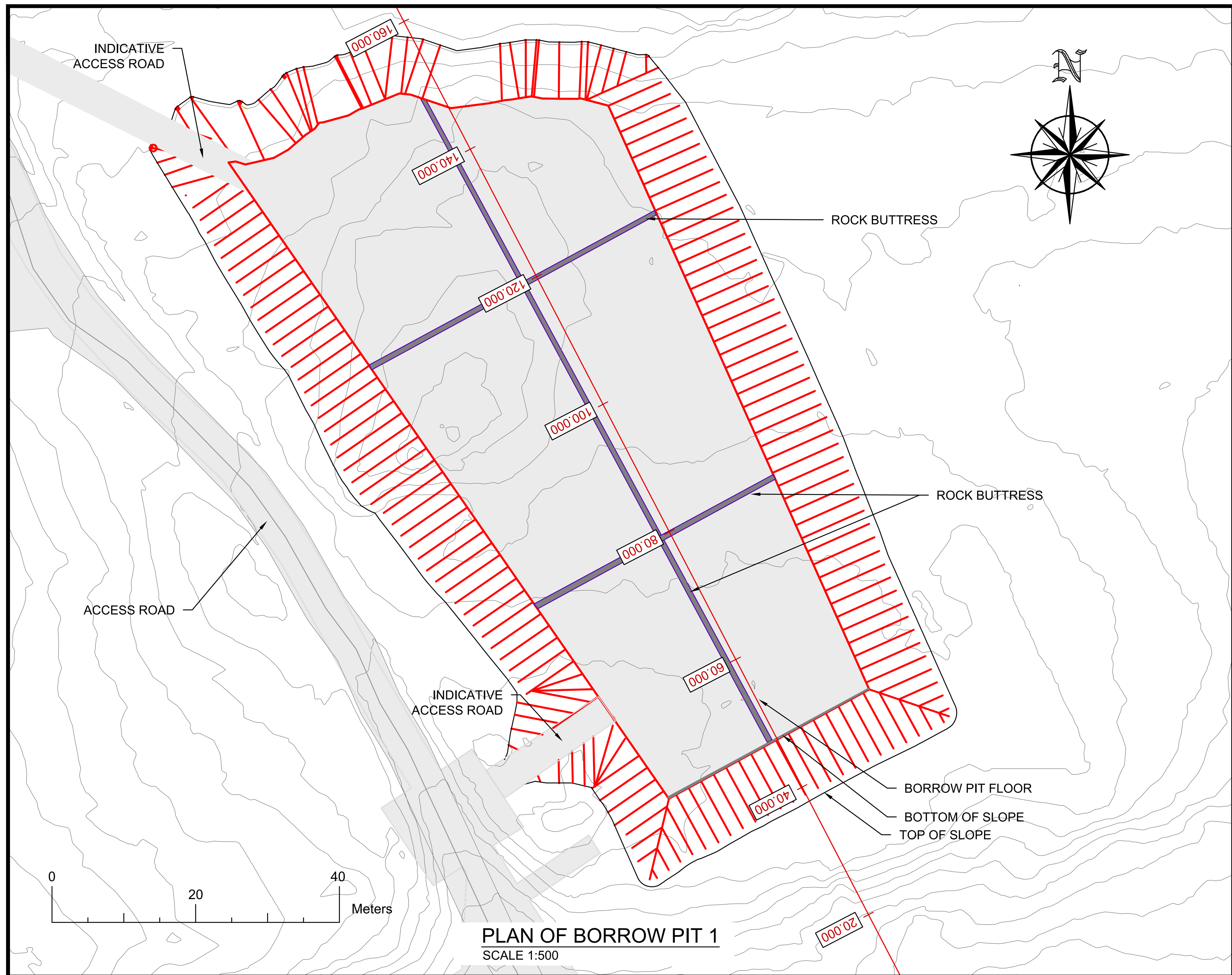
The extracted broken rock is typically loaded into a mobile crusher using a wheeled loading shovel, and crushed down to the necessary size of graded stone required for the on-site civil works. The same wheeled loader takes the stone from the crusher conveyor stockpile, and stockpiles it elsewhere away from the immediate area of the crusher until it is required elsewhere on the site of the Proposed Development.

4.3.3.2.2 Rock Blasting

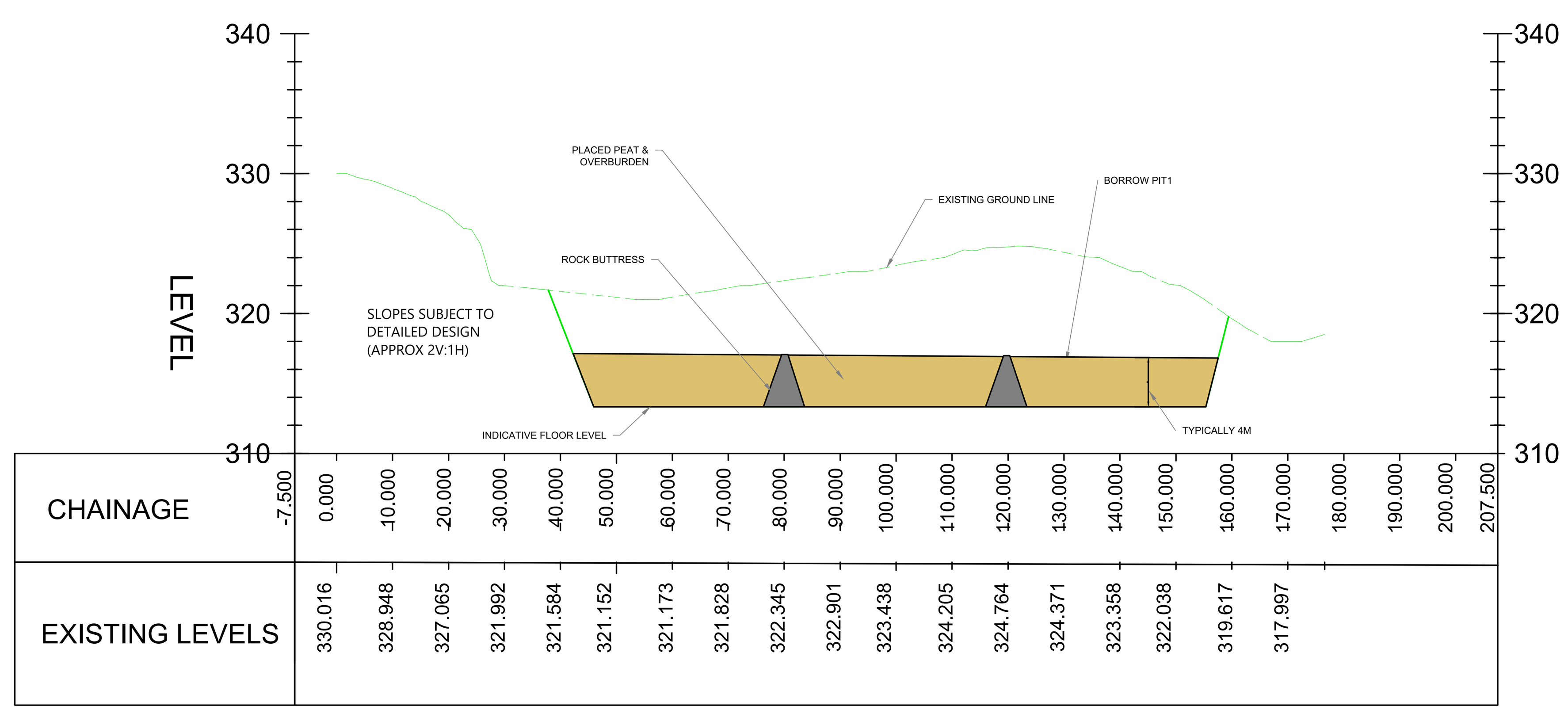
Where blasting is used as an extraction method, a mobile drilling rig is used to drill vertical boreholes into the area of rock that is to be blasted. The drilling rigs used are normally purpose built, self-propelled machines, designed specifically for drilling blast boreholes. A drilling rig working for 3-4 days would typically drill the necessary number of boreholes required for a single blast. The locations, depth and number of boreholes are determined by the blast engineer, a specialist role fulfilled by the blasting contractor that would be employed to undertake the duties. Where blasting is employed as the extraction method, it is more efficient to increase the depth of the excavation and thus minimise the excavation footprint.

The blast engineer would arrange for the necessary quantity of explosive to be brought to site to undertake a single blast. The management of explosives onsite and the actual blasting operation would be agreed in advance with and supervised by An Gardaí Siochána. The blast engineer sets the explosives in place in the boreholes, sets the charges, and fires the blast. The blast takes only a matter of milliseconds.

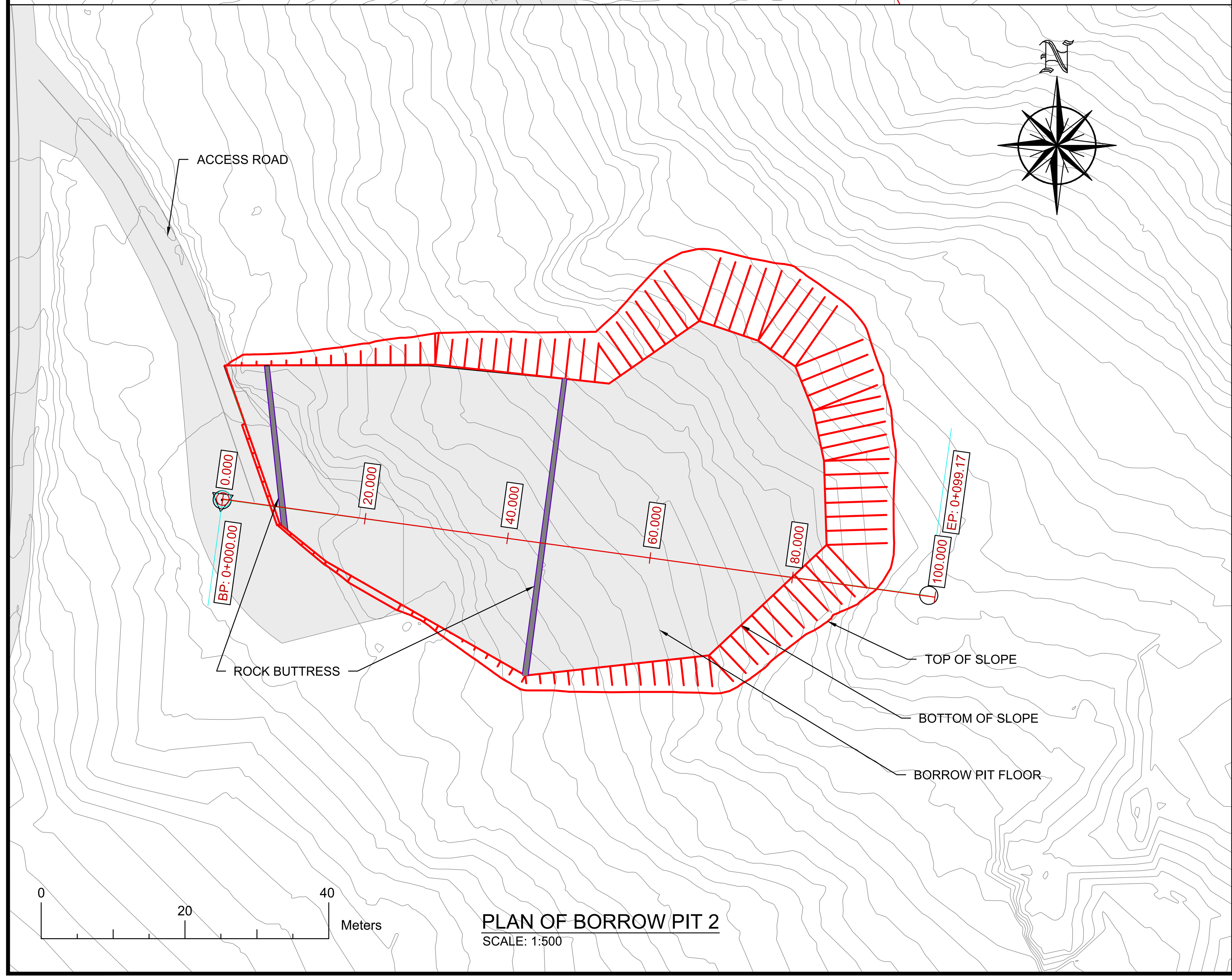
A properly designed blast should generate rock of a size that can be loaded directly into a mobile crusher, using the same wheeled loader description outlined above. From that point on, the same method is used for processing the rock generated from a blast, as would be used to process rock generated by rock breaking. It would be likely that a drilling rig would recommence drilling blast holes for the next blast as soon one blast finished. The potential impacts associated with noise are assessed in Chapter 11 Noise.



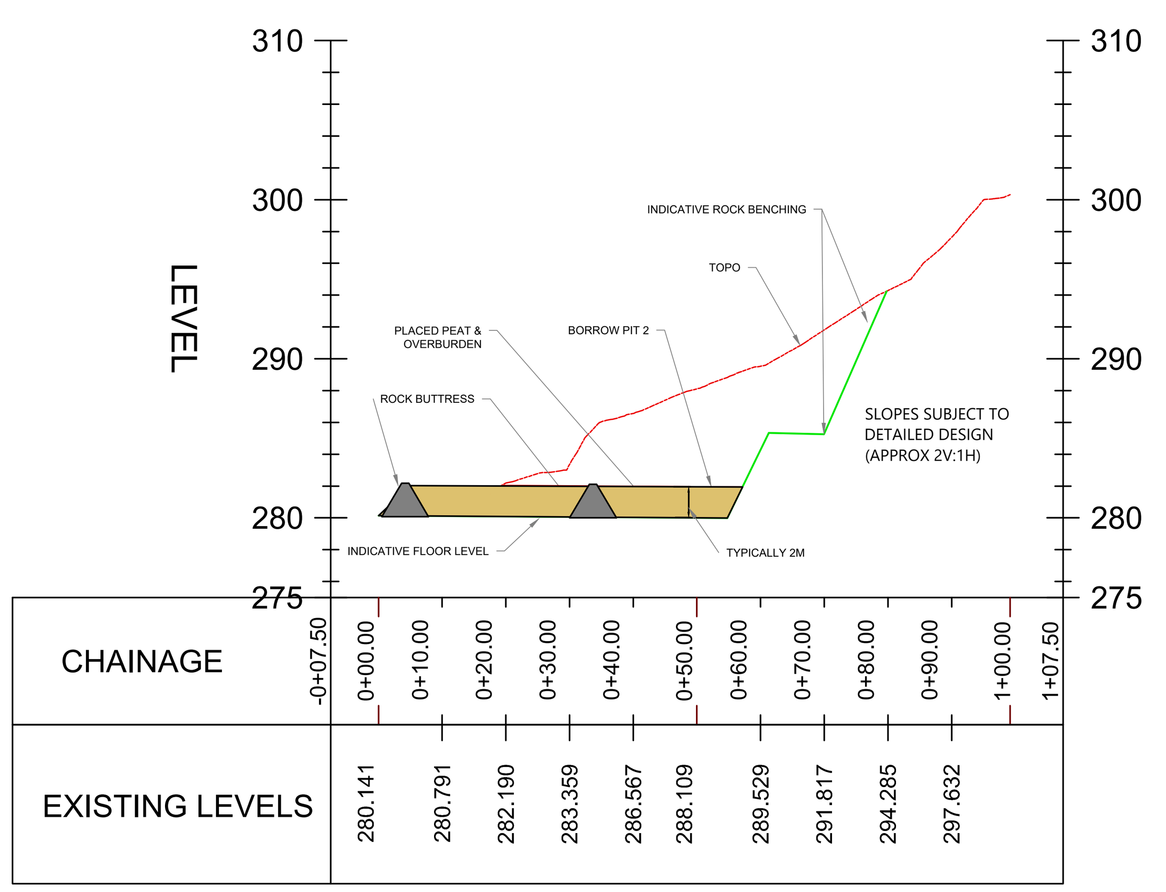
PLAN OF BORROW PIT 1
SCALE 1:500



INDICATIVE LONG SECTION OF BORROW PIT 1
SCALE Horizontal: 1:250, Vertical: 1:50



PLAN OF BORROW PIT 2
SCALE: 1:500



INDICATIVE LONG SECTION OF BORROW PIT 2
SCALE Horizontal: 1:250, Vertical: 1:50

NOTES:

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ENGINEER'S DRAWINGS AND SPECIFICATIONS.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
3. THE OUTLINE AND CROSS SECTIONS ARE INDICATIVE AND ARE SUBJECT TO DETAILED DESIGN AND SLOPE STABILITY ASSESSMENT.
4. EXPOSED ROCK SLOPES SHALL BE FORMED AT SHALLOWER INCLINATIONS (TYPICALLY 60°) WITH FACE LEFT IRREGULAR WITH DECLIVITIES TO PROMOTE RE-VEGETATION AND PROVIDE A NATURALISTIC APPEARANCE (SLOPE FACE EXAGGERATED IN SECTION).
5. ENGINEERED ROCK BUTTRESS MAY BE LEFT IN-SITU TO RESTRAIN CELLS OF PLACED PEAT OVERBURDEN.
6. EXCAVATION SHOULD BE OPTIMISED TO AVOID AREAS OF DEEPER PEAT.
7. IN-SITU ROCK SLOPE SHALL BE FORMED AT STABLE INCLINATIONS TO SUIT LOCAL ROCK CONDITIONS AND SUBJECT TO DETAILED DESIGN.
8. GEOGRID TO BE PLACED TO STRENGTHEN SURFACE OF PLACED PEAT & SPOIL, AS REQUIRED.
9. THE LOCATION OF THE ROCK BUTTRESSES SHOWN FOR THE BORROW AREAS ARE INDICATIVE ONLY AND MAY CHANGE SUBJECT TO LOCAL CONDITIONS ENCOUNTERED ON SITE DURING CONSTRUCTION.
10. THE EXCAVATABILITY OF THE ROCK AND DEPTH TO TOP OF ROCK WITHIN EACH OF THE BORROW AREAS WILL NEED TO BE DETERMINED FROM A GROUND INVESTIGATION.

LEGEND:

REV: FI -01	DATE: 29/05/20	DRAWN BY: CJM	CHECKED BY: LB
DESCRIPTION:	ISSUED FOR INFORMATION		
REV: FI -00	DATE: 22.04.20	DRAWN BY: CJM	CHECKED BY: LB
DESCRIPTION:	ISSUED FOR INFORMATION		

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ISSUED AS: FOR INFORMATION

CLIENT: MKO

PROJECT TITLE: CURRAGLASS RENEWABLE ENERGY DEVELOPMENT

DRAWING No: 19162-GDG-XX-XX-DR-C-0001

Revision: -FI -01

DRAWING TITLE: Figure 4-6 - BORROW PITS PLAN AND CROSS SECTION

SCALE: 1:250	SHEET SIZE: A1	DATE: 22/04/2021
DRAWN BY: CJM	CHECKED BY: L.B	APPROVED BY: L.B.

4.3.4 Peat and Spoil Management Plan

4.3.4.1 Quantities

The quantity of peat and spoil requiring management on the site of the Proposed Development has been calculated, as presented in Table 4-2 below.

Table 4-2 Peat and Spoil Volumes Requiring Management

Infrastructure Item	Area (m^2) (approx.)	Excavated volume – Peat (m^3)	Excavated volume – Spoil (m^3)
New Access Roads (including cable trench)	2,531	13,000	8,500
Turbine foundations and crane hardstandings	22,372	8,000	5,400
Compound hardstanding	2,399	100	100
Substation and Battery Storage	3,156	800	0
Met Mast hardstanding	300	200	50
Borrow Pit 1 and 2	10,083	3,400	0
Total		25,500	14,050

4.3.4.2 Peat and Spoil Usage in Restoration of Borrow Pit

Once the required volume of rock has been extracted from the borrow pit areas, it is intended to reinstate these areas with any surplus peat and overburden excavated from the works areas of the Proposed Development.

As rock is being extracted from the borrow pit, upstands of rock will be left in place, depending on the type of rock, to act as intermediate retaining buttresses. Where this is not achievable, stone buttresses will be constructed within the borrow pit. The upstands or buttresses will form individual restoration areas within the borrow pit which will be filled once the required volume of rock has been extracted from each individual area. The buttresses will be wide enough to allow construction traffic access for the tipping of peat and spoil into the individual cells.

A temporary access track will be placed around the perimeter of the borrow pit area to allow for the tipping of material over the edge of the borrow pit area. The placement of peat and spoil within the borrow pits will likely require the use of long reach excavators, low ground pressure machinery and possibly bog mats in particular for drainage works.

The following particular recommendations/best practice guidelines for the placement of peat & in borrow pits should be considered and taken into account during construction.

- Where possible, the surface of the placed peat & spoil should be shaped to allow efficient run-off of surface water from borrow pit areas.
- Silting ponds may be required at the lower side/outfall location of the borrow pits.
- A layer of geogrid to strengthen the surface of the placed peat & spoil within the borrow pits may be required.

- Infilling of the peat & spoil should commence at the back edge of the borrow pit and progress towards the borrow pit entrance/rock buttress. The contractor excavating the rock will be required to develop the borrow pits in a way which will allow the excavated peat & spoil to be placed safely.
- The height of the rock buttresses constructed should be greater than the height of the placed peat & spoil to prevent any surface peat & spoil run-off. Buttresses up to 5m in height are likely to be required.

Peat reinstatement volumes have been estimated and are presented in Appendix 4-4, Table 6-3.

4.3.4.3 Handling and storing excavated peat

The following recommendations/best practice guidelines for the handling of peat and spoil during the construction of the Proposed Development:

- Care shall be taken during peat excavation to ensure it is segregated from other soil types, therefore particular care should be taken to review recorded peat depths.
- Peat shall be separated and stored by type, namely the acrotelmic and catotelmic layers.
    - Acrotelm (top about 0.3 to 0.4m of peat) is generally required for landscaping and shall be stripped and temporarily stockpiled for re-use as required. Acrotelm stripping shall be undertaken before the main excavations.
    - Where possible, the acrotelm shall be placed with the vegetation part of the sod facing the right way up to encourage the growth of plants and vegetation.
    - All catotelm peat (peat below about 0.3 to 0.4m depth) shall be moved immediately on excavation to the designated areas.
- Construction sequence planning shall minimise the time that peat is stockpiled before reuse.
- Peat stockpiles shall not be allowed to substantially erode or become dry.
- Material stockpiles shall be located at least 50m away from watercourses, including site ditches, to reduce the potential for sediment to be transferred into the wider hydrological system.
- Peat stockpile locations should be selected to limit re-handling as far as reasonably possible.
- Excavated peat shall be stored and reused within that immediate area to ensure peat is used to restore peatland habitat.
- The Contractor shall consult the Ecological Clerk of Works (ECoW) to agree on locations for material stockpiles and consider minimising impacting sensitive ecological receptors.
- The Contractor shall consult the site Geotechnical Engineer and review and take into account the Peat Stability Risk Assessment 19162-001 by GDG (2020), to avoid the risk of peat instability in peat excavations, peat stockpiling and all material stockpiling in areas underlain by peat.
- Run-off from stockpiles shall be directed through the site drainage system that shall include silt fences, settlement ponds and other drainage measures as described in Section 4.6. This is detailed in the Contractor's Construction and Environmental Management Plan.

4.3.4.3.1 *Placement of Peat & Spoil alongside Access Road*

The following particular recommendations/best practice guidelines for the placement of peat & spoil alongside the founded roads should be considered and taken into account during construction.

- Peat and spoil shall be side-cast along founded roads only where it can be placed in a stable formation i.e. where the topography and ground conditions allow.
- Peat and spoil shall only be cast to safe heights and slope angles, considering the topography and the ground conditions. This height shall generally be up to 1m, and the slopes shall be not greater than 1 (v): 2 or 3 (h) unless a site-specific assessment during detailed design indicates a greater height and angle is safe.

Peat reinstatement volumes have been estimated and are presented in Appendix 4-4, Table 6-3.

4.3.5 Onsite Electricity Substation Compound

As detailed in Chapter 1, Section 1.4, it is proposed to construct one onsite electricity substation within the site of the Proposed Development. The proposed substation site is located at 508800, 562235 (ITM) within an area of forestry and is adjacent to the existing on-site substation as shown in Figure 4-1.

The footprint of the proposed onsite electricity substation compound measures approximately 3,157 square metres, and will include a wind farm control building and the electrical components necessary to consolidate the electrical energy generated on site and export that electricity to the national grid. Further details regarding the connection of the onsite substation to the national electricity grid are provided in Section 4.3.7 below.

The layout and elevations of the proposed onsite substation are shown on Figure 4-7 and Figures 4-8a to 4-8c. The substation compound will be surrounded by an approximately 2.6 metre high steel palisade fence (or as otherwise required by ESB), and internal fences will also segregate different areas within the main substation. The construction and exact layout of electrical equipment in the onsite electricity substation will be to Eirgrid/ESB networks specifications.

4.3.5.1 Wind Farm Control Building

A wind farm control building will be located within the substation compound. The control building will measure 7 metres by 21 metres and 6 metres in height, will be located in the western half of the substation compound. Layout and elevation drawings of the control building are included in Figure 4-7.

The wind farm control building will include staff welfare facilities for the staff that will work on the Proposed Development during the operational phase of the project. Toilet facilities will be installed with a low-flush cistern and low-flow wash basin. Due to the specific nature of the Proposed Development there will be a very small water requirement for occasional toilet flushing and hand washing and therefore the water requirement of the Proposed Development does not necessitate a potable source. It is proposed to harvest rainwater from the roofs of the buildings, and if necessary, bottled water will be supplied for drinking.

It is proposed to manage wastewater from the staff welfare facilities in the control buildings by means of a sealed storage tank, with all wastewater being tankered off site by permitted waste collector to wastewater treatment plants. It is not proposed to treat wastewater on-site, and therefore the EPA's 2009 *'Code of Practice: Wastewater Treatment and Disposal Systems Serving Single Houses (p.e. ≤ 10)'* does not apply. Similarly, the EPA's 1999 manual on '*Treatment Systems for Small Communities, Business, Leisure Centres and Hotels'* also does not apply, as it too deals with scenarios where it is proposed to treat wastewater on-site.

Such a proposal for managing the wastewater arising on site has become almost standard practice on wind farm sites, which are often proposed in areas where finding the necessary percolation requirements for on-site treatment would be challenging, and has been accepted by numerous Planning Authorities and An Bord Pleanála as an acceptable proposal.

The proposed wastewater storage tank will be fitted with an automated alarm system that will provide sufficient notice that the tank requires emptying. The wastewater storage tank alarm will be part of a continuous stream of data from the sites turbines, wind measurement devices and electricity substation that will be monitored remotely 24 hours a day, 7 days per week. Only waste collectors holding valid waste collection permits under the Waste Management (Collection Permit) Regulations, 2007 (as amended), will be employed to transport wastewater away from the site to a licensed facility.

Battery Storage Compound

A battery storage compound is also proposed as part of the proposed electricity substation compound. The compound will consist of up to four metal containers (similar in appearance to shipping containers).

The containers will typically measure up to 13.3m(L) x 2.4m(W) x 4.4m (H). Each of the containers will house a modular array of battery units, control systems and other electrical components. Additionally, each container will have a transformer and ancillary grid infrastructure for connection to the proposed substation. The compound will also have an entrance gate, security fencing and lighting. The layout, elevation and cross section drawings are included as Figure 4-7 and Figure 4-8. The battery storage compound will operate continuously, linked to the on-site substation. It will be monitored in tandem with the overall development and there will be sporadic maintenance visits as required.

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7. Layout plans show typical Turbine rotor diameter as per turbine drawing.
8. Final levels may vary depending on local ground conditions.

Drawing Legend

- Planning Application Boundary
- Existing Road Infrastructure
- Proposed Road
- Electrical Cable Trench
- Interceptor Drain
- Level Spreader
- Swales/Collector Drains
- Stilling Pond
- Direction of Flow
- Check Dam
- Proposed Culvert
- Existing Culvert to be Maintained/Upgraded
- Cut
- Fill

N

Figure 4-7

DRAWING TITLE:
Substation Layout

PROJECT TITLE:
Curraglass Renewable Energy Development, Co. Cork

DRAWING BY: **Joseph O Brien**	CHECKED BY: **Orla Murphy**
PROJECT No.: **190301**	DRAWING No.: **190301 - 10**
SCALE: **1:500 @ A3**	DATE: **30.06.2020**

OS SHEET No.:
6454, 6455, 6456, 6493, 6494, 6495, 6531, 6532, 6533

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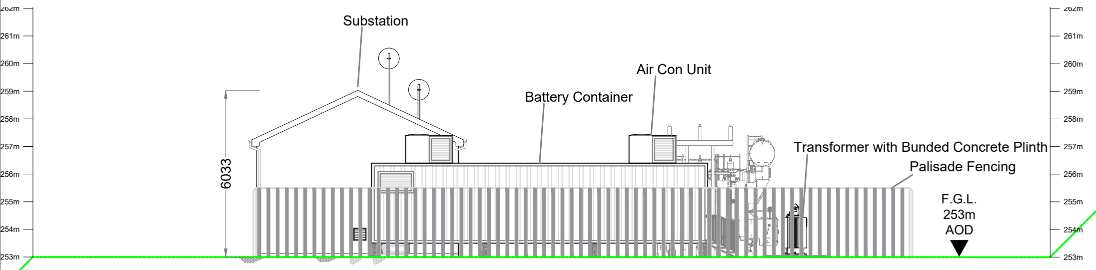
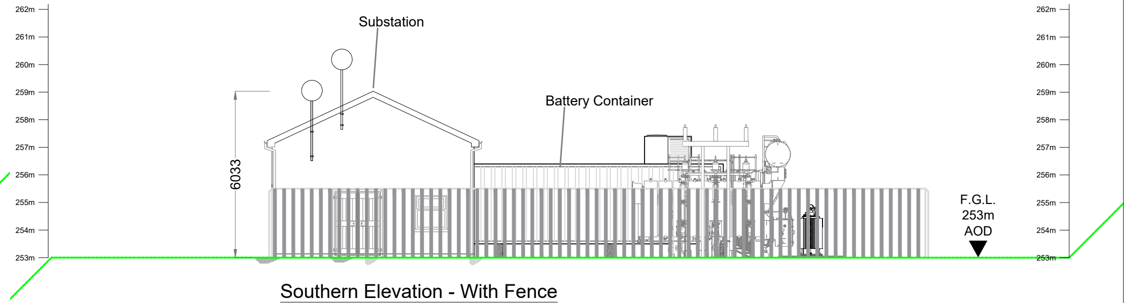
Drawing Notes

1. Layout and arrangements of substation buildings and electrical equipment is shown indicatively and for illustration purposes only as final specifications of buildings and electrical equipment is to be dictated by Eirgrid/ESB networks requirements.

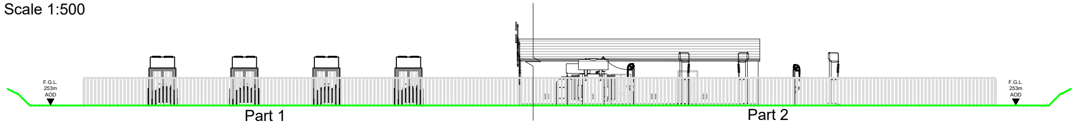


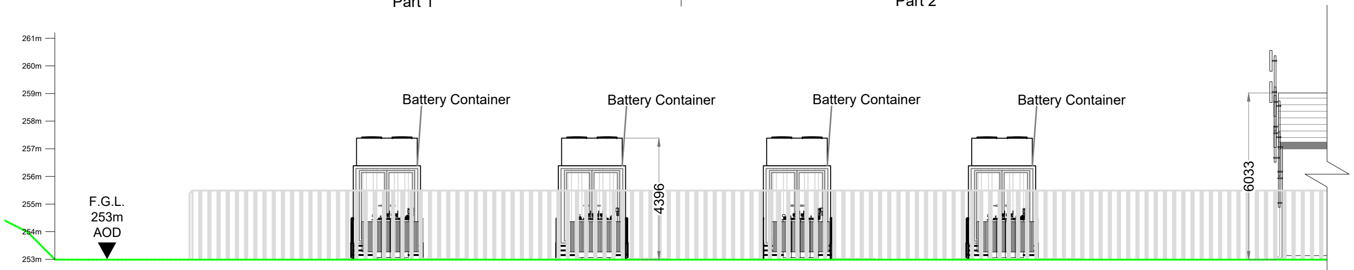
Northern Elevation - With Fence
Scale 1:200



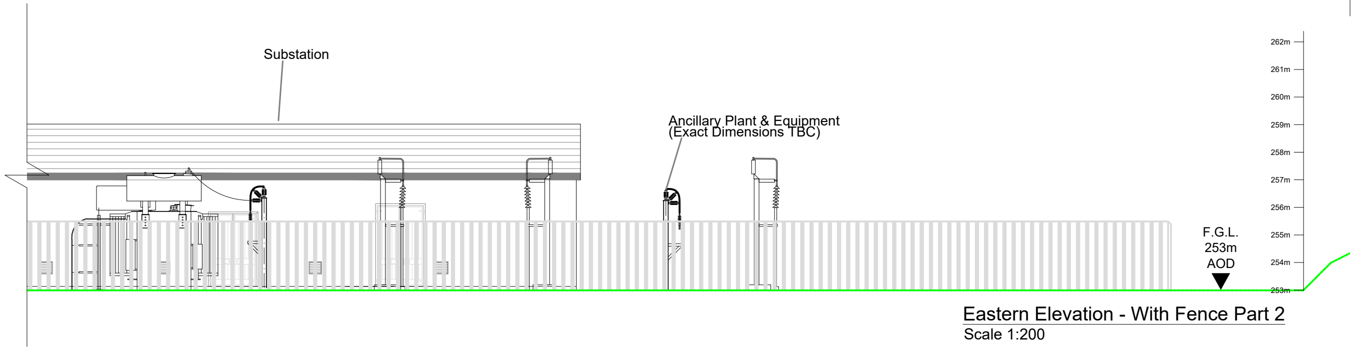
Southern Elevation - With Fence
Scale 1:200

Eastern Elevation - With Fence
Scale 1:500





Eastern Elevation - With Fence Part 1
Scale 1:200



Eastern Elevation - With Fence Part 2
Scale 1:200

Figure 4-8a

DRAWING TITLE: **Substation Elevations A**	
PROJECT TITLE: **Curraglass Renewable Energy Development, Co. Cork**	
DRAWING BY: **Joseph O Brien**	CHECKED BY: **Orla Murphy**
PROJECT No: **190301**	DRAWING No: **190301 - 11**
SCALE: **As Shown @ A3**	DATE: **30.06.2020**

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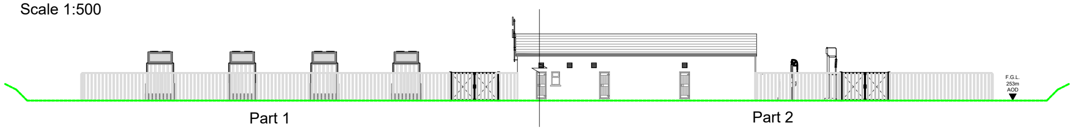
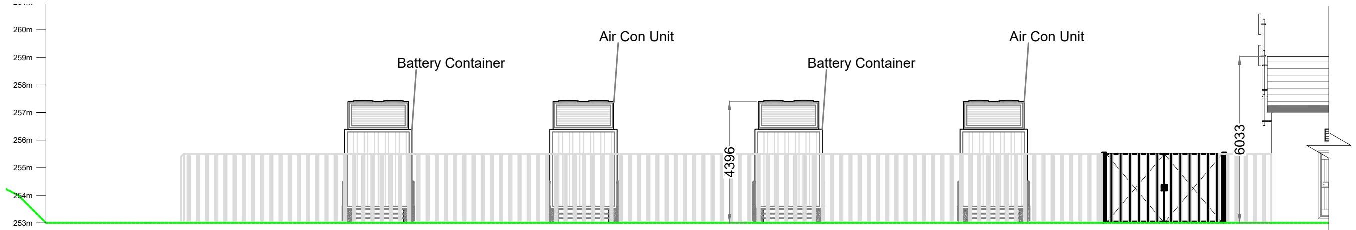
Drawing Notes

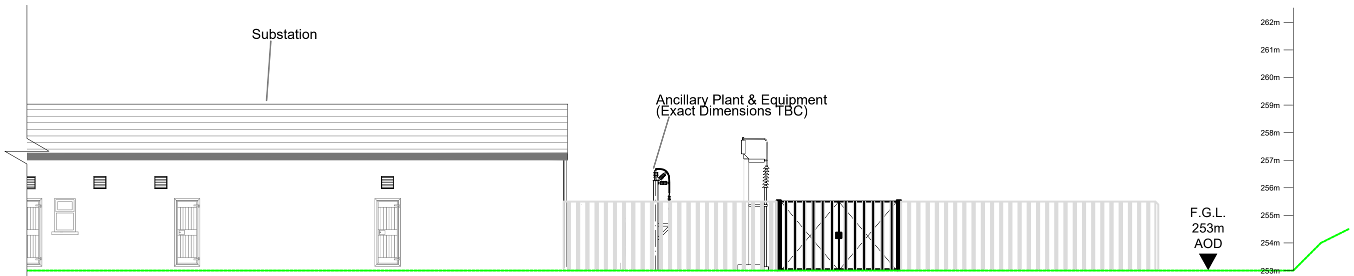
1. Layout and arrangements of substation buildings and electrical equipment is shown indicatively and for illustration purposes only as final specifications of buildings and electrical equipment is to be dictated by Eirgrid/ESB networks requirements.

Western Elevation - With Fence
Scale 1:500





Western Elevation - With Fence Part 1
Scale 1:200



Western Elevation - With Fence Part 2
Scale 1:200

Figure 4-8b

DRAWING TITLE:
Substation Elevations B

PROJECT TITLE: Curraglass Renewable Energy Development, Co. Cork	
DRAWING BY: Joseph O Brien	CHECKED BY: Orla Murphy
PROJECT No: 190301	DRAWING No: 190301 - 12
SCALE: As Shown @ A3	DATE: 30.06.2020

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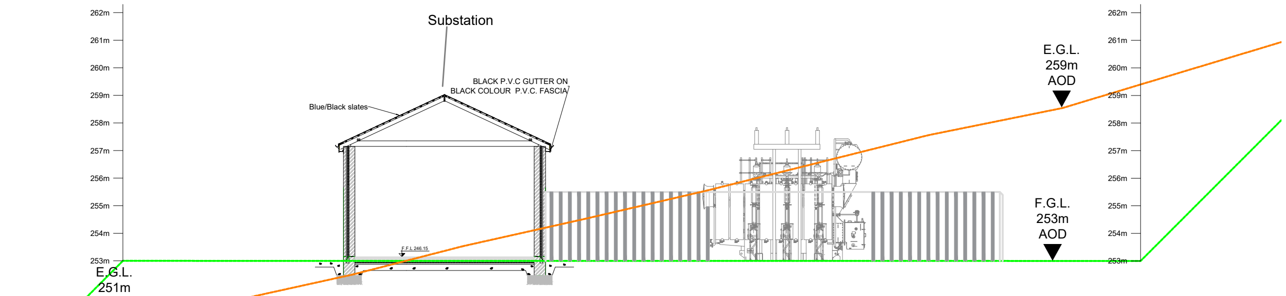
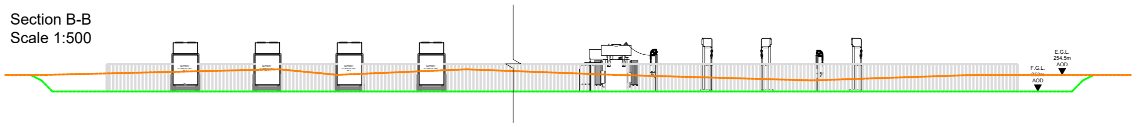
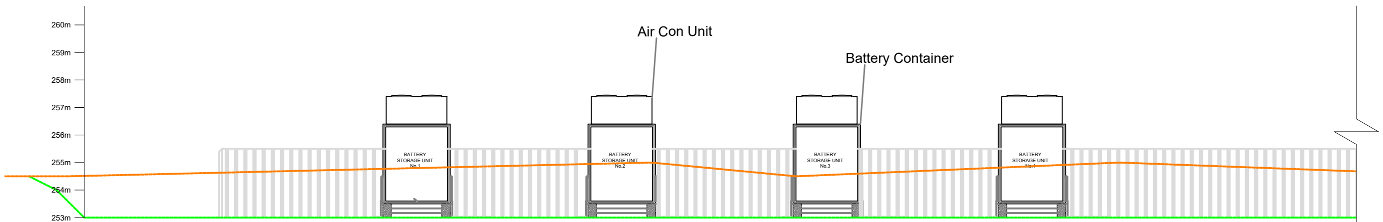


SECTION A-A
Scale 1:200

Section B-B
Scale 1:500





Section B - B Part 1
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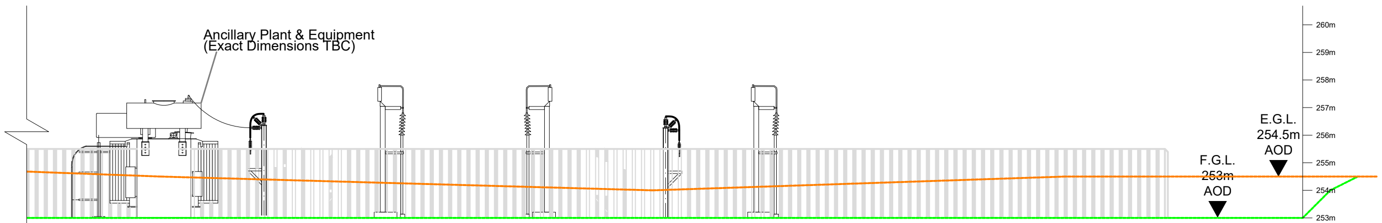

Section B - B Part 2
Scale 1:200

Figure 4-8c	
DRAWING TITLE: **Substation Sections**	
PROJECT TITLE: **Curraglass Renewable Energy Development, Co. Cork**	
DRAWING BY: **Joseph O Brien**	CHECKED BY: **Orla Murphy**
PROJECT No.: **190301**	DRAWING No.: **190301 - 13**
SCALE: **As Shown @ A3**	DATE: **30.06.2020**

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4.3.6 Site Underground Cabling

Each turbine will be connected to the on-site electricity substation via an underground electricity cable. Fibre-optic cables will also connect each wind turbine to the wind farm control building in the onsite substation compound. The electricity and fibre-optic cables running from the turbines to the onsite substation compound will be run in underground cable ducts approximately 1.3 metres below the ground surface. The route of the cable ducts will generally follow the access track to each turbine location and are indicated on the site layout drawings included as Appendix 4-1 to this report. The position of the cable trench relative to the roadways is shown in section in Figure 4-5 above. Figure 4-9 below shows a typical cable trench. The exact number and configuration of cable ducting may vary within the cabling trench.

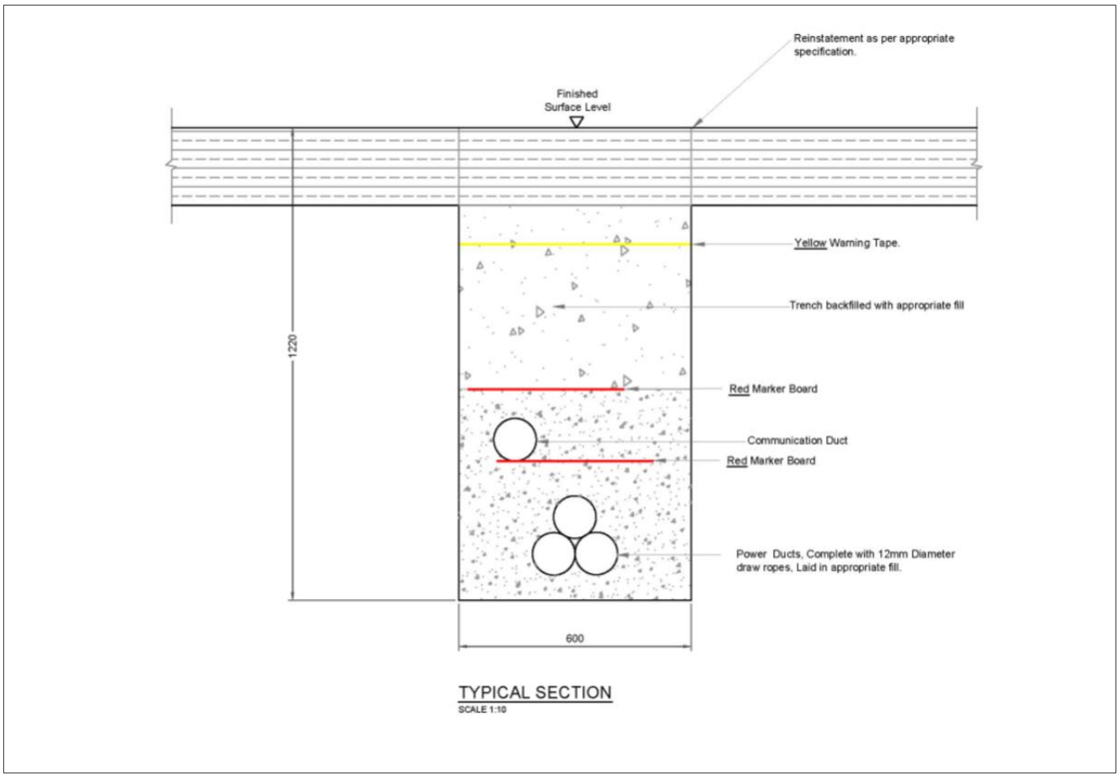


Figure 4-9 Typical Cable trench cross section detail

Clay plugs will be installed at regular intervals of not greater than 50 metres along the length of the trenches where required to prevent the trenches becoming conduits for runoff water. While the majority of the cable trenches will be backfilled with native material, clay subsoils of low permeability will be used to prevent conduit flow in the backfilled trenches. Backfill material will be imported onto the site should sufficient volumes not be encountered during the excavation phase of roadway and turbine foundation construction.

4.3.7 Grid Connection Cabling

A connection between the proposed substation and the national electricity grid will be necessary to export the electricity generated by the Proposed Development.

The Proposed Development will connect to the existing 38kV overhead line within the site. This overhead line connects into Ballylickey Substation, located approximately 12 kilometres southwest of the site. The connection will comprise of an internal underground cable, approximately 120m in length, which will connect the proposed substation to the existing overhead line infrastructure within the site. A methodology for these works is located in Section 4.7.6.

4.3.8 Meteorological Mast

One permanent anemometry mast is proposed as part of the Proposed Development. The meteorological mast will be equipped with wind monitoring equipment at various heights. The masts will be located at E509111, N562911 (ITM) as shown on the site layout drawing in Figure 4-1. The mast will be a slender structure up to 112 metres in height. The mast will be a free-standing structure. The mast will be constructed on a hard-standing area sufficiently large to accommodate the crane that will be used to erect the mast, adjacent to an existing track. The typical design of the proposed meteorological mast is shown in Figures 4-10.

4.3.9 Temporary Construction Compound

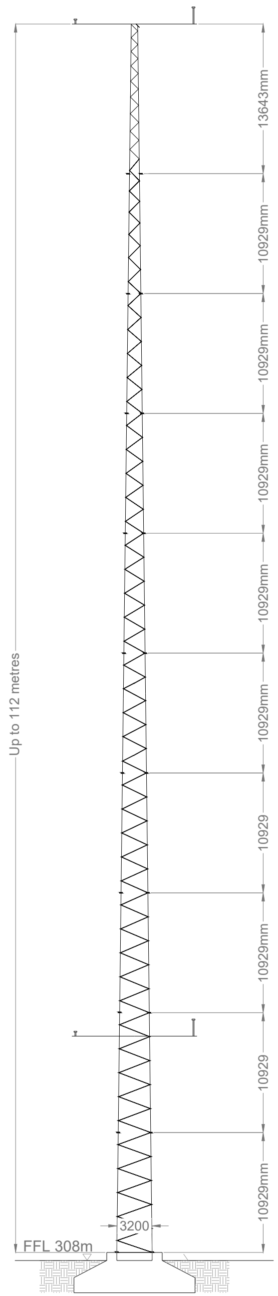
A temporary construction compound measuring approximately 60 metres by 40 metres and 2,400 square metres in area will be located in the northern part of the site of the Proposed Development, south of T1. The location of the proposed construction compound is shown on the site layout drawing in Figure 4-1.

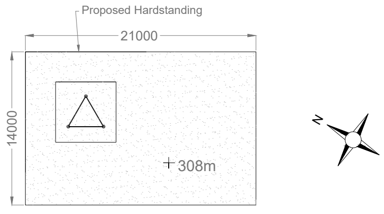
The construction compound will consist of temporary site offices, staff facilities and car-parking areas for staff and visitors. The layout of this construction compound is shown on Figure 4-11. Construction materials and turbine components will be brought directly to the proposed turbine locations following their delivery to the site.

Temporary port-a-loo toilets located within a staff portacabin will be used during the construction phase. Wastewater from staff toilets will be directed to a sealed storage tank, with all wastewater being tankered off site by permitted waste collector to wastewater treatment plants. There will also be a water supply on site for hygiene purposes.

Drawing Notes

1. Met mast on site will either be guyed met mast or free standing met mast depending on site conditions.
   Both options shown only one will be used.





Met Mast Compound Plan

Figure 4-10

DRAWING TITLE:
Met Mast Layout Plan & Elevation

PROJECT TITLE:
Curraglass Renewable Energy Development, Co. Cork

DRAWING BY: **Joseph O Brien**	CHECKED BY: **Orla Murphy**
PROJECT No. **190301**	DRAWING No. **190301 - 18**
SCALE: **1:500 @ A3**	DATE: **30.06.2020**

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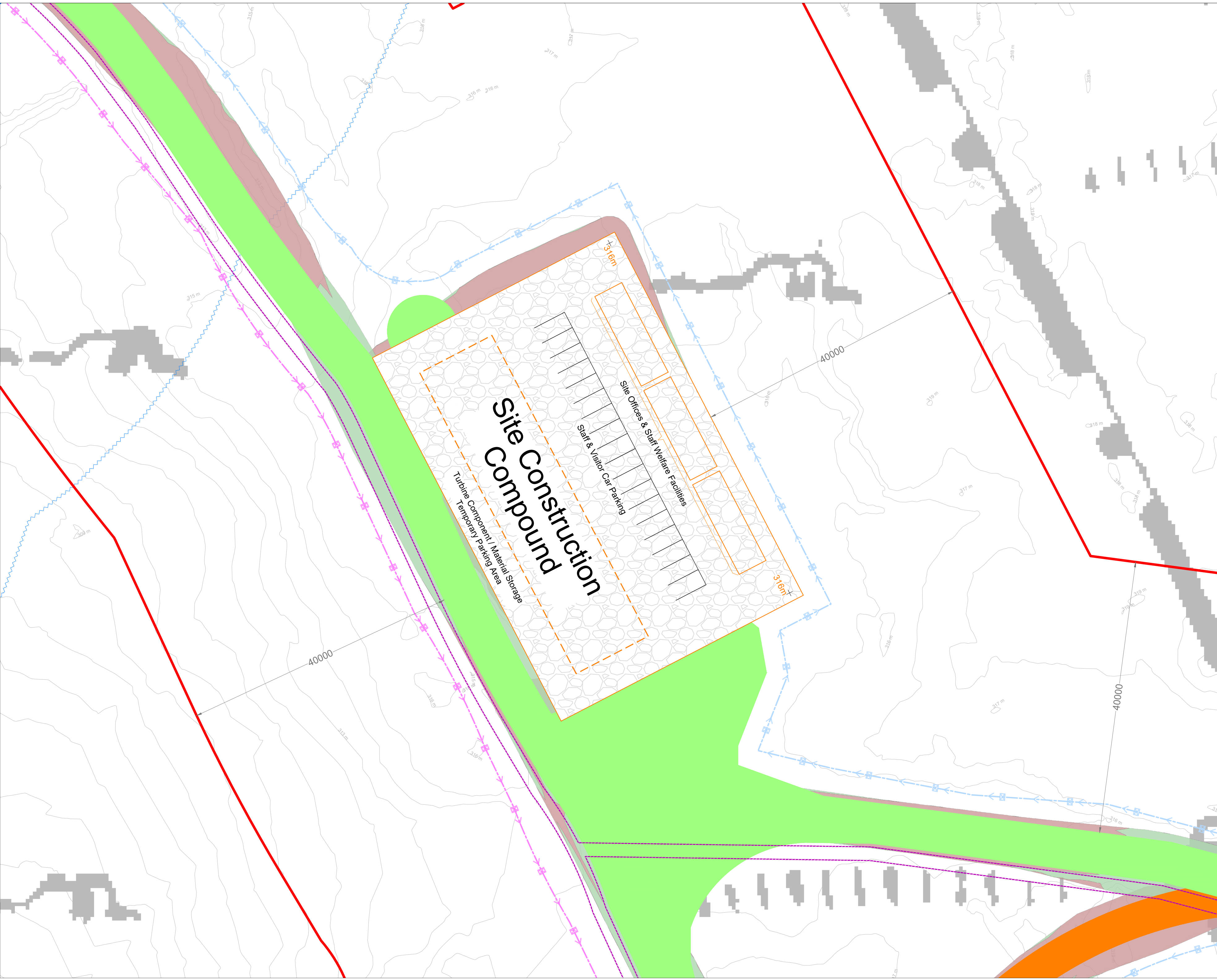

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7. Layout plans show typical Turbine rotor diameter as per turbine drawing.
8. Final levels may vary depending on local ground conditions.

Drawing Legend

- Planning Application Boundary
- Existing Road Infrastructure
- Proposed Road
- Electrical Cable Trench
- River/Stream
- River/Stream 50m Buffer
- Interceptor Drain
- Level Spreader
- Swales/Collector Drains
- Stilling Pond
- Direction of Flow
- Check Dam
- Cut
- Fill

N

Figure 4-11

DRAWING TITLE:
Temporary Construction Compound

PROJECT TITLE:
Curraglass Renewable Energy Development, Co. Cork

DRAWING BY: **Joseph O Brien**	CHECKED BY: **Orla Murphy**
PROJECT No.: **190301**	DRAWING No.: **190301 - 09**
SCALE: **1:500 @ A3**	DATE: **30.06.2020**

OS SHEET No.: 6454, 6455, 6456, 6493, 6494, 6495, 6531, 6532, 6533

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4.3.10 Tree Felling and Replanting

4.3.10.1 Tree Felling

A portion of the Proposed Development site currently comprises a coniferous forestry plantation, with approximately 53% percent of the site under forestry. As part of the Proposed Development, tree felling will be required within and around the development footprint to allow the construction of turbines, hardstanding and access roads where necessary as delineated in Figure 4-12.

Turbulence felling may also be required in the vicinity of turbine locations, the purpose of which is to avoid turbulence that can be created by the forest canopy and which can affect the performance and efficiency of the turbines.

A total of 11.73 hectares of forestry will have to be permanently felled within and around the footprint of the Proposed Development. An additional 4.59 hectares of trees will be required to be temporarily felled around all turbines in order to facilitate infrastructure construction and turbine erection. It is assumed, for the purposes of assessment within the EIAR, that another 25 hectares of trees will be required to be temporarily felled in order to prevent those trees causing a turbulence effect around the proposed turbine locations. If the amount of turbulence felling is determined to be greater or less prior to felling, this will not change the assessment. The total extent of turbulence felling required will be determined by the turbine manufacturer which will not be known until prior to the construction phase. The amount of tree felling required on the site is therefore approximately 41.32 hectares or 12% of the currently forested area. Figure 4-12 shows the extent of the area to be felled as part of the Proposed Development.

The tree felling activities required as part of the Proposed Development will be the subject of two Limited Felling Licence (LFL) applications to the Forest Service, as per the Forest Service's policy on granting felling licenses for wind farm developments. The policy requires that a copy of the planning permission for the Proposed Development be submitted with the felling licence applications; therefore the felling licenses cannot be applied for until such time as planning permission is obtained for the Proposed Development.

One LFL will be applied for to cover felling required around the footprint of the Proposed Development footprint, for example along access roads and at turbine bases. A second LFL will be applied for to cover temporary felling. Should a requirement for turbulence felling be identified by the selected turbine manufacturer, a separate LFL will be applied for to cover same.

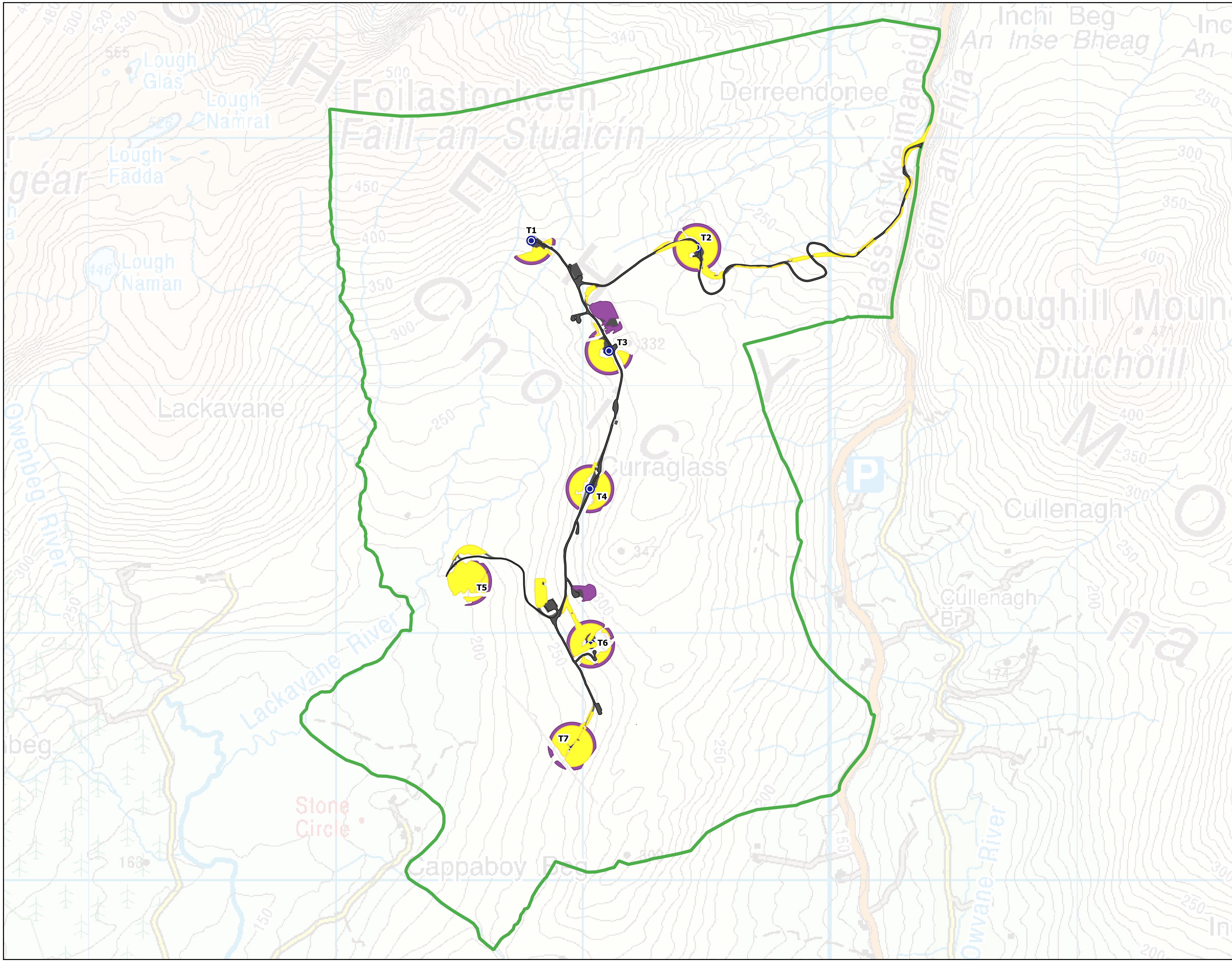
4.3.10.2 Tree Planting

In line with the Forest Service's published policy on granting felling licences for wind farm developments, areas cleared of forestry for turbine bases, access roads, and any other wind farm-related uses will have to be replaced by replanting at an alternative site.

The Forest Service policy requires replanting on a hectare for hectare basis for the footprint of the turbines and the other infrastructure developments. In the case of the area to undergo turbulence felling, there is a requirement for replanting on a hectare for hectare basis within the site plus an additional 10% offsite.

Approximately 14.23 hectares of forestry will be replanted as a condition of any felling licence that might issue in respect of the Proposed Development. Replanting is a requirement of the Forestry Act and is primarily a matter for the statutory licensing processes that are under the control of the Forest service.

The Forest Service policy states that where turbulence felling is necessary, a 'short rotation forestry' (SRF) approach will be made a condition of the felling licence. The SRF approach recommends the use of lodgepole pine or another suitable species as the replanting choice. The north coastal variety of lodgepole pine is preferred because it is unlikely to reach ten metres in height, the height at which the trees would again have to be felled to prevent turbine turbulence effects, over the 30-year lifetime of the project. In



Map Legend

- EIAR Site Boundary
- Proposed Turbine Locations
- Proposed Development Footprint
- Temporary Forestry Felling Area (4.59 hectares)
- Permananet Forestry Felling Area (11.73 hectares)

N

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Drawing Title	
Proposed Felling	
Project Title	
Curraglass Renewable Energy Development, Co. Cork	
Drawn By: ÓM	Checked By: MW
Project No.: 190301	Drawing No.: Figure 4-12
Scale: 1:13500	Date: 24.06.2020

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accordance with the Forest Service policy and requirements, the 4.59 hectares and 25 hectares that will be temporarily felled for infrastructure construction and possible turbulence respectively, will be replanted in the same location with the north coastal variety of lodgepole pine or similar species.

The replacement replanting of the remaining 11.73 hectares of forestry and the 10% of the overall assumed turbulence felling (2.5ha), totalling 14.23 ha can occur anywhere in the State subject to licence. Two replanting areas, located in Cloghaun More, Co. Clare and Sheehaun, Co. Roscommon have been identified for assessment purposes, with a total availability of 24.95 hectares. These lands have been granted Forest Service Technical Approval for afforestation, and these or similarly approved lands will be used for replanting should the Proposed Development receive planning permission. A description of the proposed replanting land and an assessment of the potential impacts including cumulative impacts associated with afforestation at this location are provided in Appendix 4-2 of this EIAR.

4.3.11 Site Activities

4.3.11.1 Environmental Management

All proposed activities on the site of the Proposed Development will be provided for in an environmental management plan. A Construction and Environmental Management Plan (CEMP) has been prepared for the Proposed Development and is included in Appendix 4-3 of this EIAR. The CEMP includes details of drainage, peat and overburden management and waste management. It is intended that the CEMP; should the project secure planning permission, will be updated, in line with all conditions and obligations which apply to any grant of permission. Due to its structure and nature, it will require constant updating and revision throughout the construction period. Therefore, it is a working document and will be developed further prior to and during the construction phase of the wind farm development.

4.3.11.2 Refuelling

Wherever possible, vehicles will be refuelled off-site. This will be the case for regular, road-going vehicles. However, for construction machinery that will be based on-site continuously, a limited amount of fuel will have to be stored on site in bunded areas.

On-site refuelling of machinery will be carried out at dedicated refuelling locations using a mobile double skinned fuel bowser. The fuel bowser, a double-axle custom-built refuelling trailer will be re-filled off site, and will be towed around the site by a 4x4 jeep to where machinery is located. It is not practical for all vehicles to travel back to a single refuelling point, given the size of the cranes, excavators, etc. that will be used during the construction of the Proposed Development. The 4x4 jeep will also carry fuel absorbent material and pads in the event of any accidental spillages. The fuel bowser will be parked on a level area in the construction compound when not in use.

Only designated trained and competent operatives will be authorised to refuel plant on site. Mobile measures such as drip trays, spill kits and fuel absorbent mats will be used during all refuelling operations.

4.3.11.3 Concrete Deliveries

Only ready-mixed concrete will be used during the construction phase, with all concrete being delivered from local batching plants in sealed concrete delivery trucks. The use of ready-mixed concrete deliveries will eliminate any potential environmental risks of on-site batching. When concrete is delivered to site, only the chute of the delivery truck will be cleaned, using the smallest volume of water necessary, before leaving the site. Concrete trucks will be washed out fully at the batching plant, where facilities are already in place.

The small volume of water that will be generated from washing of the concrete lorry's chute will be directed into a temporary lined impermeable containment area. Where temporary lined impermeable containment areas are used, such containment areas are typically built using straw bales and lined with an impermeable membrane. Two examples are shown in Plate 4-4 below.

Plate 4-4 Concrete Washout Area

The areas are generally covered when not in use to prevent rainwater collecting. In periods of dry weather, the areas can be uncovered to allow much of the water to be lost to evaporation. At the end of the concrete pours, any of the remaining liquid contents will be tankered off-site. Any solid contents that will have been cleaned down from the chute will have solidified and can be broken up and disposed of along with other construction waste.

Alternatively, a Siltbuster-type concrete wash unit or equivalent (http://www.siltbuster.co.uk/sb_prod/siltbuster- roadside-concrete-washout-rcw/). This type of Siltbuster unit catches the solid concrete and filters and holds wash liquid for pH adjustment and further solids separation. The residual liquids and solids can be disposed of off-site at an appropriate waste facility.

Due to the volume of concrete required for each turbine foundation, and the requirement for the concrete pours to be continuous, deliveries are often carried out outside normal working hours in order to limit the traffic impact on other road users, particularly peak period school and work commuter traffic. Such activities are limited to the day of turbine foundation concrete pours, which are normally complete in a single day per turbine.

The risks of pollution arising from concrete deliveries will be further reduced by the following:

- Concrete trucks will not be washed out on the site, but will be directed back to their batching plant for washout.
- Site roads will be constructed to a high standard to allow transport of the turbine components around the site, and hence, concrete delivery trucks will be able to access all areas where the concrete will be needed. No concrete will be transported around the site in open trailers or dumpers so as to avoid spillage while in transport. All concrete used in the construction of turbine bases will be pumped directly into the shuttered formwork from the delivery truck. If this is not practical, the concrete will be pumped from the delivery truck into a hydraulic concrete pump or into the bucket of an excavator, which will transfer the concrete to the location where it is needed.
- The arrangements for concrete deliveries to the site will be discussed with suppliers before work starts, agreeing routes, prohibiting on-site washout and discussing emergency procedures.
- Clearly visible signage will be placed in prominent locations close to concrete pour areas specifically stating washout of concrete lorries is not permitted on the site.

4.3.11.4 Concrete Pouring

Because of the scale of the main concrete pours that will be required to construct the Proposed Development, the main pours will be planned days or weeks in advance. Special procedures will be adopted in advance of and during all concrete pours to minimise the risk of pollution. These may include:

- Using weather forecasting to assist in planning large concrete pours, and avoiding large pours where prolonged periods of heavy rain is forecast.
- Restricting concrete pumps and machine buckets from slewing over watercourses while placing concrete.
- Ensuring that excavations are sufficiently dewatered before concreting begins and that dewatering continues while concrete sets.
- Ensuring that covers are available for freshly placed concrete to avoid the surface washing away in heavy rain.
- Disposing of surplus concrete after completion of a pour in agreed suitable locations away from any watercourse or sensitive habitats.

4.3.11.5 Dust Suppression

In periods of extended dry weather, dust suppression may be necessary along haul roads to ensure dust does not cause a nuisance. If necessary, water will be taken from stilling ponds in the site's drainage system, and will be pumped into a bowser or water spreader to dampen down haul roads and site compounds to prevent the generation of dust. Silty or oily water will not be used for dust suppression, because this would transfer the pollutants to the haul roads and generate polluted runoff or more dust. Water bowser movements will be carefully monitored, as the application of too much water may lead to increased runoff.

4.3.11.6 Vehicle Washing

Wheels or vehicle underbodies are often washed before leaving sites to prevent the build-up of mud on public (and site) roads. It is not considered necessary that vehicle or wheel washing facilities will be required as part of the construction phase of the Proposed Development because site roads will be formed using on-site materials before other road-going trucks begin to make regular or frequent deliveries to the site (e.g. with steel or concrete). In the unlikely event that deliveries of materials to site are necessary, a wheelwash facility will be made available. The site roads will be well finished with compacted hardcore, and so the public road-going vehicles will not be travelling over soft or muddy ground where they might pick up mud or dirt.

A road sweeper will be available if any section of the public roads were to be dirtied by trucks associated with the Proposed Development.

4.4 Access and Transportation

4.4.1 Site Entrance

It is intended to access the site of the Proposed Development via an existing Coillte entrance in the townland of Derreendonee, Co. Cork, off the R584 Regional Route. This is the same access used for the previous turbines on the site.

The delivery of all turbine components and construction materials to the site will be via the site entrance described above. From here, the vehicles will use the internal site roads to access the proposed infrastructure locations within the site. An outline Traffic Management Plan is included in the CEMP in Appendix 4-3 of this EIAR.

4.4.2 Turbine and Construction Materials Transport Route

There are two potential turbine transport/haul route options for the Proposed Development, originating from Ringaskiddy, Co. Cork, and these are shown on Figure 4-13.

4.4.2.1 Route Selection

The turbine delivery route option chosen for the delivery of turbine components will be determined by the specialist transport haulier that is chosen by the turbine manufacturer. All deliveries of turbine components to the site of the Proposed Development will only be by way of the chosen transport route option. The number of construction vehicles that will be generated during the construction phase of the Proposed Development are outlined as part of the traffic and transport assessment in Section 14.1 of this EIAR.

Deliveries to site such as concrete, steel and construction materials will use the same transport route as the wind turbines, with HGVs accessing the site via the site entrance along the R584, both from the north and south. The number of construction vehicles generated during the construction phase of the Proposed Development are outlined as part of the traffic and transport assessment in Chapter 14 of this EIAR. Further

4.4.2.2 Option 1

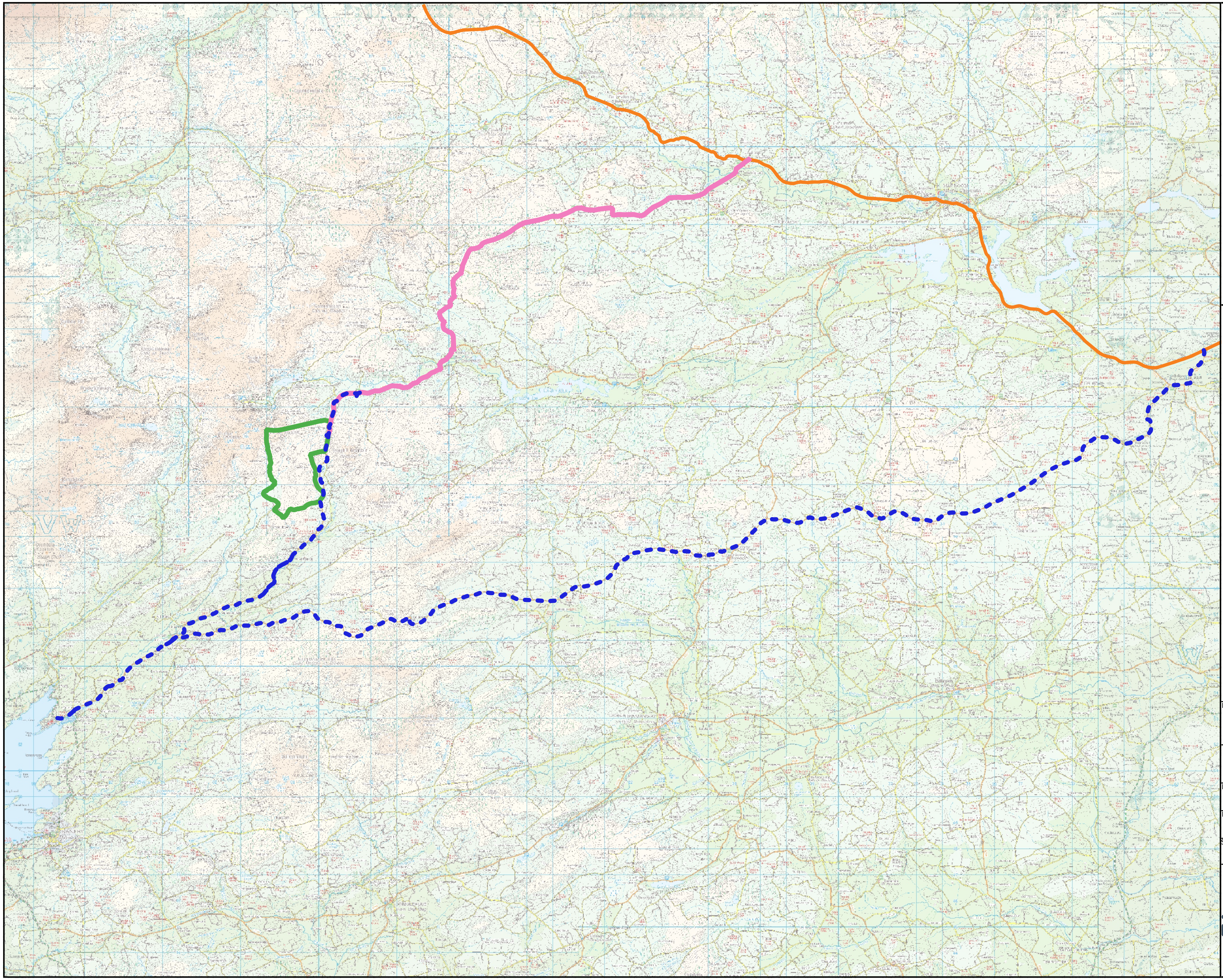
In Option 1, for the purposes of assessment, the turbine components and other abnormal loads will be transported, from Ringaskiddy Port, west on the N22, before turning southwest along the R585 Regional Road via Crookstown to the junction with the R584 Regional Road at the village of Kealkill. From Kealkill, the turbine delivery route will continue along the R584 to Ballylickey, where a reversing manoeuvre occurs at Ballylickey bridge. Once the manoeuvre is complete, the turbines will travel north east back along the R584, through Kealkill towards Ballingeary. The turbines will travel past the site entrance, performing a reversing manoeuvre further along the R584, before travelling back south along the same road and accessing the site from the north via the existing Coillte entrance. This is the preferred route for turbine and construction material delivery.

The proposed turning area along the R584, with the reversing manoeuvre shown on Figure 4-14, will require removal of fencing and temporary placement of hardcore, so the area can be used during the delivery of large turbine components. Once the turbines have been delivered, this area will be returned to its original state.

The existing Coillte entrance will be upgraded to facilitate the delivery of the construction materials and oversized loads. The site entrance was subject to Autotrack assessment to identify the area required to access the site. The proposed junction is shown in Figure 4-15 and is detailed Section 14.1 of the Traffic and Transport Assessment. Works will involve removal of trees north of the entrance and placement of hardcore.

4.4.2.3 Option 2

Option 2 follows the same route as Option 1, but the delivery vehicles will continue on the N22, through Macroom before making a turn west at Lissacresig along the L-3402 to Ballingeary. From here the delivery vehicles will travel west along the R584 accessing the site from the north via the existing Coillte entrance, which requires upgrade works as noted above.



Map Legend

- EIAR Site Boundary
- Turbine Delivery Route Option 1 (From Crookstown, Co. Cork)
- Turbine Delivery Route Option 2 (From Lissnarig, Co. Cork)
- N22

N

Drawing Title	Proposed Turbine Delivery Routes
Project Title	Curraglass Renewable Energy Development, Co. Cork
Drawn By: Órla Murphy	Checked By: Michael Watson
Project No.: 190301	Drawing No.: 4-13
Scale: 1:190000	Date: 24.06.2020

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NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Base mapping provided by MKO

Figure 14-14 Location 19 - Reverse turn on R584, blade extended artic

PROJECT:	Curraglass Renewable Energy Development		
CLIENT:	Wingleaf Ltd	SCALE:	1:1000
PROJECT NO: 8010	DATE: 04.06.20	DRAWN BY:	AL

ALAN LIPSCOMBE
TRAFFIC & TRANSPORT CONSULTANTS

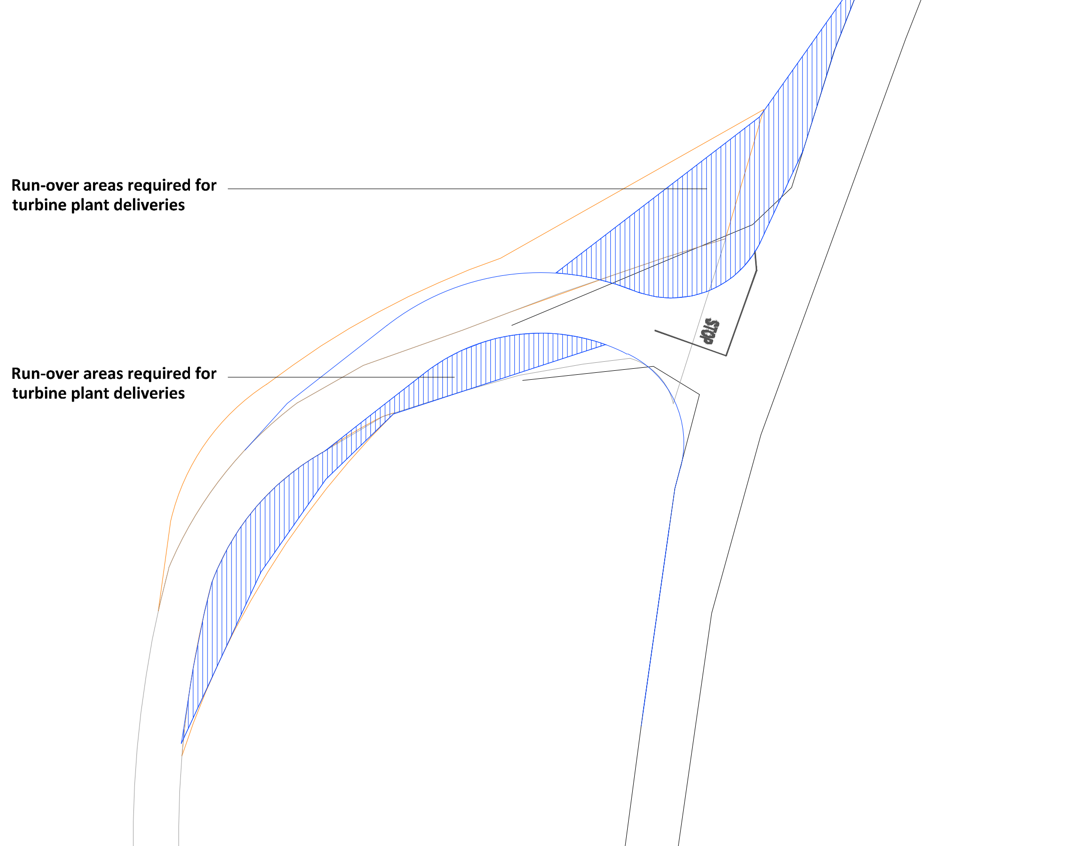
Access Junction

Junction radii are 13m with 1:10 tapers for HGVs in accordance with TII DN-GEO-03060

Junction markings to be as per Figure 7.35 of the Traffic Signs Manual

- Centreline RM 001
- STOP line RRM 017
- STOP lettering M114.

Junction stop signs to be as per RUS 027 of the Traffic Signs Manual.



NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Base mapping provided by MKO

Figure 14-15 Access Junction on R584, proposed layout

PROJECT:	Curraglass Renewable Energy Development		
CLIENT:	Wingleaf Ltd	SCALE:	1:1000
PROJECT NO: 8010	DATE: 04.06.20	DRAWN BY:	AL

ALAN LIPSCOMBE
TRAFFIC & TRANSPORT CONSULTANTS

4.4.3 Traffic Management

A turbine with a blade length of 58.5 metres has been used in assessing the traffic impact of the Proposed Development. the blade transporter for such a turbine blade would have a total vehicle length of 64 metres, including the blade which overhangs the back of the vehicle. The total length of the tower transporter is 46.7 metres with the axles located at the front and rear of the load with no overhang. The vehicles used to transport the nacelles will be similar to the tower transporter. All other vehicles requiring access to the site of the Proposed Development will be smaller than the design test vehicles. The turbine delivery vehicles have been modelled accurately in the Autotrack assessments for the site access junctions, as detailed in Section 14.1 of this EIAR.

The need to transport turbine components on the public roads is not an everyday occurrence in the vicinity of the site of the Proposed Development. However, the procedures for transporting abnormal size loads on the country's roads are well established. While every operation to transport abnormal loads is different and requires careful consideration and planning, escort vehicles, traffic management plans, drive tests, road marshals and convoy escorts from the Garda Traffic Corps are all measures that are regularly employed to gets unusual loads from origin to destination. With over 368 No. wind farms already built and operating in Ireland (Republic and Northern Ireland combined, as per latest available figures on www.iwea.com), transport challenges are something the wind energy industry and specialist transport sector has become particularly adept in finding solutions to.

As an alternative solution for transport of turbine blades, delivery vehicles fitted with blade adapters may be used in order to navigate the existing roads along the turbine delivery route. Blade adaptors allow the turbine blade to be transported at a suitable angle in order to navigate tight bends or obstacles along the delivery route. Plate 4-5 below shows an example of a blade adapter.

Plate 4-5 Blade adaptor transport system

Prior to the construction of the Proposed Development, a detailed traffic management plan will be prepared by the haulage company and submitted to the relevant Local Authority for approval. The plan will include:

- A delivery schedule.
- Details of works or any other minor alteration identified.
- A dry run of the route using vehicles with similar dimensions.

The deliveries of turbine components to the site may be made in convoys of three to five vehicles at a time, and at night when roads are quietest. Convoys will be accompanied by escorts at the front and rear operating a "stop and go" system. Although the turbine delivery vehicles are large, they will not prevent other road users or emergency vehicles passing, should the need arise. The delivery escort vehicles will ensure the turbine transport is carried out in a safe and efficient manner with minimal delay or inconvenience for other road users.

It is not anticipated that any section of the public road network will be closed during transport of turbines, although there will be some delays to local traffic at pinch points. During these periods it may be necessary to operate local diversions for through traffic. All deliveries comprising abnormally large loads where required will be made outside the normal peak traffic periods, usually at night, to avoid disruption to work and school-related traffic.

Prior to the Traffic Management Plan being finalised, a full dry run of the transport operation along the potential routes will be completed using vehicles with attachments to simulate the dimensions of the wind turbine transportation vehicles. This dry run will inform the traffic management plan for agreement with the relevant Local Authority. All turbine deliveries will be provided for in a transport management plan which will have to be prepared in advance of the turbine delivery stage, when the exact transport arrangements are known, delivery dates confirmed and escort proposals in place. Such a transport management plan is typically submitted to the Local Authority for agreement in advance of any abnormal loads using the local roads, and will provide for all necessary safety measures, including a convoy and Garda escort as required, off-peak turning/reversing movements and any necessary safety controls.

4.5 Community Gain Proposal

4.5.1 Background

The Proposed Development has the potential to have significant benefits for the local economy, by means of job creation, landowner payments and commercial rate payments. An important part of wind farm development, which Wingleaf Ltd. has been at the forefront of developing, is its Community Benefit Package. The concept of directing benefits from wind farms to the local community is promoted by the National Economic and Social Council (NESC) and the Irish Wind Energy Association (IWEA) among others. While it may be simpler and easier to put a total fund aside for a wider community area, Wingleaf Ltd. is endeavouring to develop new ways to direct increased gain towards the local community with particular focus on those living closest to the Proposed Development.

The applicant company has given careful consideration to the issue of community gain arising from the Proposed Development, if permitted and constructed. Community gain from significant development proposals, including wind farms, whilst a relatively recent approach, is now a common consideration for developers and, indeed, planning authorities. This approach recognises that, with any significant wind farm proposal, the locality in which the site is situated is making a significant contribution towards helping achieve national renewable energy and climate change targets, and the local community should derive some benefit from accommodating such a development in their locality.

Community gain proposals can take a number of forms, generally depending on the nature and location of the Proposed Development and the nature and make-up of the local community. The nature of the community gain proposal will be subject to discussions with and input from the local community. In some instances, funds are paid by the developer, either annually or as a one-off payment, to a community fund that is administered as agreed by the community. These funds may then be used for a variety of projects, such as environmental improvements, local amenities and facilities, voluntary and sporting groups and clubs, educational projects and energy efficiency improvement works.

4.5.2 The Proposal

The Community Benefit Package which is being proposed for this project has been directed by feedback from ongoing consultation with the local community. Those spoken to in the local area felt that the project should bring with it enduring economic benefits for the local community and that these should be developed at an early stage from operation of the Proposed Development. It was also felt that there should be an opportunity for households in the area to receive a return from the project and that those closest to the Proposed Development should benefit most.

The types of projects and initiatives that could be supported by such a Community Gain proposal could include youth, sport and community facilities, schools, educational and training initiatives, and wider amenity, heritage, and environmental projects. Initial local suggestions for use of the fund included grants for Cappabue National School and St. Colums GAA club, water-mains connections for residents who relied on river water, local enterprise schemes, riparian planting of native species, energy retro-fitting of houses and contributions to electrical bills.

4.5.2.1 Financial Contributions

The community benefit scheme proposes to provide a fund of €60,000 per annum over the lifespan of the proposed development based on the current estimated generating capacity. This will equate to potential funding of €1.8 million to the local community which is a substantial contribution.

The number and size of grant allocations will be decided by a Community Fund liaison committee with various groups and project benefiting to varying degrees depending on their funding requirement.

4.5.3 Community and Voluntary Group Fund

A dedicated annual fund could be made available through the Community Gain Fund for local community groups and voluntary organisations to support their efforts and initiatives in the local communities around the Proposed Development. The types of projects and initiatives that could be supported by such a Community Gain proposal could include youth, sport and community facilities, schools, educational and training initiatives, and wider amenity, heritage, and environmental projects.

The Developer and the Community will set the final qualifying criteria for projects and initiatives seeking funding from the Community Gain Fund. Local community groups and not-for profit organisations around the Proposed Development site that promote the sustainable development of the area will all be considered for their projects and initiatives.

4.5.4 Renewable Energy Fund for Local Residents

As referred to in this EIAR above, the Proposed Development will make a significant contribution towards helping achieve national renewable energy and climate change targets. For a strategic renewable energy project of the scale proposed, a portion of the Community Gain Fund could be dedicated to local residents living within an agreed range of any proposed wind turbine through a Renewable Energy Fund. Such a proposal could see direct payments being made to local residents from the Renewable Energy Fund on an annual basis to cover the cost of their annual electricity bill from a renewable energy supplier of their choosing, and may fund some renewable energy upgrades to their properties to improve energy efficiency, install domestic renewable energy technologies such as heat pumps or solar panels, and overall make them less reliant on fossil-fuel.

4.6 Site Drainage

4.6.1 Introduction

The drainage design for the Proposed Development has been prepared by MKO and reviewed by Hydro Environmental Services Ltd. (HES), and by the firm's principal, Mr. Michael Gill. The protection of the watercourses within and surrounding the site, and downstream catchments that they feed is of utmost importance in considering the most appropriate drainage proposals for the site of the Proposed Development. The Proposed Development's drainage design has therefore been proposed specifically with the intention of having no negative impact on the water quality of the site and its associated rivers and lakes, and consequently no impact on downstream catchments and ecological ecosystems. No routes of any natural drainage features will be altered as part of the Proposed Development and turbine locations and associated new roadways were originally selected to avoid natural watercourses, and existing roads are to be used wherever possible. There will be no direct discharges to any natural watercourses, with all drainage waters being dispersed as overland flows. A self-imposed 50m buffer from streams and lakes was applied where possible during the project design stage and will be maintained during the construction phase. The majority of the Proposed Development areas (including all turbine locations) are located outside of areas that have been assessed to be hydrologically sensitive. All discharges from the proposed works areas will be made over vegetation filters at a minimum of 50m distance from streams and lakes.

Where a 50m buffer has not been achieved from infrastructure on site, appropriate mitigation will be implemented to ensure protection of streams and lakes. This is further detailed in Chapter 9.

4.6.2 Existing Drainage Features

The routes of any natural drainage features will not be altered as part of the Proposed Development. Turbine locations have been selected to avoid natural watercourses. One watercourse crossing will be required on site as part of the Proposed Development, along the new access track to Turbine 6.

There will be no direct discharges to natural watercourses. For the wind turbines and associated infrastructure, all discharges from the proposed works areas or from interceptor drains will be made over vegetated ground at a minimum of 50m distance from streams and lakes, unless otherwise specified in future revisions of the drainage design. Buffer zones around the existing natural drainage features have informed the layout of the Proposed Development, and are indicated on the drainage design drawings. Where a 50m buffer has not been achieved from infrastructure on site, appropriate mitigation will be implemented to ensure protection of streams and lakes.

Where artificial drains are currently in place in the vicinity of proposed works areas, these drains may have to be diverted around the proposed works areas to minimise the amount of water in the vicinity of works areas. Where it may not be possible to divert artificial drains around proposed work areas, the drains will be blocked to ensure sediment laden water from the works areas has no direct route to other watercourses. Where drains have to be blocked, the blocking will only take place after an alternative drainage system to handle the same water has been put in place.

Existing artificial drains in the vicinity of existing site roads will be maintained in their present location where possible. If it is expected that these artificial drains will receive drainage water from works areas, check dams will be added (as specified below) to control flows and sediment loads in these existing artificial drains. If road widening or improvement works are necessary along the existing roads, where possible, the works will take place on the opposite side of the road to the drain.

4.6.3 Drainage Design Principles

The key principles of drainage design that will be implemented and adhered to as part of the Proposed Development are as follows:

- Keep clean water clean by intercepting it where possible, upgradient of works areas, and divert it around the works areas for discharge as diffuse overland flow or for rewetting of land.
- Collect potentially silt-laden runoff from works areas via downgradient collector drains and manage via series of avoidance, source, in-line, treatment and outfall controls prior to controlled diffuse release as overland flow or for rewetting of land.
- No direct hydraulic connectivity from construction areas to watercourses, or drains connecting to watercourses.
- Where possible, maintain 50-metre watercourse buffer zones for the wind turbines.
- No alteration of natural watercourses.
- Maintain the existing hydrology of the site.
- Blocking of existing manmade forestry drainage as appropriate.
- Daily inspection and recording of surface water management system by on-site clerk of works and immediate remedial measures to be carried out as required and works temporarily ceased if a retained stormwater/sediment load is identified to have the potential to migrate from the site.
- Use of siltbuster if required

Drainage water from any works areas of the site of the Proposed Development will not be directed to any natural watercourses within the site. Two distinct methods will be employed to manage drainage water within the site. The first method involves keeping clean water clean by avoiding disturbance to natural drainage features, minimising any works in or around artificial drainage features, and diverting clean surface water flow around excavations and construction areas. The second method involves collecting any drainage waters from works areas within the site that might carry silt or sediment, to allow attenuation and settlement prior to controlled diffuse release.

The drainage design is intended to maximise erosion control, which is more effective than having to control sediment during high rainfall. Such a system also requires less maintenance. The area of exposed ground will be minimised. The drainage measures will prevent runoff from entering the works areas of the site from adjacent ground, to minimise the volume of sediment-laden water that has to be managed. Discoloured run-off from any construction area will be isolated from natural clean run-off.

A schematic line drawing of the proposed drainage design is presented in Figure 4-16 below.

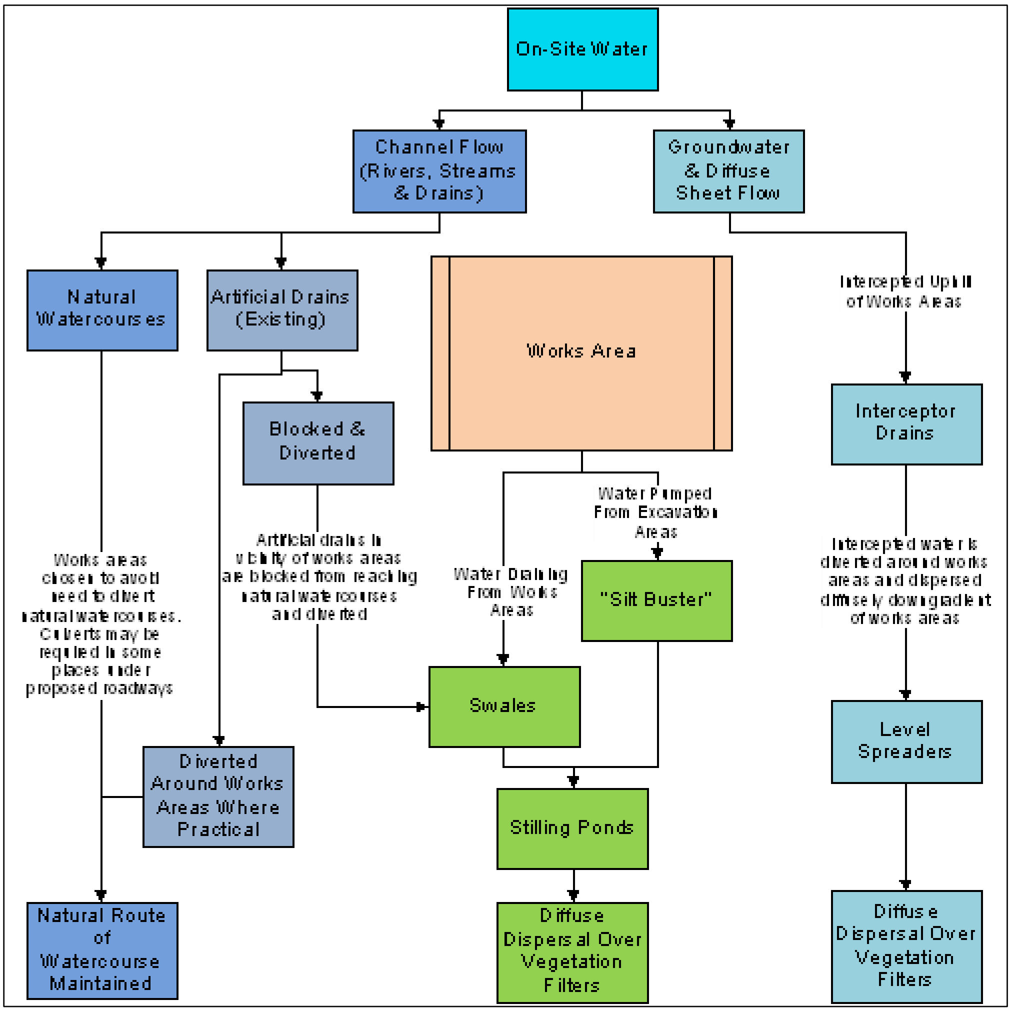


Figure 4-16 Proposed Development Drainage Process Flow

4.6.4 References

The drainage design has been prepared based on experience of the project team of other wind energy sites in similar environments, and the number of best practice guidance documents referred to in the References section of the EIAR.

4.6.5 Drainage Design

A detailed drainage design for the Proposed Development, incorporating all principles and measures outlined in this drainage design description, has been prepared, and is included in Appendix 4-1 to this EIAR. The drainage design employs the various measures further described below.

4.6.5.1 Interceptor Drains

Interceptor drains will be installed upgradient of any works areas to collect surface flow runoff and prevent it reaching excavations and construction areas of the site where it might otherwise have come into contact with exposed surfaces and picked up silt and sediment. The drains will be used to divert upslope runoff around the works area to a location where it can be redistributed over the ground surface as sheet flow. This will minimise the volume of potentially silty runoff to be managed within the construction area.

The interceptor drains will be installed in advance of any main construction works commencing. The material excavated to make the drain will be compacted on the downslope edge of the drain to form a diversion dike. On completion of the construction phase works, it is envisaged that the majority of the interceptor drains could be removed. At that stage, there will be no open excavations or large areas of exposed ground that are likely to give rise to large volumes of potentially silt-laden run off. Any areas in which works were carried out to construct roads, turbine bases or hardstands, will have been built up with large grade hardcore, which even when compacted in place, will retain sufficient void space to allow water infiltrate the subsurface of these constructed areas. It is not anticipated that roadways or other installed site infrastructure will intercept ground-conveyed surface water runoff to any significant extent that would result in scouring or over-topping or spill over. Where the drains are to be removed, they will be backfilled with the material from the diversion dike. Interceptor drains may have to be retained in certain locations, for example where roadways are to be installed on slopes, to prevent the roadways acting of conduits for water that might infiltrate the roadway sub-base. In these cases, interceptor drains would be maintained in localised areas along the roadway with culverts under the roadway, which would allow the intercepted water to be discharged to vegetation filters downgradient of the roadway. Similarly, in localised hollows where water is likely to be funnelled at greater concentrations than on broader slopes, interceptor drains and culverts may be left in situ following construction.

Figure 4-17 below shows an illustrative drawing of an interceptor drain.

The velocity of flow in the interceptor will be controlled by check dams (see Section 4.6.5.3 below), which will be installed at regular intervals along the drains to ensure flow in the channel is non-erosive. On steeper sections where erosion risks are greater, a geotextile membrane will be added to the channel.

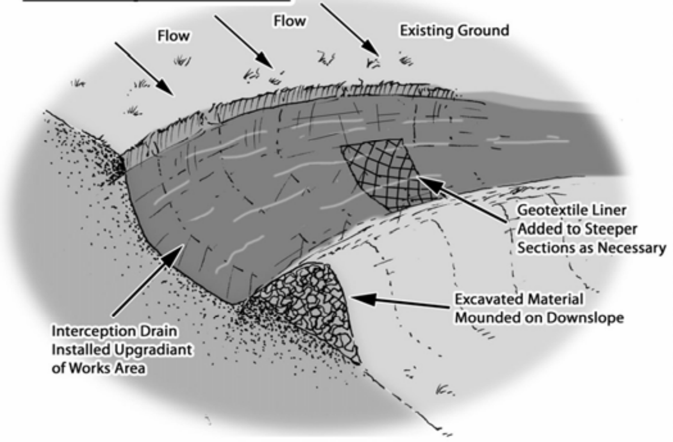
Interceptor drains will be installed horizontally across slopes to run in parallel with the natural contour line of the slope. Intercepted water will travel along the interceptor drains to areas downgradient of works areas, where the drain will terminate at a level spreader (see Section 4.6.5.4 below). Across the entire length of the interceptor drains, the design elevation of the water surface along the route of the drains will not be lower than the design elevation of the water surface in the outlet at the level spreader.

4.6.5.2 Swales

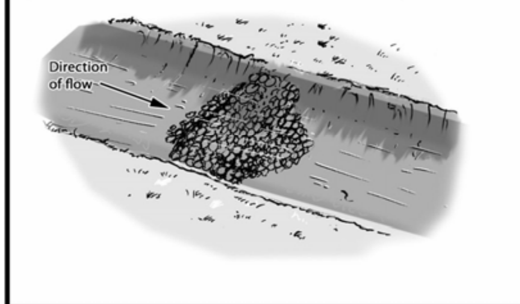
Drainage swales are shallow drains that will be used to intercept and collect run off from construction areas of the site during the construction phase. Drainage swales will remain in place to collect runoff from roads and hardstanding areas of the Proposed Development during the operational phase. A swale is an excavated drainage channel located along the downgradient perimeter of construction areas, used to collect and carry any sediment-laden runoff to a sediment-trapping facility and stabilised outlet. Swales are proven to be most effective when a dike is installed on the downhill side. They are similar in design to interceptor drains and collector drains described above. Figure 4-17 below, shows an illustrative example of a drainage swale.

Drainage swales will be installed downgradient of any works areas to collect surface flow runoff where it might have come into contact with exposed surfaces and picked up silt and sediment. Swales will intercept

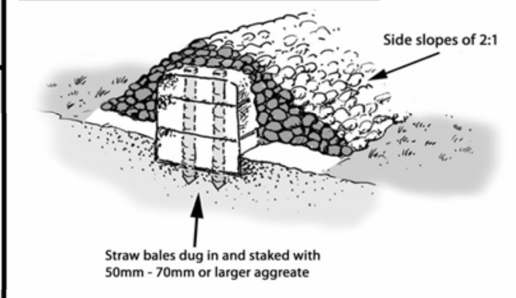
Interceptor Drain



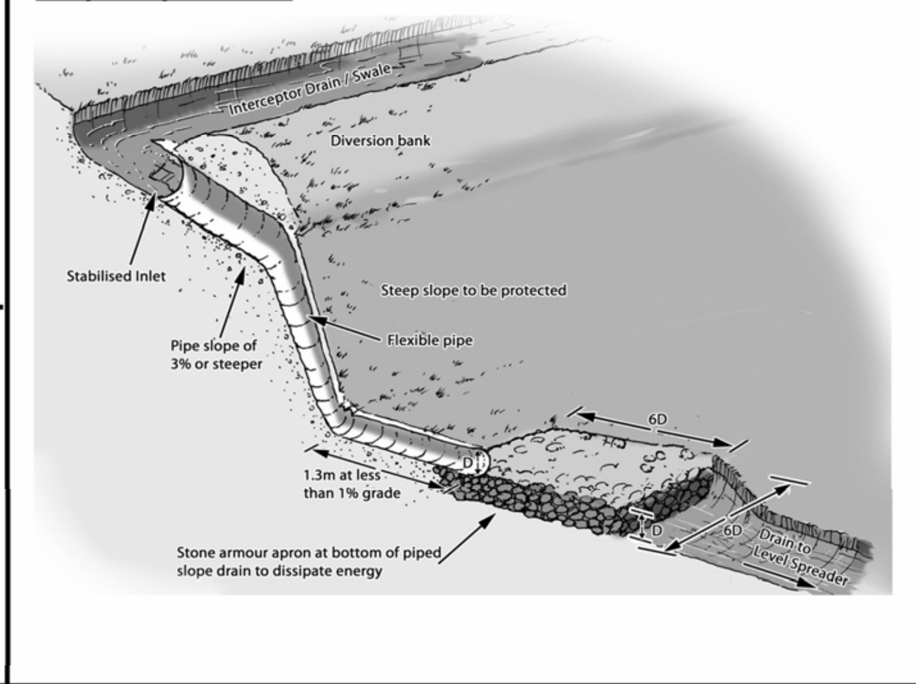
Check Dam (Stone Dam in Drain)



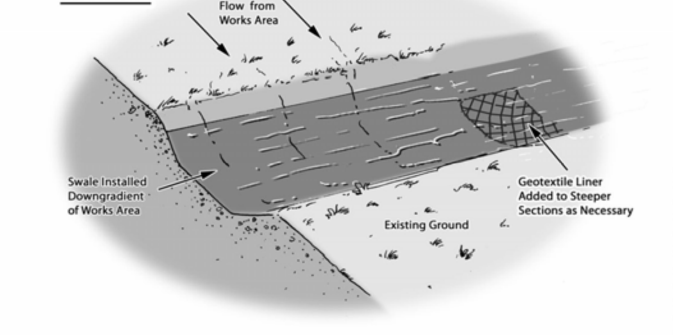
Check Dam
(Straw Bale & Stone Dam - Cross Section)



Slope Pipe Drain

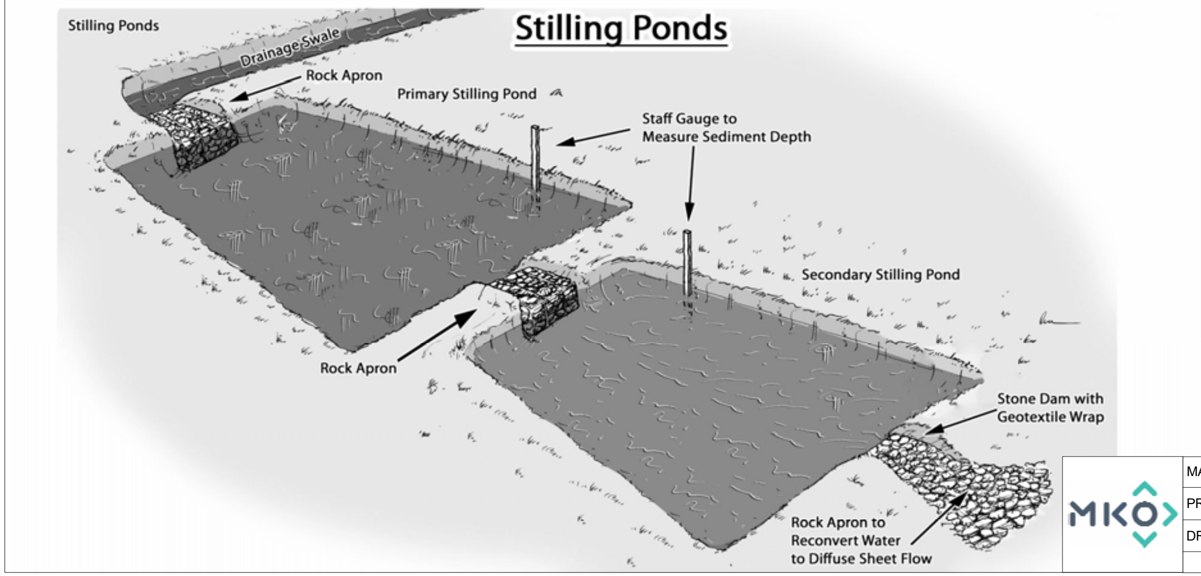


Swale

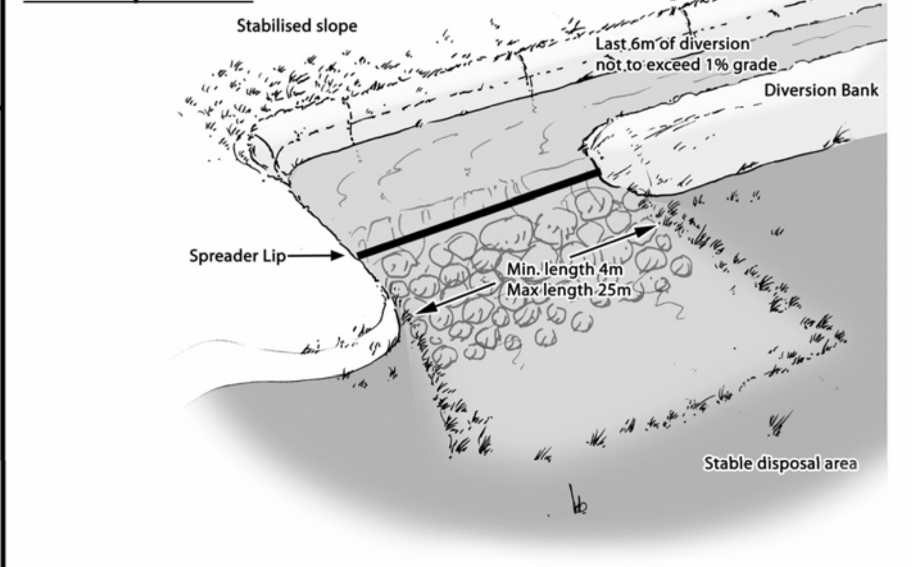


Drainage Design Measures

Stilling Ponds



Level Spreader



MAP TITLE: **Drainage Design Measure Illustrations**		MAP NO.: **Figure 4-17**	SCALE: **NTS**
PROJECT TITLE: **190301- Curraglass Renewable Energy Development, Co. Cork**		DATE: **28-04-2020**	
DRAWING BY: **Órla Murphy**	CHECKED BY: **Michael Watson**	ISSUE NO.: **190301 - 2020.04.28- F**	

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the potentially silt-laden water from the excavations and construction areas of the site and prevent it reaching natural watercourses.

Drainage swales will be installed in advance of any main construction works commencing. The material excavated to make the swale will be compacted on the downslope edge of the drain to form a diversion dike.

4.6.5.3 Check Dams

The velocity of flow in the interceptor drains and drainage swales, particularly on sloped sections of the channel, will be controlled by check dams, which will be installed at regular intervals along the drains to ensure flow in the swale is non-erosive. Check dams will also be installed in some existing artificial drainage channels that will receive waters from works areas of the site.

Check dams will restrict flow velocity, minimise channel erosion and promote sedimentation behind the dam. The check dams will be installed as the interceptor drains are being excavated. Check dams may also be installed in some of the existing artificial drainage channels on the site, downstream of where drainage swales connect in.

The proposed check dams will be made up of straw bales or stone, or a combination of both depending on the size of the drainage swale it is being installed in. Where straw bales are to be used, they will be secured to the bottom of the drainage swale with stakes. Clean 4-6 inch stone will be built up on either side and over the straw bale to a maximum height of 600mm over the bottom of the interceptor drain. In smaller channels, a stone check dam will be installed and pressed down into place in the bottom of the drainage swale with the bucket of an excavator.

Figure 4-17, above, shows illustrative examples of check dams.

The check dams will be installed at regular intervals along the interceptor drains to ensure the bottom elevation of the upper check dam is at the same level as the top elevation of the next down-gradient check dam in the drain. The centre of the check dam will be approximately 150mm lower than the edges to allow excess water to overtop the dam in flood conditions rather than cause upstream flooding or scouring around the dams.

Check dams will not be used in any natural watercourses, only artificial drainage channels and interceptor drains. The check dams will be left in place at the end of the construction phase to limit erosive linear flow in the drainage swales during extreme rainfall events.

Check dams are designed to reduce velocity and control erosion and are not specifically designed or intended to trap sediment, although sediment is likely to build up. If necessary, any excess sediment build up behind the dams will be removed. For this reason, check dams will be inspected and maintained regularly to insure adequate performance. Maintenance checks will also ensure the centre elevation of the dam remains lower than the sides of the dam.

4.6.5.4 Level Spreaders

A level spreader will be constructed at the end of each interceptor drain to convert concentrated flows in the drain, into diffuse sheet flow on areas of vegetated ground. The levels spreaders will be located downgradient of any proposed works areas in locations where they are not likely to contribute further to water ingress to construction areas of the site.

The water carried in interceptor drains will not have come in contact with works areas of the site, and therefore should be free of silt and sediment. The level spreaders will distribute clean drainage water onto vegetated areas where the water will not be reconcentrated into a flow channel immediately below the point of discharge. The discharge point will be on level or only very gently sloping ground rather than on a steep slope so as to prevent erosion. Figure 4-17, above, shows an illustrative example of a level spreader.

The slope in the channel leading into the spreader will be less than or equal to 1%. The slope downgradient of the spreader onto which the water will dissipate will have a grade of less than 6%. The availability of slopes with a grade of 6% or less will determine the locations of level spreaders. If a slope grade of less than 6% is not available in the immediate area downgradient of a works area at the end of a diversion drain, a piped slope drain (see Section 4.6.5.5 below) will be used to transfer the water to a suitable location.

The spreader lip over which the water will spill will be made of a concrete kerb, wooden board, pipe, or other similar piece of material that can create a level edge similar in effect to a weir. The spreader will be level across the top and bottom to prevent channelised flow leaving the spreader or ponding occurring behind the spreader. The top of the spreader lip will be 150mm above the ground behind it. The length of the spreader will be a minimum of four metres and a maximum length of 25 metres, with the actual length of each spreader to be determined by the size of the contributing catchment, slope and ground conditions.

Clean four-inch stone can be placed on the outside of the spreader lip, and pressed into the ground mechanically to further dissipate the flow leaving the level spreader over a larger area.

4.6.5.5 Piped Slope Drains

Piped slope drains will be used to convey surface runoff from diversion drains safely down slopes to flat areas without causing erosion. Once the runoff reaches the flat areas it will be reconverted to diffuse sheet flow. Level spreaders will only be established on slopes of less than 6% in grade. Piped slope drains will be used to transfer water away from areas where slopes are too steep to use level spreaders.

The piped slope drains will be semi-rigid corrugated pipes with a stabilised entrance and a rock apron at the outlet to trap sediment and dissipate the energy of the water. The base of drains leading into the top of the piped slope drain will be compacted and concavely formed to channel the water into the corrugated pipe. The entrance at the top of the pipe will be stabilised with sandbags if necessary. The pipe will be anchored in place by staking at approximately 3-4 metre intervals or by weighing down with compacted soil. The bottom of the pipe will be placed on a slope with a grade of less than 1% for a length of 1.5 metres, before outflowing onto a rock apron.

The rock apron at the outlet will consist of 6-inch stone to a depth equal to the diameter of the pipe, a length six times the diameter of the pipe. The width of the rock apron will be three times the diameter of the pipe where the pipe opens onto the apron and will fan out to six times the diameter of the pipe over its length. Figure 4-17, above, shows a diagrammatic example of a piped slope drain and rock apron.

Piped slope drains will only remain in place for the duration of the construction phase of the Proposed Development. on completion of the works, the pipes and rock aprons will be removed and all channels backfilled with the material that was originally excavated from them.

Piped slope drains will be inspected weekly and following rainfall events. Inlet and outlets will be checked for sediment accumulation and blockages. Stake anchors or fill over the pipe will be checked for settlement, cracking and stability. Any seepage holes where pipe emerges from drain at the top of the pipe will be repaired promptly.

4.6.5.6 Vegetation Filters

Vegetation filters are the existing vegetated areas of land that will be used to accept surface water runoff from upgradient areas. The selection of suitable areas to use as vegetation filters will be determined by the size of the contributing catchment, slope and ground conditions.

Vegetation filters will carry outflow from the level spreaders as overland sheet flow, removing any suspended solids and discharging to the groundwater system by diffuse infiltration.

Vegetation filters will not be used in isolation for waters that are likely to have higher silt loadings. In such cases, silt-bearing water will already have passed through stilling ponds prior to diffuse discharge to the vegetation filters via a level spreader.

4.6.5.7 Stilling Ponds

Stilling ponds will be used to attenuate runoff from works areas of the site of the Proposed Development during the construction phase, and will remain in place to handle runoff from roads and hardstanding areas of the Proposed Development during the operational phase. The purpose of the stilling ponds is to intercept runoff potentially laden with sediment and to reduce the amount of sediment leaving the disturbed area by reducing runoff velocity. Reducing runoff velocity will allow larger particles to settle out in the stilling ponds, before the run-off water is redistributed as diffuse sheet flow in filter strips downgradient of any works areas.

Stilling ponds will be excavated/constructed at each required location as two separate ponds in sequence, a primary pond and a secondary pond. The points at which water enters and exits the stilling ponds will be stabilised with rock aprons, which will trap sediment, dissipate the energy of the water flowing through the stilling pond system, and prevent erosion. The primary stilling pond will reduce the velocity of flows to less than 0.5 metres per second to allow settlement of silt to occur. Water will then pass from the primary pond to the secondary pond via another rock apron. The secondary stilling pond will reduce the velocity of flows to less than 0.3 metres per second. Water will flow out of the secondary stilling pond through a stone dam, partially wrapped in geo-textile membrane, which will control flow velocities and trap any sediment that has not settled out. Figure 4-17, above, shows an illustrative example of a stilling pond system.

Water will flow by gravity through the stilling pond system. The stilling ponds will be sized according to the size of the area they will be receiving water from, but will be sufficiently large to accommodate peak flows storm events. The stilling ponds will be dimensioned so that the length to width ratio will be greater than 2:1, where the length is the distance between the inlet and the outlet. Where ground conditions allow, stilling ponds will be constructed in a wedge shape, with the inlet located at the narrow end of the wedge. Each stilling pond will be a minimum of 1-1.5 metres in depth. Deeper ponds will be used to minimise the excavation area needed for the required volume.

The embankment that forms the sloped sides of the stilling ponds will be stabilised with vegetated turves, which will have been removed during the excavation of the stilling ponds area. All material excavated during pond construction will be used locally for landscaping and berm construction around these ponds.

Stilling ponds will be located towards the end of swales, close to where the water will be reconverted to diffuse sheet flow. Upon exiting the stilling pond system, water will be immediately reconverted to diffuse flow via a fan-shaped rock apron if there is adequate space and ground conditions allow. Otherwise, a swale will be used to carry water exiting the stilling pond system to a level spreader to reconvert the flow to diffuse sheet flow.

Stilling ponds will be inspected weekly and following rainfall events. Inlet and outlets will be checked for sediment accumulation and anything else that might interfere with flows.

4.6.5.8 Siltbuster

A “siltbuster” or similar equivalent piece of equipment will be available to filter any water pumped out of excavation areas if necessary, prior to its discharge to stilling ponds or swales.

Siltbusters are mobile silt traps that can remove fine particles from water using a proven technology and hydraulic design in a rugged unit. The mobile units are specifically designed for use on construction sites.

The unit stills the incoming water/solids mix and routes it upwards between a set of inclined plates for separation. Fine particles settle onto the plates and slide down to the base for collection, whilst treated water flows to an outlet weir after passing below a scum board to retain any floating material. The inclined plates dramatically increase the effective settling area of the unit giving it a very small footprint on site and making it highly mobile. Figure 4-18 below shows an illustrative diagram of the Siltbuster.

The Siltbuster units are now considered best practice for the management of dirty water pumped from construction sites. The UK Environment Agency and the Scottish Environmental Protection Agency have all recommended/specified the use of Siltbuster units on construction projects.

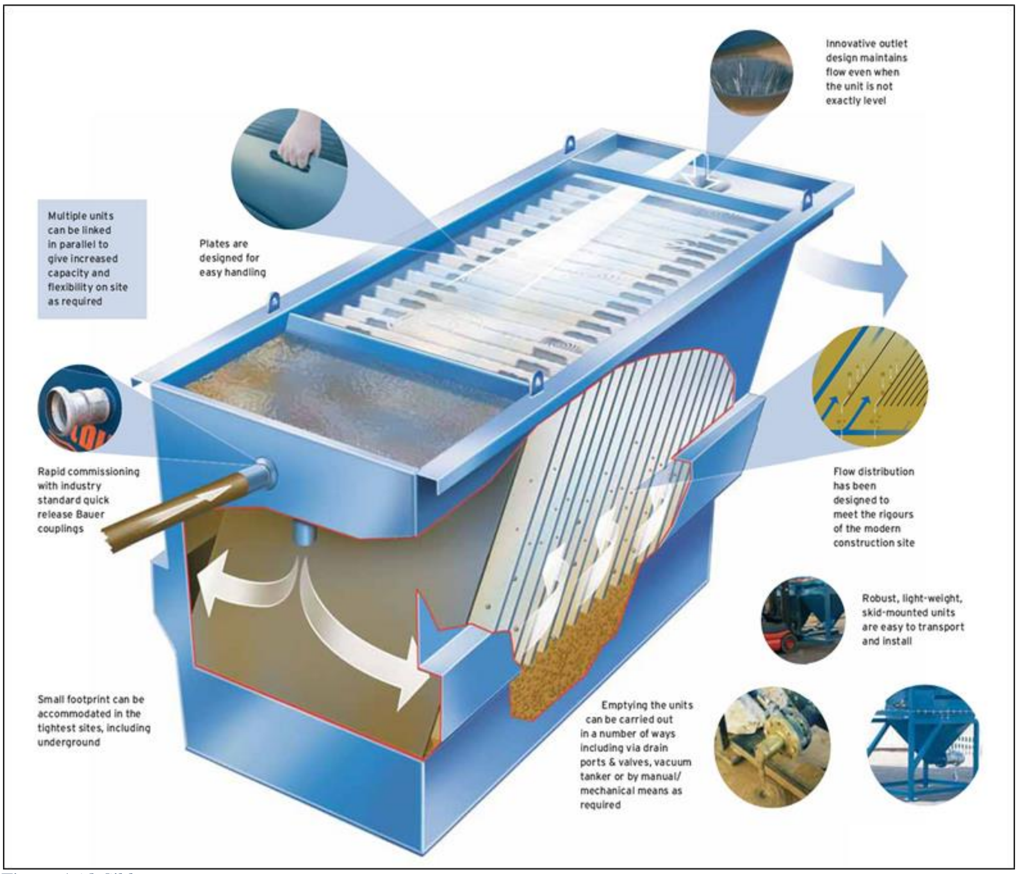

Figure 4-18 Siltbuster

4.6.5.9 Silt Bags

Dewatering silt bags allow the flow of water through them while trapping any silt or sediment suspended in the water. The silt bags provide a passive non-mechanical method of removing any remaining silt contained in the potentially silt-laden water collected from works areas within the site.

Dewatering silt bags are an additional drainage measure that can be used downgradient of the stilling ponds at the end of the drainage swale channels and will be located, wherever it is deemed appropriate, throughout the site. The water will flow, via a pipe, from the stilling ponds into the silt bag. The silt bag will allow the water to flow through the geotextile fabric and will trap any of the finer silt and sediment remaining in the water after it has gone through the previous drainage measures. The dewatering silt bags will ensure that there will be no loss of peaty silt into the stream.

The dewatering silt bag that will be used will be approximately 3 metres in width by 4.5 metres (see Plate 4-6 and Plate 4-7 below) in length and will be capable of trapping approximately four tonnes of silt. The dewatering silt bag, when full, will be removed from site by a waste contractor with the necessary waste collection permit, who will then transport the silt bag to an appropriate, fully licensed waste facility.

Plate 4-6 Silt Bag with water being pumped through

Plate 4-7 Silt bag under inspection

4.6.5.10 Sedimats

Sediment entrapment mats, consisting of coir or jute matting, will be placed at the outlet of the silt bag to provide further treatment of the water outfall from the silt bag. Sedimats will be secured to the ground surface using stakes/pegs. The sedimat will extend to the full width of the outfall to ensure all water passes through this additional treatment measure.

4.6.5.11 Culverts

All new proposed culverts and proposed culvert upgrades will be suitably sized for the expected peak flows in the watercourse. The proposed new access track to Turbine no. 6 will traverse a forestry drain as part of providing access to the turbine area. The crossing of this drain will be completed using a culvert system.

Some culverts may be installed to manage drainage waters from works areas of the Proposed Development, particularly where the waters have to be taken from one side of an existing roadway to the other for discharge. The size of culverts will be influenced by the depth of the track or road sub-base. In some cases, two or more smaller diameter culverts may be used where this depth is limited, though this will be avoided as they will have a higher associated risk of blockage than a single, larger pipe. In all cases, culverts will be oversized to allow mammals to pass through the culvert.

Culverts will be installed with a minimum internal gradient of 1% (1 in 100). Smaller culverts will have a smooth internal surface. Larger culverts may have corrugated surfaces which will trap silt and contribute to the stream ecosystem. Depending on the management of water on the downstream side of the culvert, large stone may be used to interrupt the flow of water. This will help dissipate its energy and help prevent problems of erosion. Smaller water crossings will simply consist of an appropriately sized pipe buried in the sub-base of the road at the necessary invert level to ensure ponding or pooling doesn't occur above or below the culvert and water can continue to flow as necessary.

All culverts will be inspected regularly to ensure they are not blocked by debris, vegetation or any other material that may impede conveyance. All new crossings and upgrades to existing crossings will be completed as detailed in Appendix 4-3.

4.6.5.12 Silt Fences

Silt fences will be installed as an additional water protection measure around existing watercourses in certain locations, particularly where works are proposed within the 50-metre buffer zone of a stream or 100m buffer zone of a lake, which is inevitable where existing roads in proximity to watercourses are to be upgraded as part of the Proposed Development. These areas include around existing culverts, around the headwaters of watercourses, and the proposed locations are indicated on the detailed drainage design drawings included in Appendix 4-1.

Silt fences will be installed as single, double or a series of triple silt fences, depending on the space available and the anticipated sediment loading. The silt fence designs follow the technical guidance document '*Control of Water Pollution from Linear Construction Projects*' published by CIRIA (Ciria, No. C648, 1996). Up to three silt fences may be deployed in series.

All silt fencing will be formed using Terrastop Premium or equivalent silt fence product.

Silt fences will be inspected regularly to ensure water is continuing to flow through the fabric, and the fence is not coming under strain from water backing up behind it.

4.6.5.13 Forestry Felling Drainage

The Proposed Development will only require the felling of a very small area of forestry, relative to the overall area of the site. Tree felling to facilitate the Proposed Development will not be undertaken simultaneously with construction groundworks. Keyhole felling to facilitate construction works will take place prior to groundworks commencing. Some further turbulence felling may take place after all groundworks have been completed but while turbines are being commissioned (depending on the requirements of the selected turbine manufacturer).

Before the commencement of any felling works, an Environmental Clerk of Works (ECoW) shall be appointed to oversee the keyhole and extraction works. The ECoW shall be experienced and competent, and shall have the following functions:

- Attend the site for the setup period when drainage protection works are being installed, and be present on site during the remainder of the forestry keyhole felling works.
- Prior to the commencement of works, review and agree the positioning by the Operator of the required Aquatic Buffer Zones (ABZs), silt traps, silt fencing (see below), water crossings and onsite storage facilities for fuel, oil and chemicals (see further below).
- Be responsible for preparing and delivering the Environmental Tool Box Talk (TBT) to all relevant parties involved in site operations, prior to the commencement of the works.
- Conduct daily and weekly inspections of all water protection measures and visually assess their integrity and effectiveness in accordance with Section 3.4 (Monitoring and Recording) and Appendix 3 (Site Monitoring Form (Visual Inspections)) of the Forestry & FPM Requirements.
- Take representative photographs showing the progress of operation onsite, and the integrity and effectiveness of the water protection measures.
- Collect water samples for analysis by a 3rd party accredited laboratory, adhering to the following requirements:
    - Surface water samples shall be collected upstream and downstream of the keyhole felling site at suitable sampling locations.
    - Sampling shall be taken from the stream / river bank, with no in-stream access permitted.
    - The following minimum analytical suite shall be used: pH, EC, TSS, BOD, Total P, Ortho-P, Total N, and Ammonia.
- Review of operator's records for plant inspections, evidence of contamination and leaks, and drainage checks made after extreme weather conditions.
- Prepare and maintain a contingency plan.
- Suspend work where potential risk to water from siltation and pollution is identified, or where operational methods and mitigation measures are not specified or agreed.
- Prepare and maintain a Water Protection Measure Register. This document is to be updated weekly by the ECoW.

All relevant measures set out in the Forestry & Freshwater Pearl Mussel Requirements, Forestry & Water Quality Guidelines, Forest Harvesting & the Environment Guidelines and the Forest Protection Guidelines will apply. To protect watercourses, the following measures will be adhered to during all keyhole/tree felling activities.

- Works will be overseen by an ECoW as described above.
- The extent of all necessary tree felling will be identified and demarcated with markings on the ground in advance of any felling commencing.
- All roads and culverts will be inspected prior to any machinery being brought on site to commence the felling operation. No tracking of vehicles through watercourses will

occur. Vehicles will only use existing road infrastructure and established watercourse crossings.

- Existing drains that drain an area to be felled towards surface watercourses will be blocked, and temporary silt traps will be constructed to ensure collection of all silt within felling areas. These temporary silt traps will be cleaned out and backfilled once felling works are complete. This ensures there is no residual collected silt remaining in blocked drains after felling works are completed. No direct discharge of such drains to watercourses will occur from within felling areas.
- New collector drains and sediment traps will be installed during ground preparation to intercept water upgradient of felling areas and divert it away. Collector drains will be excavated at an acute angle to the contour (0.3%-3% gradient), to minimise flow velocities.
- All silt traps will be sited outside of buffer zones and have no direct outflow into the aquatic zone. Machine access will be maintained to enable the accumulated sediment to be excavated. Sediment will be carefully disposed of away from all aquatic zones.
- All new collector drains will taper out before entering the aquatic buffer zone to ensures the discharging water gently fans out over the buffer zone before entering the aquatic zone.
- Machine combinations will be chosen which are most suitable for ground conditions at the time of felling, and which will minimise soils disturbance;
- Mechanised operations will be suspended during and immediately after heavy rainfall.
- Where brash is required to form brash mats, it is to be laid out at harvesting stage to prevent soil disturbance by machine movement.
- Brash which has not been pushed into the soil may be moved within the site to facilitate the creation of mats in more demanding locations.
- Felling of trees will be pointed directionally away from watercourses.
- Felling will be planned to minimise the number of machine passes in any one area.
- Extraction routes, and hence brash mats, will be aligned parallel to the ground contours where possible.
- Harvested timber will be stacked in dry areas, and outside any 50-metre watercourse buffer zone. Straw bales and check dams to be emplaced on the down gradient side of timber storage sites.
- Branches, logs or debris will not be allowed to build up in aquatic zones. All such material will be removed when harvesting operations have been completed, but removing of natural debris deflectors will be avoided.

4.6.6 Borrow Pit Drainage

While surface water will be contained in the borrow pit areas, the design proposal is to control the level of water in the borrow pit area by creating a single point outlet from the basin-like area that will ensure the water does not overtop the pit area. Run-off from the proposed borrow pit areas will be controlled via a single outlet that will be installed at the edge of the borrow pit. The single outfall point will be constructed to handle runoff from the borrow pit and its immediate surrounds. Interceptor drains will already have been installed upgradient of the borrow pit area before any extraction begins.

During the construction phase of the project, it will be necessary to keep the borrow pit area free of standing water while rock is still being extracted. This will be achieved by using a mobile pump, which will pump water into the same series of drains, settlement ponds with a level spreader, siltbuster or equivalent, which will receive the water from the single outlet.

4.6.7 Cable Trench Drainage

Cable trenches are typically developed in short sections, thereby minimising the amount of ground disturbed at any one time, and minimising the potential for drainage runoff to pick up silt or suspended solids. Each short section of trench is excavated, ducting installed and bedded, and backfilled with the appropriate materials, before work on the next section commences.

To efficiently control drainage runoff from cable trench works areas, excavated material is stored on the upgradient side of the trench. Should any rainfall cause runoff from the excavated material, the material is contained in the downgradient cable trench. Excess subsoil is removed from the cable trench works area immediately upon excavation, and in the case of the Proposed Development, would be transported to the on-site borrow pit or used for landscaping and reinstatements of other areas elsewhere on site.

On steeper slopes, silt fences, as detailed in Section 4.6.5.12, above, will be installed temporarily downgradient of the cable trench works area, or on the downhill slope below where excavated material is being temporarily stored to control run-off.

Measures that will be implemented to ensure that directional or horizontal drilling works, underneath natural watercourse channels, do not have a negative effect on water quality are outlined below, including a blow-out (Frac-out) prevention and contingency plan.

- In order to prevent significant water quality impacts and morphological impacts, trenchless technology will be carried out to install the cable below the watercourse;
- The crossing works area will be clearly marked out with fencing or flagging tape to avoid unnecessary disturbance of vegetation;
- A minimum 15 metre vegetative buffer zone will be maintained between the works area and the watercourse;
- There will be no storage of material / equipment or overnight parking of machinery inside the 15m buffer zone;
- Before any ground works are undertaken, double silt fencing will be placed upslope of the watercourse channel along the 15m buffer zone boundary;
- Additional silt fencing or straw bales (pinned down firmly with stakes) will be placed across any natural surface depressions / channels that slope towards the watercourse;
- Silt fencing will be embedded into the local soils to ensure all site water is captured and filtered;
- If rainfall events occur during the works, there will be a requirement to collect and treat small volumes of surface water from areas of disturbed ground (i.e. soil and subsoil exposures created during site preparation works);
- This will be completed using a shallow swale and sump down slope of the disturbed ground; and water will be pumped to a proposed percolation area at least 50m from the watercourse
- The discharge of water onto vegetated ground at the percolation area will be via a silt bag which will filter any remaining sediment from the pumped water. The entire percolation area will be enclosed by a perimeter of double silt fencing;
- Any sediment laden water from the works area will not be discharged directly to a watercourse or drain;
- Works shall not take place during periods of heavy rainfall and will be scaled back or suspended if heavy rain is forecasted;
- Daily monitoring of the launch and reception pit works area, the water treatment and pumping system and the percolation area will be completed by a suitably qualified person during the construction phase. All necessary preventative measures will be implemented to ensure no entrained sediment, or deleterious matter is discharged to the watercourse
- If high levels of silt or other contamination is noted in the pumped water or the treatment systems, all construction works will be stopped. No works will recommence until the issue is resolved and the cause of the elevated source is remedied;
- On completion of the works, the ground surface disturbed during the site preparation works and at the entry and exit pits will be carefully reinstated and re-seeded at the earliest opportunity to prevent soil erosion;
- The silt fencing upslope of the river will be left in place and maintained until the disturbed ground has re-vegetated;
- There will be no batching or storage of cement allowed at the watercourse crossing;
- There will be no refuelling allowed within 100m of the watercourse crossing; and,
- All plant will be checked for purpose of use prior to mobilisation at the watercourse crossing.

4.6.8 Site and Drainage Management

4.6.8.1 Preparative Site Drainage Management

All materials and equipment necessary to implement the drainage measures outlined above, will be brought on-site in advance of any works commencing. An adequate amount of straw bales, clean stone, terram, stakes, etc will be kept on site at all times to implement the drainage design measures as necessary. The drainage measures outlined in the above will be installed prior to, or at the same time as the works they are intended to drain.

4.6.8.2 Pre-emptive Site Drainage Management

The works programme for the groundworks part of the construction phase of the Proposed Development will also take account of weather forecasts, and predicted rainfall in particular, working under a schedule of works operation system (SOWOR) system as proposed in the planning application. Large excavations, large movements of overburden or large scale overburden or soil stripping will be suspended or scaled back if heavy rain is forecast. The extent to which works will be scaled back or suspended will relate directly to the amount of rainfall forecast.

4.6.8.3 Reactive Site Drainage Management

The final drainage design prepared for the Proposed Development prior to commencement of construction will have to provide for reactive management of drainage measures. The effectiveness of drainage measures designed to minimise runoff entering works areas and capture and treat silt-laden water from the works areas, will be monitored continuously by the environmental clerk of works or supervising hydrologist on-site. The environmental clerk of works or supervising hydrologist will respond to changing weather, ground or drainage conditions on the ground as the project proceeds, to ensure the effectiveness of the drainage design is maintained in so far as is possible. This may require the installation of additional check dams, interceptor drains or swales as deemed necessary on-site. The drainage design may have to be modified on the ground as necessary, and the modifications will draw on the various features outlined above in whatever combinations are deemed to be most appropriate to situation on the ground as a particular time.

In the event that works are giving rise to siltation of watercourses, the environmental clerk of works or supervising hydrologist will stop all works in the immediate area around where the siltation is evident. The source of the siltation will be identified and additional drainage measures such as those outlined above will be installed in advance of works recommencing.

4.6.9 Drainage Maintenance

An inspection and maintenance plan for the drainage system onsite will be prepared in advance of commencement of any works on the Proposed Development. Regular inspections of all installed drainage features will be necessary, especially after heavy rainfall, to check for blockages, and ensure there is no build-up of standing water at parts of the systems where it is not intended. The inspection of the drainage system will be the responsibility of the environmental clerk of works or the supervising hydrologist.

If necessary, any excess sediment build up behind check dams will be removed. For this reason, check dams will be inspected and maintained weekly during the construction phase of the project to insure adequate performance. Maintenance checks will also ensure the centre elevation of the dam remains lower than the sides of the dam.

Check dams will also be inspected weekly during the construction phase of the Proposed Development and following rainfall events to ensure the structure of the dam is still effective in controlling flow. Any scouring around the edges of the check dams or overtopping of the dam in normal flow conditions will be rectified be reinforcement of the check dam.

Drainage swales will be regularly inspected for evidence of erosion along the length of the swale. If any evidence of erosion is detected, additional check dams will be installed to limit the velocity of flow in the channel and reduce the likelihood of erosion occurring in the future.

Silt traps will be inspected weekly during the construction phase of the Proposed Development and following rainfall events. Inlet and outlets will be checked for sediment accumulation and anything else that might interfere with flows.

The frequency of drainage system inspections will be reduced following completion of the construction phase of the Proposed Development. The project hydrologist will inspect and review the drainage system after construction has been completed to provide guidance on the requirements of an operational phase drainage system.

4.6.10 Construction Timing

It is estimated that the construction phase of the Proposed Development will take approximately 12-18 months from starting on site to the commissioning of the electrical system. In the interest of breeding birds, construction will not commence during the bird breeding season which runs from the 1st of March to the 31st of August inclusive. Construction may commence at any stage from September onwards to the end of February, so that construction activities are ongoing by the time the next breeding bird season comes around, and can continue throughout the next breeding season.

4.6.11 Construction Sequencing

The construction phase can be broken down into three main phases, 1) civil engineering works - 10 months, 2) electrical works - 6 months, and 3) turbine erection and commissioning - 8 months. The main task items under each of the three phases are outlined below.

Civil Engineering Works

- Clear and hardcore area for temporary site offices. Install same.
- Construct bunded area for oil tanks.
- Construct new site roads and hard-standings and crane pads.
- Construct drainage ditches, culverts etc. integral to road construction.
- Excavate for turbine bases. Place blinding concrete to turbine bases. Fix reinforcing steel and anchorage system for tower section. Construct shuttering. Fix any ducts etc. to be cast in. Pour concrete bases. Cure concrete. Remove shutters after 1-2 days.
- Construct bases/plinths for transformer.
- Excavate trenches for site cables, lay cables and backfill. Provide ducts at road crossings.
- Erect fencing at transformer compound.
- Backfill tower foundations and cover with previously stored topsoil.
- Complete site works, reinstate site.
- Remove temporary site offices. Provide any gates, landscaping, signs etc. which may be required.

Electrical Works

- Erect transformers at compound.
- Install Ring Main Units
- Install battery storage containers and ancillary equipment.

Turbine and Meteorological Mast Erection

- Erect towers, nacelles and blades.
- Complete electrical installation.
- Grid connection.
- Commission and test turbines.

The phasing and scheduling of the main construction task items are outlined in Figure 4-19 below, where January 2021 has been selected as an arbitrary start date for construction activities.

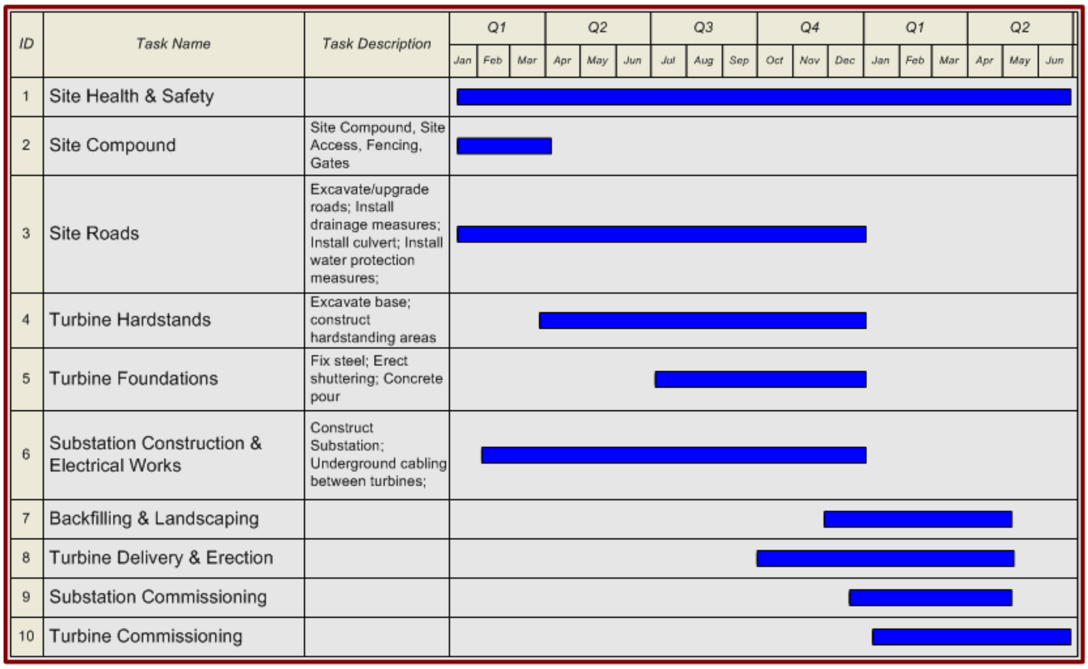

Figure 4-19 Indicative Construction Schedule

4.6.12 Construction Phase Monitoring and Oversight

The requirement for a Construction and Environmental Management Plan (CEMP) to be prepared in advance of any construction works commencing on any development site and submitted for agreement to the Planning Authority is now well-established. The proposed procedures for the implementation of the mitigation measures outlined in such a CEMP and their effectiveness and completion is typically audited by way of a Construction and Environmental Management Plan Audit Report. The CEMP Audit Report effectively lists all mitigation measures prescribed in any of the planning documentation, all conditions attached to the grant of planning permission and any further mitigation measures proposed during the detailed design stage, and allows them to be audited on a systematic and regular basis. The first assessment is a simply Yes/No question, has the mitigation measure been employed on-site or not? Following confirmation that the mitigation measure has been implemented, the effectiveness of the mitigation measures has to be the subject of regular review and audit during the full construction stage of the project. If some remedial actions are needed to improve the effectiveness of the mitigation measure, then these are notified to the site staff immediately during the audit site visit, and in writing by way of the circulation of the audit report. Depending on the importance and urgency of rectifying the issue, the construction site manager is given a timeframe by when the remedial works need to be completed.

A Construction Environmental Management Plan (CEMP) has been prepared for the Proposed Development, and is included in Appendix 4-3 of this EIAR. The CEMP includes details of drainage, peat and overburden management, waste management etc, and gives examples of how the above-mentioned Audit Report will function and be presented. It is intended that the CEMP would be updated prior to the commencement of the Proposed Development, to include all mitigations measures, conditions and or alterations to the EIAR and application documents that may emerge during the course of the planning process, and would be submitted to the Planning Authority for written approval.

The on-site construction staff will be responsible for implementing the mitigation measures specified in the EIAR and compiled in the Audit Report. Their implementation will be overseen by the environmental clerk of works or supervising hydrogeologists, environmental scientists, ecologists or geotechnical engineers, depending on who is best placed to advise on the implementation. The system of auditing referred to above ensures that the mitigation measures are maintained for the duration of the construction phase, and into the operational phase where necessary.

4.7 Construction Methodologies

4.7.1 Turbine Foundations

Each of the turbines to be erected on site will have a reinforced concrete base. Overburden will be stripped off the foundation area to a suitable formation using a 360° excavator with most being removed to the onsite borrow pit while some will be stored locally for later reuse in backfilling around the turbine foundation. A five-metre-wide working area will be required around each turbine base, with the sides of the excavated areas sloped sufficiently to ensure that slippage does not occur. Material excavated to create the working area will be stored locally for later reuse in backfilling the working area around the turbine foundation. The excavated material will be surrounded by silt fences to ensure sediment-laden run-off does not occur.

The formation material will have to be approved by an engineer as meeting the turbine manufacturer's requirements. If the formation level is reached at a depth greater than the depth of the foundation, the ground level will have to be raised with clause 804 or similar hardcore material, compacted in 250 millimetres (mm) layers, with sufficient compacted effort (i.e. compacted with seven passes using 12 tonne roller). Drainage measures will be installed to protect the formation by forming an interceptor drain around the perimeter of the base which will outfall out at the lowest point level spreader or settlement pond.

An embankment approximately 600 mm high will be constructed around the perimeter of each turbine base and a fence will be erected to prevent construction traffic from driving into the excavated hole and to demarcate the working area. All necessary health and safety signage will be erected to warn of deep excavations etc. Access to and from excavated bases will be formed by excavating a pedestrian walkway to 1:12 grade.

There will be a minimum of 100 mm of blinding concrete laid on the formation material positioned using concrete skip and 360° excavator to protect ground formation and to give a safe working platform.

The anchor cage is delivered to site in 2 or more parts depending on the turbine type. A 360° excavator with suitable approved lifting equipment will be used to unload sections of the anchor cage and reinforcing steel. The anchor cage is positioned in the middle of the turbine base and is assembled accordingly. When the anchor cage is in final position it is checked and levelled by using an appropriate instrument. The anchor cage is positioned 250mm – 300mm from formation level by use of adjustable legs. Reinforcement bars are then placed around the anchor cage, first radial bars, then concentric bars, shear bars and finally the superior group of bars. Earthing material is attached during the steel foundation build up. The level of the anchor cage will be checked again prior to the concrete pour and during the concrete pour

Formwork to concrete bases will be propped/supported sufficiently so as to prevent failure. Concrete for bases will be poured using a concrete pump. Each base will be poured in three stages. Stage 1 will see the concrete being poured and vibrated in the centre of the anchor cage to bring the concrete up to the required level inside the cage. Stage 2 will see the centre of the steel foundation being poured and vibrated to the required level. Stage 3 will see the remaining concrete being poured around the steel foundation to bring it up to the required finished level. After a period of time when the concrete has set sufficiently the top surface of the concrete surface is to be finished with a power float.

Once the base has sufficient curing time it will be backfilled with suitable fill up to existing ground level and finished with the original material that was excavated.

4.7.2 Site Roads and Crane Pad Areas

Site roads will be constructed to each turbine base and at each base a crane hard standing will be constructed to the turbine manufacturer's specifications. Tracked excavators will carry out excavation for roads with appropriate equipment attached. The excavations shall follow a logical route working away from the borrow pit locations. Excavated material not required for localised landscaping will be transported back to the borrow pit in haul trucks. A two to three metre wide working area will be required around each hard standing area, with the sides of the excavated areas sloped sufficiently to ensure that slippage does not occur. Material excavated to create the working area will be stored locally for later reuse in backfilling the working area around the turbine foundation. The excavated material will be covered with polythene sheets or sealed with the excavator bucket and surrounded by silt fences to ensure sediment-laden run-off does not occur.

When the formation layer has been reached, stone from the on-site borrow pit shall be placed to form the road foundation. In the event of large clay deposits being encountered in sections of road, a geotextile layer will be required at sub base level. The sub grade will be compacted with the use of a roller. The final wearing course will not be provided until all bases have been poured. This prevents damage to the wearing course due to stone and concrete trucks movements. The road will be upgraded prior to the arrival of the first turbine. All roads will be maintained for the duration of the operation of the Proposed Development.

4.7.3 Onsite Electricity Substation and Control Building

The onsite substation will be constructed by the following methodology:

- The area of the substation will be marked out using ranging rods or wooden posts.;
- The wind farm control building will also be built within the substation compound;
- The foundations will be excavated down to the level indicated by the project engineer. The foundations will be shuttered and poured with reinforced concrete. An anti-bleeding admixture will be included in the concrete mix;
- The substation will be constructed with masonry blockwork. The block work walls will be built up from the footings to DPC level and the floor slab constructed, having first located any ducts or trenches required by the follow on mechanical and electrical contractors;
- The block work will then be raised to wall plate level and the gables & internal partition walls formed. Scaffold will be erected around the outside of the building for this operation;
- Concrete roof slabs will be lifted into position using an adequately sized mobile crane;
- The timber roof trusses will then be lifted into position using a telescopic load all or mobile crane depending on site conditions. The roof trusses will then be felted, battened, tiled and sealed against the weather.
- A rainwater harvesting system will be installed to provide the small volume of water required for the operation of the proposed substation and control building.
- The electrical equipment will be installed and commissioned.
- Steel palisade fencing will be erected around the substation and control building compound area.
- All wastewater from the staff welfare facilities in the control buildings will pass to a sealed storage tank. The wastewater will be transported off site by a waste management contractor holding valid waste collection permits under the Waste Management (Collection Permit) Regulations, 2007 (as amended).

The battery storage compound will be located adjacent to the substation compound at the southern end of the site. The compound will include up to 4 no. battery storage units (similar to shipping containers) as shown in the Planning Drawings accompanying this application.

The battery storage compound will be constructed adjacent the substation, as follows:

- The area of the battery storage compound will be marked out using ranging rods or wooden posts.
- The compound platform will be established using a similar technique as the construction of the substation platform discussed above;
- The electrical equipment will be installed on a concrete plinth and commissioned.
- Perimeter fencing will be erected around the battery storage compound and control building compound area.

4.7.4 Temporary Construction Compound

The temporary construction compounds will be constructed as follows:

- The area to be used as the compound will be marked out at the corners using ranging rods or timber posts. Drainage runs and associated settlement ponds will be installed around the perimeter;
- The compound platform will be established using a similar technique as the construction of the substation platform discussed above;
- A layer of geo-grid will be installed and compacted layers of well graded granular material will be spread and lightly compacted to provide a hard area for site offices and storage containers;
- Areas within the compound will be constructed as site roads and used as vehicle hardstandings during deliveries and for parking;
- The compound will be fenced and secured with locked gates if necessary; and,
- Upon completion of the Proposed Development the temporary construction compound will be decommissioned and backfilled with surplus material arising during excavation and allowed to vegetate naturally.

4.7.5 Internal Wind Farm Cable Trench

The underground cable will be laid beneath the surface of the ground along the wind farm site and forestry roads using the following methodology:

- The area where excavations are planned will be surveyed with all existing culverts identified.
- A tracked 360-degree excavator will be used to excavate the trench to a depth of 1200mm.
- All excavated material not used for backfilling/ landscaping will be removed to the on-site borrow pit using trucks.
- Any ingress of ground water will be removed from the trench using submersible pumps.
- A silt filtration system will be used to prevent contamination of any watercourse.
- Once the trench has been excavated a base layer of Clause 804 material will be laid and compacted.
- Ducting will then be placed in the trench as per specification including a single 50mm communication duct.
- Once the ducts have been installed couplers will be fitted and capped to prevent any dirt etc. entering the duct. In poor ground conditions the end of the ducts will be shimmed up off of the bed of the trench to prevent any possible ingress of water dirt. The shims will be removed again once the next length has been connected.
- Extreme care will be taken to ensure that all duct collars (both ends) are clean and in good condition prior to ducts being joined.
- The as built location of the ducting will be surveyed using a total station/GPS.
- Clause 804 material concrete will be carefully installed so as not to displace the ducting to 300mm from the finished ground level.
- Yellow marker tape will be installed at 300mm maximum below finished road/ground level.
- The finished surface will be reinstated as per original specification or to the requirements of the landowner.

4.7.6 Grid Connection Cable Trench

Underground cable will be laid beneath the surface of the ground to connect the proposed onsite substation into the overhead line using the following methodology:

- The area where excavations are planned will be surveyed with all existing culverts identified.

- A 13-tonne rubber tracked 360-degree excavator will be used to excavate the trench to the dimensions specified in the ESB Networks "Specification for the Installation of Ducts and Structures for Underground Power Cables and Communications Cables".
- All excavated material not used for backfilling/ landscaping will be removed to the on-site borrow pit using trucks.
- The trench depth is specified 1250mm and trench support will be installed, or the trench sides will be benched or battered back where appropriate.
- Any ingress of ground water will be removed from the trench using submersible pumps.
- A silt filtration system will be used to prevent contamination of any watercourse.
- Once the trench has been excavated a base layer of 15 Newton CBM4 concrete will be installed and compacted. All concrete will be offloaded directly from the concrete truck directly into the trench.
- Ducting will then be placed in the trench as per specification, approved cable ties will be used where required to secure the trefoil ducts together (at 3-metre centres).
- Once the trefoil ducts have been installed couplers will be fitted and capped to prevent any dirt etc. entering the duct. In poor ground conditions the end of the trefoil ducts will be shimmed up off of the bed of the trench to prevent any possible ingress of water dirt. The shims will be removed again once the next length has been connected.
- Extreme care will be taken to ensure that all duct collars (both ends) are clean and in good condition prior to ducts being joined.
- The as built location of the ducting will be surveyed using a total station/GPS.
- 15 Newton CBM4 concrete will be carefully installed so as not to displace the ducting to the underside of the communications duct and compacted as per approved detail.
- Spacers will be used to ensure that the correct cover is achieved at both sides of the trefoil ducting.
- ESB marker board will be fitted above the trefoil ducting.
- The Communication ducts will be fitted and kept to one side of the trench ensuring that the minimum cover is achieved, and 15 Newton CBM4 concrete will be placed to the specified cover and compacted (see Plate 4-9).
- ESB red marker board will be installed, and the remainder of trench will be backfilled in two compacted layers with approved material (lean mix concrete or clause 804).
- Yellow marker tape will be installed as per approved detail specifications, 300mm maximum below finished road/ground level.
- The finished surface will be reinstated as per original specification or to the requirements of the landowner.
- Marker Posts will denote the location of the underground power cables.


Plate 4-9 Typical Cable Trench View

4.8 Operation

The Proposed Development is expected to have a lifespan of approximately 30 years. Planning permission is being sought for a 30-year operation period commencing from the date of full operational commissioning of the Proposed Development. During the operational period, on a day-to-day basis the wind turbines will operate automatically, responding by means of meteorological equipment and control systems to changes in wind speed and direction.

The wind turbines will be connected together and data relayed from the wind turbines to an off-site control centre. Each turbine will also be monitored off-site by the wind turbine supplier. The monitoring of turbine output, performance, wind speeds, and responses to any key alarms will be monitored at an off-site control centre 24-hours per day.

Each turbine will be subject to a routine maintenance programme involving a number of checks and changing of consumables, including oil changes. In addition, there will be a requirement for unscheduled maintenance, which could vary between resetting alarms to major component changes requiring a crane. Typically, maintenance traffic will consist of four-wheel drive vehicles or vans. The electricity substation components and site tracks will also require periodic maintenance.

The Battery Storage units will operate continuously, linked to the on-site substation. It will be monitored in tandem with the overall development and there will be sporadic maintenance visits as required.

4.9 Decommissioning

The wind turbines proposed as part of the Proposed Development are expected to have a lifespan of approximately 30 years. Following the end of their useful life, the equipment may be replaced with a new technology, subject to planning permission being obtained, or the Proposed Development may be decommissioned fully. The onsite substation will remain in place as it will be under the ownership of the ESB. The battery storage units will also remain and serve as permanent infrastructure for the national electricity grid.

Upon decommissioning of the Proposed Development, the wind turbines will be disassembled in reverse order to how they were erected. All above ground turbine components will be separated and removed off-site for recycling. Turbine foundations will remain in place underground and will be covered with earth and reseeded as appropriate. Leaving the turbine foundations in-situ is considered a more environmentally prudent option, as to remove that volume of reinforced concrete from the ground could result in unnecessary environment nuisances such as noise, dust and/or vibration.

Site roadways could be in use for purposes other than the operation of the development by the time the decommissioning of the Proposed Development is to be considered, and therefore it may be more appropriate to leave the site roads in situ for future use. It is envisaged that the roads will provide a useful means of extracting the commercial forestry crop which exists on the site. If it were to be confirmed that the roads were not required in the future for any other useful purpose, they could be removed where required. Underground cables, that are redundant, will be removed and the ducting left in place. A decommissioning plan will be agreed with the local authority three months prior to decommissioning the Proposed Development. An outline decommissioning plan is contained in the CEMP in Appendix 4-3.

As noted in the Scottish Natural Heritage report (SNH) *Research and Guidance on Restoration and Decommissioning of Onshore Wind Farms* (SNH, 2013) reinstatement proposals for a wind farm are made approximately 30 years in advance, so within the lifespan of the wind farm, technological advances and preferred approaches to reinstatement are likely to change. According to the SNH guidance, it is therefore:

> *"best practice not to limit options too far in advance of actual decommissioning but to maintain informed flexibility until close to the end-of-life of the wind farm".*