FEHILY TIMONEY

CONSULTANTS IN ENGINEERING,
ENVIRONMENTAL SCIENCE
& PLANNING

APPENDIX 6.1

Soil Management Plan

FEHILY TIMONEY

CONSULTANTS IN ENGINEERING, ENVIRONMENTAL SCIENCE & PLANNING

ENVIRONMENTAL IMPACT ASSESMENT REPORT (EIAR) FOR THE PROPOSED BARNADIVANE WIND FARM & SUBSTATION, CO. CORK

Spoil Management Plan

Prepared for:

Barna Wind Energy (B.W.E.) Ltd. & Arran Windfarm Ltd.

Date: **February 2023**

Core House, Pouladuff Road, Cork, T12 D773, Ireland

T: +353 21 496 4133 | E: info@ftco.ie

CORK | DUBLIN | CARLOW

www.fehilytimoney.ie

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

1.1 Fehily Timoney and Company

Fehily Timoney and Company (FT) is an Irish engineering, environmental science and planning consultancy with offices in Cork, Dublin and Carlow. The practice was established in 1990 and currently has c.90 members of staff, including engineers, scientists, planners and technical support staff. We deliver projects in Ireland and internationally in our core competency areas of Waste Management, Environment and Energy, Civils Infrastructure, Planning and GIS and Data Management.

1.2 Project Description

FT was engaged by Barna Wind Energy (B.W.E.) Ltd. & Arran Windfarm Ltd to compile a Spoil Management Plan for the Barnadivane Wind Farm site (here after known as the Proposed Development site).

The Proposed Development site is located approximately 5km south-west of Lissarda, Co. Cork.

The Proposed Development site predominantly comprises agricultural land with areas of shrubbery and trees located along field boundaries. No peat was identified during the site walkover.

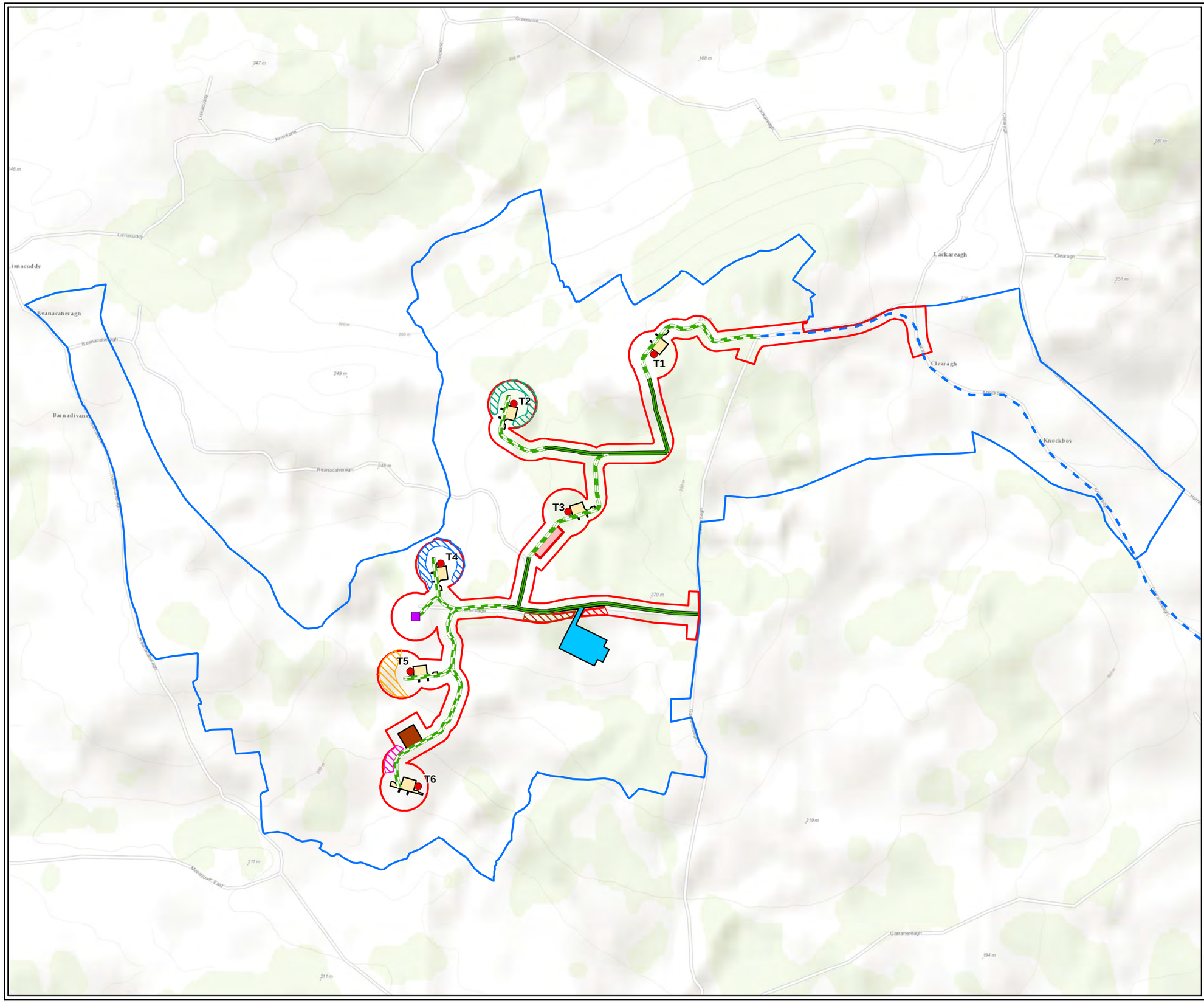
1.3 Purpose

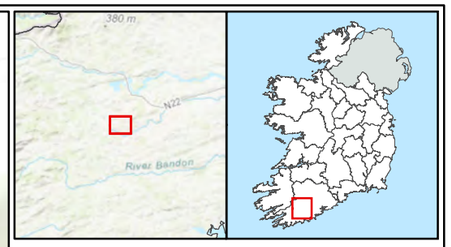
The purpose of this report is to provide a spoil management plan - for the construction phase of the Proposed Development and to assess slope stability across the Proposed Development site based on a desktop review and field observations. The intention of the report is to describe how spoil, which will be excavated from infrastructure locations such as turbine bases and roads, will be handled and placed/reinstated onsite. The report also provides construction details for the types of roads which will be put in place at the site and soil placement/reinstatement areas which will be developed at the site.

As for all construction projects, a detailed engineering construction design must be carried out by the appointed construction stage designer prior to any construction work commencing on site. This must take account of the consented project details and any conditions imposed by that consent. This must account for any changes in the environment which may have occurred in the time leading up to the commencement of construction and a spoil management plan to allow for the most appropriate geotechnical and environmental led solutions to be developed for the management of soil.

As work is carried out on site the contents of the soil management plan will be updated in the Construction & Environmental Management Plan (CEMP) for the construction phase. A copy of the CEMP is presented within the EIAR, Volume 2 - Appendix 2.2.

This spoil management plan contains some drainage guidelines for construction works and for management of spoil on site. It should be noted that the control of water quality and drainage measures for site is outlined in detail in the relevant chapter of Environmental Impact Assessment Report (EIAR).





Legend

- Development Planning Boundary
- Study Area
- Proposed Substation
- Turbine Hardstandings
- Proposed Temporary Construction Compound
- Proposed Borrow Pit
- Proposed Met Mast
- Proposed Turbine Layout
- Turbine Delivery Route
- Tracks-Existing
- Tracks-Proposed

Spoil Depositions Areas

- 1
- 2
- 3
- 4
- 5
- 6

TITLE:	Site Layout		
PROJECT:	Barnadivane Wind Farm, Co.Cork		
FIGURE NO:	1.1		
CLIENT:	Barna Wind Energy Ltd.		
SCALE:	1:12500	**REVISION:**	0
DATE:	25/01/2023	**PAGE SIZE:**	A3

FEHILY TIMONEY
Cork | Dublin | Carlow
www.fehilytimoney.ie

N W E S

0 0.25 0.5 1 Kilometers

2. DESK STUDY

The existing environment is described hereunder. This includes descriptions of the underlying Quaternary and bedrock geology and the hydrogeology of the site. This section also includes a summary of site-specific information obtained during site walkovers undertaken as part of the baseline assessment works.

The desktop study involved an examination of the following sources of information:

- Geology of South Cork (Sheet 25) [i]
- Geology of West Cork (Sheet 24) [ii]
- County Cork (Southern Division) Groundwater Protection Scheme [iii]
- Aerial imagery from Google and Bing accessed in 2022;
- Current and historical (6 inch and 25 inch) Ordnance Survey maps and aerial imagery [iv]
- Cork County Development Plan 2022-2028 [v]
- DoEHLG Wind Farm Planning Guidelines [vi]
- IWEA Best Practice Guidelines [vii]
- Flood Risk Data [viii]
- Ecological Designations [ix]
- Mapping data of the area produced by the Geological Survey of Ireland (GSI) [x]
    - Quaternary subsoil geology;
    - 100k bedrock geology;
    - Karst features;
    - Geological heritage features;
    - Aggregate potential;
    - Landslide susceptibility;
    - Physiographic Units;
- Datasets from the EPA [xi]
- European Union open datasets [xii]
- Peat Landslide Hazard and Risk Assessments, Best Practice Guide for Proposed Electricity Generation Developments (2nd Edition, 2017)[xiii]

2.1 Soils, Subsoils and Geology

2.1.1 Quaternary Geology

GSI 1:50,000 Quaternary Subsoil mapping (Figure 6-1 in Chapter 6 of the main EIAR) indicates the Proposed Development site is predominantly underlain by Glacial Till deposits derived from sandstone and siltstone. Frequent areas of 'bedrock outcrop or subcrop' are also mapped throughout the Proposed Development site. Isolated albeit relatively large (up to 12 hectares) deposits of Blanket Peat can be found along the western and southern margins of the Proposed Development site, however, no infrastructure is located within close proximity to the areas of Blanket Peat.

2.1.2 Bedrock Geology

The GSI online 1:100,000 scale bedrock geology mapping (Figure 6-2 in Chapter 6 of the main EIAR) indicates the Proposed Development site is underlain by Devonian "Old Red Sandstone" comprising the Toe Head, Castlehaven and Gunpoint Formations.

The majority of the Proposed Development site is underlain by The Toe Head Formation, comprising cross-bedded sandstone and minor mudstone. This formation is mapped across the central portion of the Proposed Development site and underlies all of the proposed turbines with the exception of turbine T6 to the south.

The southern extent and portions of the northern extent of the Proposed Development site is underlain by the Castlehaven Formation, comprising purple mudstone and siltstone. This formation underlies turbine T6.

The Gunpoint Formation can be found underlying the northern margin of the site and comprises green-grey sandstone and purple siltstone.

Rock outcrops are mapped across much of the Proposed Development site. During the site walkover outcrops were observed at several locations, particularly within the southern part of the Proposed Development site between turbines T5 and T6 including the location of the proposed borrow pit. The exposed rock has near vertical bedding and extremely closely spaced vertical fractures and is likely part of the Toe Head and Castlehaven Formations.

2.1.3 Structural Geology

The Proposed Development site lies within a regional scale syncline, whose axis passes from east to west through the central portion of the Proposed Development site.

The core of this syncline comprises the younger rocks of the Toe Head Formation, whereas the northern and southern limbs of the syncline comprise the older rocks of the Castlehaven and Gunpoint Formations. A series of broadly north-south and east-west trending faults cut through the site, displacing the rock formations within this syncline.

The entire Proposed Development site lies within a broader thrust block, juxtaposing younger Gunpoint Formation against older Caha Mountain Formation. The east-west trending faults associated with this block are located approximately 1.5km to the north and south of the Proposed Development site.

2.2 Hydrogeology

2.2.1 Anticipated Groundwater Regime

The overburden deposits of till and peat have generally low permeability and may therefore act as a confining layer (where present), preventing the free movement of surface water to the underlying aquifer within the bedrock. The topography of the Proposed Development site is generally sloping gently towards the south, locally to the west and north. Groundwater at the Proposed Development site is expected to flow in the general direction of the topography and surface water courses which again flow predominantly from north to south.

2.2.2 Groundwater Vulnerability

Groundwater vulnerability, as defined by the GSI, is the term used to represent the intrinsic and hydrogeological characteristics that determine the ease of which groundwater could be contaminated by human activities. The vulnerability of an aquifer to contamination is influenced by the leaching characteristics of the topsoil, the permeability and thickness of the subsoil, the presence of an unsaturated zone, the type of aquifer, and the amount and form of recharge (the hydraulic process where water moved downward from surface water to groundwater).

Groundwater vulnerability is determined mainly according to the thickness and permeability of the subsoil that underlies the topsoil, as both properties strongly influence the travel times and attenuation process of contaminants that could be released into the subsurface from below the topsoil.

The Groundwater Vulnerability within the Proposed Development site is predominantly 'High' with some areas of 'Extreme' vulnerability and 'X - Rock at or near Surface'(Figure 6-3 in Chapter 6 of the main EIAR).

Based on the GSI aquifer vulnerability mapping and findings from the site walkovers, overburden deposits are generally <3m deep across the majority of the Proposed Development site.

2.2.3 Groundwater Bodies (GWB) Description

The Proposed Development site lies within the Ballinhassig East GWB. The description of the GWB within the study area has been taken from the 'Summary of Initial Characterisation' draft reports published by the GSI in accordance with the Groundwater Working Group Publication: Guidance Document GW2 (2003). The GWB Characterisation Report is available from the GSI Public Data Viewer. Site specific data derived from the site walkover have been used to supplement and validate the published information.

According to interim classification work carried out as part of the Water Framework Directive and published by the EPA, the GWB is classified as having 'Good' status. The overall risk result is under 'Review' for the Ballinhassig East GWB.

2.2.4 Groundwater Wells and Springs

Based on a review of the GSI Groundwater Wells and Springs database there are four wells recorded near the Proposed Development in the Ballinhassig East GWB and Ballinhassig West GWB. Based on GSI mapping, there is an accuracy of 50 to 1,000m of the well location. There may also be additional wells not included in the GSI dataset.

2.3 Karst Features

According to the GSI datasets, there are no karst features recorded within the Proposed Development site. Karst features are not likely to occur within the Proposed Development site or broader study area due to the absence of carbonate bedrock. The closest mapped karst feature is a swallow hole within the Waulsortian Limestones located approximately 19km to the east of the site (GSI ref. number 1405NWK001).

2.4 Geological Heritage

The GSI Online Irish Geological Heritage database indicates that the Proposed Development is not located in an area of specific geological heritage interest. There are no audited or unaudited geological heritage areas within the Proposed Development site boundary. The nearest designated area is the 'The Gearagh, River Lee' unaudited CGS, which is located approximately 11km NW of the Proposed Development site (ITM Coordinates E 529965, N 570062). The heritage site has been described by GSI as 'a unique part of a formerly much larger floodplain with a forested anastomosing channel system'.

2.5 Economic Geology

The GSI Online Minerals database shows no mineral (metallic and non-metallic) occurrences within the Proposed Development site. An iron deposit has been recorded within the Castlehaven Formation approximately 1km west of the Proposed Development site (ITM coordinates E 532335, N 562365). Disseminated malachite has been recorded within the Gun Point Formation approximately 8km west-south-west of the Proposed Development site (ITM coordinates E 525926, N 561214).

The GSI Aggregates database indicates that there is predominantly a low crushed rock aggregate potential across most of the Proposed Development site (See Figure 6-8 in Chapter 6 of the main EIAR). Localised extents of 'moderate' crushed rock potential can be found throughout the Proposed Development site; their presence directly correlates to areas of mapped 'bedrock outcrop or subcrop'. Discrete areas of 'high' to 'very high' crushed rock potential are mapped along the eastern and northernmost extents of the site respectively and correspond to the underlying Gun Point Formation (north) and Old Head Sandstone Formation (east).

There are no areas of granular aggregate potential mapped within or adjacent to the site (See Figure 6-9 in Chapter 6 of the main EIAR)

3. SITE WALKOVER

As part of the geotechnical assessment two site walkovers were undertaken by Fehily Timoney and Company (FT) in July 2014 and October 2022 to determine the baseline characteristics of the Proposed Development site. The walkovers comprised inspections of the Proposed Development site to record any areas of instability with respect to the Proposed Wind Farm infrastructure and to provide a preliminary assessment of the ground conditions using hand-held probes.

The design layout of the site has been slightly modified since the original July 2014 site walkover. As a result, a second site walkover was undertaken in October 2022 to account for these changes. Although findings from the initial site walkover will be taken into consideration, the October 2022 walkover will be the primary source of field data used to inform this chapter.

The following salient geomorphological features were considered:

- Any active, incipient or relict areas of instability
- Wet areas
- Any notable change in vegetation
- Inspection of ground conditions
- Slope inclination and break in slope

The survey covered the proposed locations for the turbine bases, associated infrastructure and access tracks.

3.1 Findings of Site Walkover

The most recent site walkover was undertaken on the 11th October 2022. Weather conditions during the visit were recorded as dry with sunny spells.

The main findings of the site reconnaissance are as follows:

1. The Proposed Development site lies within privately owned farmland that is used for pasture and tillage, and is located approximately 5km south-west of Lissarda, Co. Cork.
2. All turbines and associated infrastructure are located in open agricultural fields.
3. Topography is typically flat to gently sloping agricultural lands, with localised slightly inclined terrain.
4. No peat deposits were recorded during the site walkover.
5. Ground conditions typically comprise topsoil over mineral soil, which was occasionally exposed at the ground surface in the ditches running along the edge of the fields. Rock outcrops of Old Red Sandstone are present in the southern part of the site.
6. Slope angles at the turbine locations and other infrastructural elements typically range from 4 to 10 degrees with a mean and median value of 6.5 and 6 degrees, respectively. The slope angle readings are based on site recordings using a Suunto Slope Clinometer.
7. No evidence of past failures or any signs of instability were noted within the Proposed Development site.
8. The conclusions from the site reconnaissance are as follows:
    a. The ground conditions recorded on site from a limited number of exposures indicate that typically the site consists of topsoil over mineral soil over bedrock.

b. Based on visual inspection of a limited number of exposed ground conditions on site, the bedrock is likely to be suitable for re-use within the lower layers of access roads, crane hardstands, lay down areas, etc.

c. All proposed access tracks for the wind farm will comprise upgrading of existing founded access tracks and construction of new proposed access tracks using excavate and replace construction techniques.

d. No evidence of past failures or any signs of instability were noted.

4. SUMMARY OF SITE CONDITIONS AT INFRASTRUCTURE LOCATIONS

As part of the site walkover, details of any soft ground and slope angles were recorded across the Proposed Development site. Inspections were completed at the proposed turbine locations, access tracks, borrow pit, Proposed Substation and met mast.

A summary of the site conditions at the proposed infrastructure locations is given in Table 4-1. No peat was encountered during the site walkover.

Table 4-1: Summary of Site Walkover Results (October 2022)

Infrastructure Element	ITM Coordinates		Peat Depth (m)	Slope (°)	Comments
	Easting	Northing			
T1	534486	563861	0.00	6	Agricultural field
T2	534016	563695	0.00	8	Agricultural field
T3	534198	563333	0.00	6	Agricultural field
T4	533772	563159	0.00	4	Agricultural field
T5	533669	562798	0.00	6	Agricultural field
T6	533695	562414	0.00	6	Agricultural field, sandstone rock outcrop present within close proximity to turbine location
Substation	534254	562891	0.00	10	Agricultural field
Borrow Pit	533685	562575	0.00	6	Agricultural field, sandstone rock outcrop present
Met Mast	533695	562987	0.00	6	Agricultural field

5. EXISTING SLOPE STABILITY

The recent site walkover indicated that peat was not present at any of the proposed infrastructure locations across the Proposed Development site.

A summary of the general topography and slopes at the Proposed Development are summarised below.

5.1 Site Topography

The Proposed Development site sits on an area of raised ground forming a northeast-southwest trending ridge that dominates the site and wider study area.

GSI physiographic mapping indicates this upland ridge is part of a broader 'mountain to hill' topography that encompasses the Proposed Development site. In general, site slopes can be categorised as gentle to moderate generally sloping down the south. However, slope gradients increase along the northern and north-eastern margins of the Proposed Development site where they become steep to extremely steep sloping down towards the north and northwest. Slope angles measured during the October 2022 site walkover range from 2 to 10 degrees with a mean and median value of 6.5 and 6 degrees, respectively. Elevations range from 180m AOD in the south to 270m AOD in the north.

5.2 Slope Stability Assessment

From a review of the GSI Landslide Susceptibility database, the Proposed Development and proposed infrastructure locations are generally located within areas of 'Low' to 'Moderately Low' susceptibility.

Turbine locations T5 and T6 and portions of the access road linking the two turbines are located within an area of 'Moderately High' susceptibility. These areas directly correlate with mapped 'bedrock outcrop or subcrop' (Figure 6 1) with no other significant factor adding to the susceptibility rating. Field observations at both turbine locations indicate gentle to moderate slopes (6^{o} slope angle) with no evidence of historic slope instability. In addition, desktop review of available aerial photography did not identify evidence of slope instability. It is therefore considered that the risk of landslide at turbine locations T5 and T6 is considered to be negligible and that the GSI Landslide Susceptibility Classification rating at these locations does not accurately reflect actual ground conditions encountered on site.

An isolated area of 'High' landslide susceptibility is located to the north of the Proposed Development site and relates to steepened topography; however, there is no infrastructure proposed here. A summary of the GSI landslide susceptibility with respect to the Proposed Development is provided in Figure 6 10 - Chapter 6 of the main EIAR.

No evidence of slope instability was observed at the Proposed Development site and there are no historical records of landslide activity within 10km of the Proposed Development site on the GSI database.

6. GENERAL CONSTRUCTION CONSIDERATIONS

6.1 Access Tracks

Up to 1.5km of existing access tracks requiring upgrade are present across the site.

Up to 2.35km of new proposed access roads will be constructed as part of the Proposed Development. Due to the ground conditions the access tracks on site will be founded. The typical make-up of the founded access tracks is a minimum stone thickness of 500mm.

6.1.1 Upgrade of Existing Access Tracks

This methodology includes procedures that are to be included in the construction to minimise any adverse impact on slope stability. The methodology is not intended to cover all aspects of construction such as drainage and environmental considerations, which are discussed separately in Chapters 5 (Ecology) and 7 (Hydrology and Water Quality) of the EIAR.

Standard details for typical upgrade of existing access tracks is presented in Figure 6-1.

The following guidelines apply:

1. Excavation will be required on one or both sides of the existing access track to a competent stratum.
2. Benching of the excavation will be required between the existing section of access track and the widened section of access track where the depth of excavation exceeds 500mm.
3. Granular fill to be placed in layers in accordance with the designer's specification.
4. The surface of the existing access track to be overlaid with up to 300mm of selected granular fill.
5. Access roads to be finished with a layer of capping across the full width of the road.
6. A layer of geogrid/geotextile may be required at the surface of the existing access road in areas of excessive rutting (to be confirmed by the site engineer).
7. For excavations in overburden, side slopes shall be not greater than 1 (v): 2. This slope inclination will be reviewed during construction, as appropriate.
8. The finished road width will have a running width of 5m, with wider sections on bends and corners.
9. On side long sloping ground any road widening works required will be done on the upslope side of the existing access road, where possible.
10. A final surface layer will be placed over the existing access track, as per design requirements, to provide a suitable road profile and graded to accommodate wind turbine construction and delivery traffic.

6.1.2 Construction of New Access Tracks

The excavation of topsoil and spoil and founding of access roads on competent stratum for new access roads will be carried out at various locations on the site. The proposed locations for new excavated access roads on site are shown in Figure 1-1.

Standard details for typical access road construction is presented in Figure 6.1-2.

The following methodology includes procedures that are to be included in the construction to minimise any adverse impact on slope stability. The methodology is not intended to cover all aspects of construction such as drainage and environmental considerations which are described in Chapters 5 and 7 of the EIAR.

1. Interceptor drains will be installed upslope of the access road alignment to divert any surface water away from the construction area.
2. Excavation will take place to a competent stratum beneath the topsoil (as agreed with the site designer and resident engineer).
3. Road construction will be carried out in sections of approximately 50m lengths i.e. no more than 50m of access road to be excavated without re-placement with stone fill.
4. The surface of the excavated access road will be overlaid with up to 500mm of selected granular fill. Granular fill to be placed in layers in accordance with the designer's specification.
5. Access roads to be finished with a layer of capping across the full width of the road.
6. A layer of geogrid/geotextile may be required at the surface of the competent stratum (to be confirmed by the Site Engineer).
7. For excavations in overburden, side slopes shall be not greater than 1 (v): 2. This slope inclination will be reviewed during construction, as appropriate.
8. A final surface layer shall be placed over the excavated road, as per design requirements, to provide a suitable road profile and graded to accommodate wind turbine construction and delivery traffic.

6.2 Guidelines for Borrow Pit Construction and Spoil Placement

Upon removal of the rock from the borrow pit (Figures 6.1-4), it is proposed to restore the borrow pits using excavated spoil within cells located inside the borrow pits. The excavated rock from the borrow pits will be used in the construction of the wind farm infrastructure elements (turbine bases, access tracks etc). The contractor excavating the rock will be required to develop the borrow pits in a way which will allow the excavated spoil to be contained safely. It is proposed to construct cells within the borrow pits for the placement of the excavated spoil. This is to allow for the safe placement and grading of the spoil using dumper trucks and excavators. The text below provides design and construction guidelines for the borrow pits.

The borrow pits shall be typically constructed as follows:

1. The rock within the proposed borrow pit footprint will be removed by breaking depending on whether it can be excavated, determined from a ground investigation conducted at the proposed borrow pit location. The ground investigation shall comprise rotary core drilling with associated engineering logging including rock quality designation and strength testing, as required.
2. It is proposed to construct the borrow pit so that the base of the borrow pit is below the level of the adjacent section of access road. This may vary and as excavation progresses into the back edge of the borrow pit, the base of the borrow pit may be raised to suit local conditions. Localised deepening of the borrow pit floor may be required depending on extraction operations.
3. Depending on the depth and type of rock present in the borrow pits it may be possible to excavate the rock from the borrow pit whilst leaving in place upstands/segments of intact rock which will help to retain the placed spoil. The upstands/segments of intact rock will essentially act as engineered rock buttresses.
4. Slopes within the excavated rock formed around the perimeter of the borrow pits will be formed at stable inclinations to suit local in-situ rock conditions. Exposed sections of the rock slopes will be left with irregular faces and declivities to promote re-vegetation and provide a naturalistic appearance.
5. The stability of the rock faces within the borrow pit will be inspected by competent personnel upon excavation to ensure stability during construction works and in the long term. This inspection will allow unfavourable rock conditions to be identified and suitable mitigation measures to be applied such as removal of loose rock.

6. Where it is not possible to leave upstands/segments of intact rock in place it may be necessary to construct rock buttresses founded on in-situ rock within the borrow pits. The rock buttresses will be constructed of rock fill from the borrow pit excavation. The founding stratum for each rock buttress will be inspected and approved by a competent person.
7. It may be necessary to construct the rock buttress within the borrow pit in stages as infilling of spoil behind the buttresses progresses. The buttress will be constructed of selected rock fill and placed and compacted in suitable layers to form a buttress of sufficient stability to retain the placed spoil, as necessary.
8. Infilling of the spoil will commence at the back edge of the borrow pit and progress towards the borrow pit entrance. The contractor excavating the rock will be required to develop the borrow pits in a way which will allow the excavated spoil to be placed safely.
9. The height of the rock buttresses constructed will be greater than the height of the placed spoil to prevent any surface spoil run-off.
10. The use of temporary access ramps and long reach excavators during the placement of the excavated spoil is likely to be required.
11. Where possible, the surface of the placed spoil will be shaped to allow efficient run-off of surface water from borrow pit areas.
12. An interceptor drain will also be installed upslope of the borrow pit. This drain will divert any surface water away from the borrow pit and hence prevent water from ponding and lodging on the re-instated borrow pit area.
13. Control of groundwater within the borrow pits may be required and measures will be determined as part of the ground investigation programme. A temporary pump and suitable outfall locations are likely to be required during construction.
14. A silting pond will be required at the lower side/outfall location of the borrow pit.
15. Supervision by a geotechnical engineer or appropriately competent person will be carried out for the works.
16. All of the above commitments will be implemented in full and may be added to by the designer prior to construction.

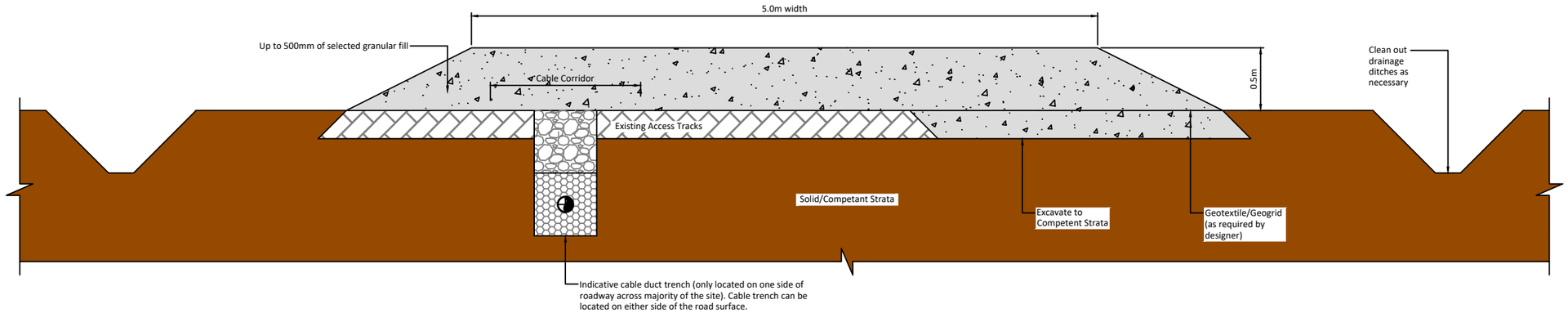
6.3 Spoil Placement Alongside Excavated Access Tracks

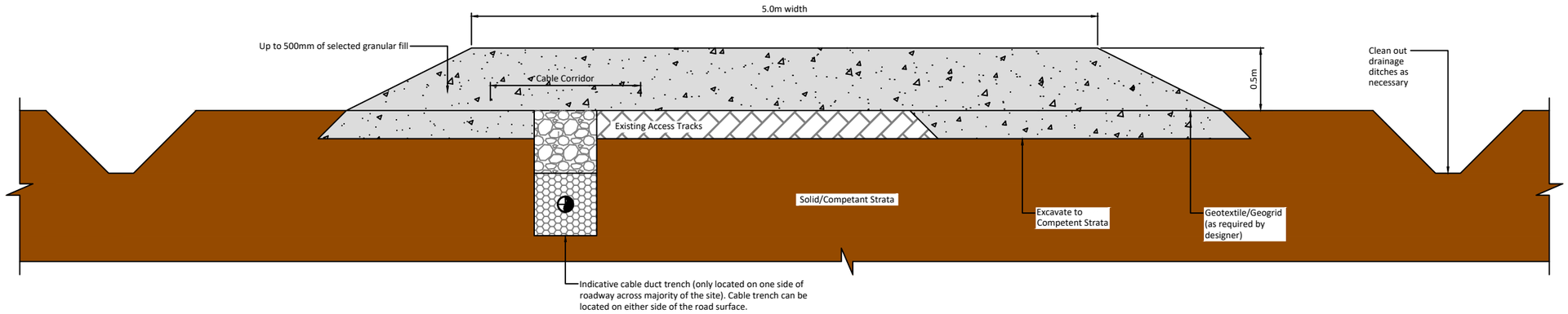
The following recommendations/best practice guidelines for the placement of spoil alongside the access tracks will be applied during construction. Storage of spoil in this way will be considered an additional measure/storage solution, borrow pit storage is the primary storage solution. Recommendations for placement of excavated material along the access tracks has been included in this report for completeness.

1. The potential spoil placement locations to be identified are alongside the existing excavated and proposed new access tracks with cross slopes of less than 10 degrees.
2. As a general, guide, the spoil placed adjacent to the existing and proposed excavated access tracks will be restricted to a maximum height of 1m over a 3m wide corridor on both sides of the access tracks. However, to achieve a maximum heigh of 1m, a berm width of 4m is recommended. It should be noted that the designer will define/confirm the maximum restricted height for the placed spoil.
3. The placement of excavated spoil is to be avoided without first establishing the adequacy of the ground to support the load.
4. Where there is any doubt as to the stability of the ground then no material shall be placed on to the surface.

5. Where practical, it will be ensured that the surface of the placed spoil is shaped to allow efficient run-off of surface water. Shaping of the surface of the spoil will be carried out as placement of spoil within the area progresses. This will reduce the likelihood of debris run-off and ensure stability of the placed spoil.
6. Finished/shaped side slopes in the placed spoil shall be not greater than 1 (v): 2 or 3 (h). This slope inclination will be reviewed during construction, as appropriate.
7. Supervision by a geotechnical engineer or appropriately competent person will be carried out for the works.
8. An interceptor drain will be installed upslope of the designated spoil placement areas to divert any surface water away from these areas. This will help ensure stability of the placed spoil and reduce the likelihood of debris run-off.
9. All the above-mentioned general guidelines and requirements will be confirmed by the designer prior to construction.

Figure 6.1-1: Upgrade of Existing Excavated Access Tracks





Scale 1:40

Scale (@ A3)
1:40

Date - 25.10.22

FIGURE 6.1-1: - TYPE A - UPGRADE OF EXISTING EXCAVATED ACCESS TRACKS

Drawn - POR

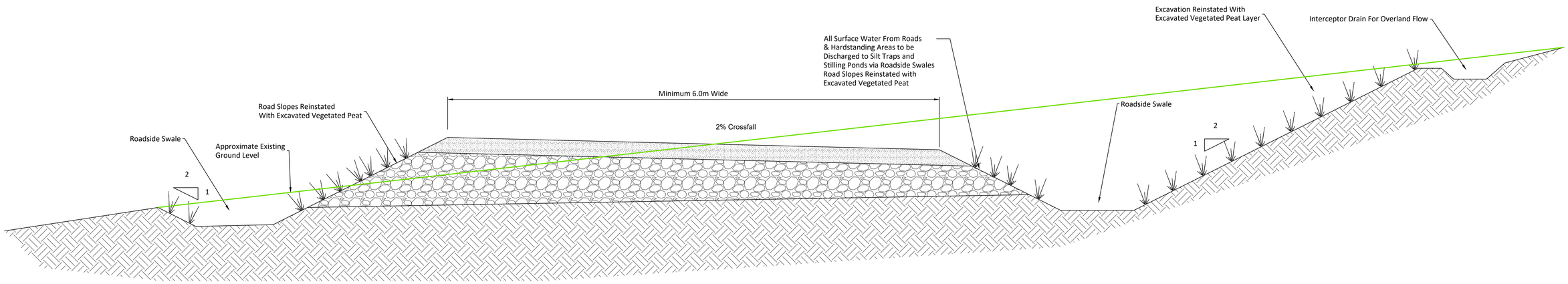
Checked - IH

Rev - B

O:\ACAD\2020\P20-312\P20-312-0600-SHES-0008

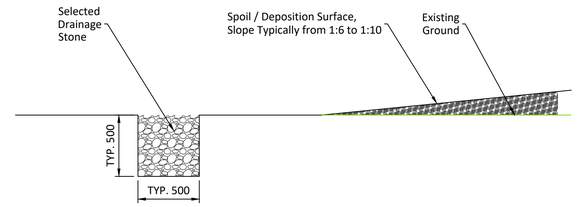
Wednesday 26 October 2022

CONSTRUCTION:
150mm clause 804 wearing course on non crushable site won granular material. (Depth subject to detailed design) on competent subgrade.



CROSS SECTION THROUGH ROAD (IN CUT)

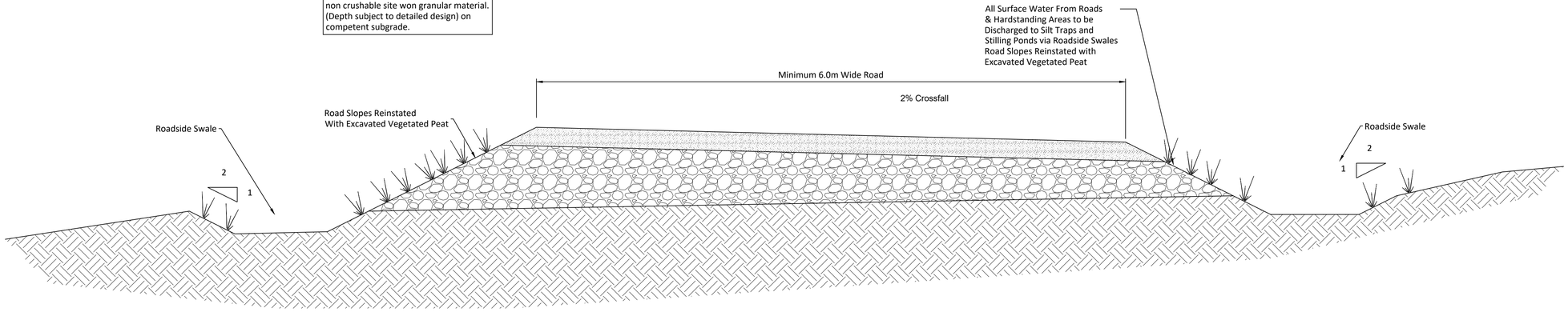
Scale 1:25



FRENCH DRAIN / FILTER DRAIN

Scale 1:25

CONSTRUCTION:
150mm clause 804 wearing course on non crushable site won granular material. (Depth subject to detailed design) on competent subgrade.



CROSS SECTION THROUGH ROAD (IN FILL)

Scale 1:25

FEHILY TIMONEY
Cork | Dublin | Carlow
www.fehilytimoney.ie

Rev.	Description	App By	Date
A	ISSUE FOR PLANNING	JH	08.03.23

PROJECT: BARNADIVANE WIND FARM UPDATED EIAR

CLIENT: BARNA WIND ENERGY (B.W.E.) LTD

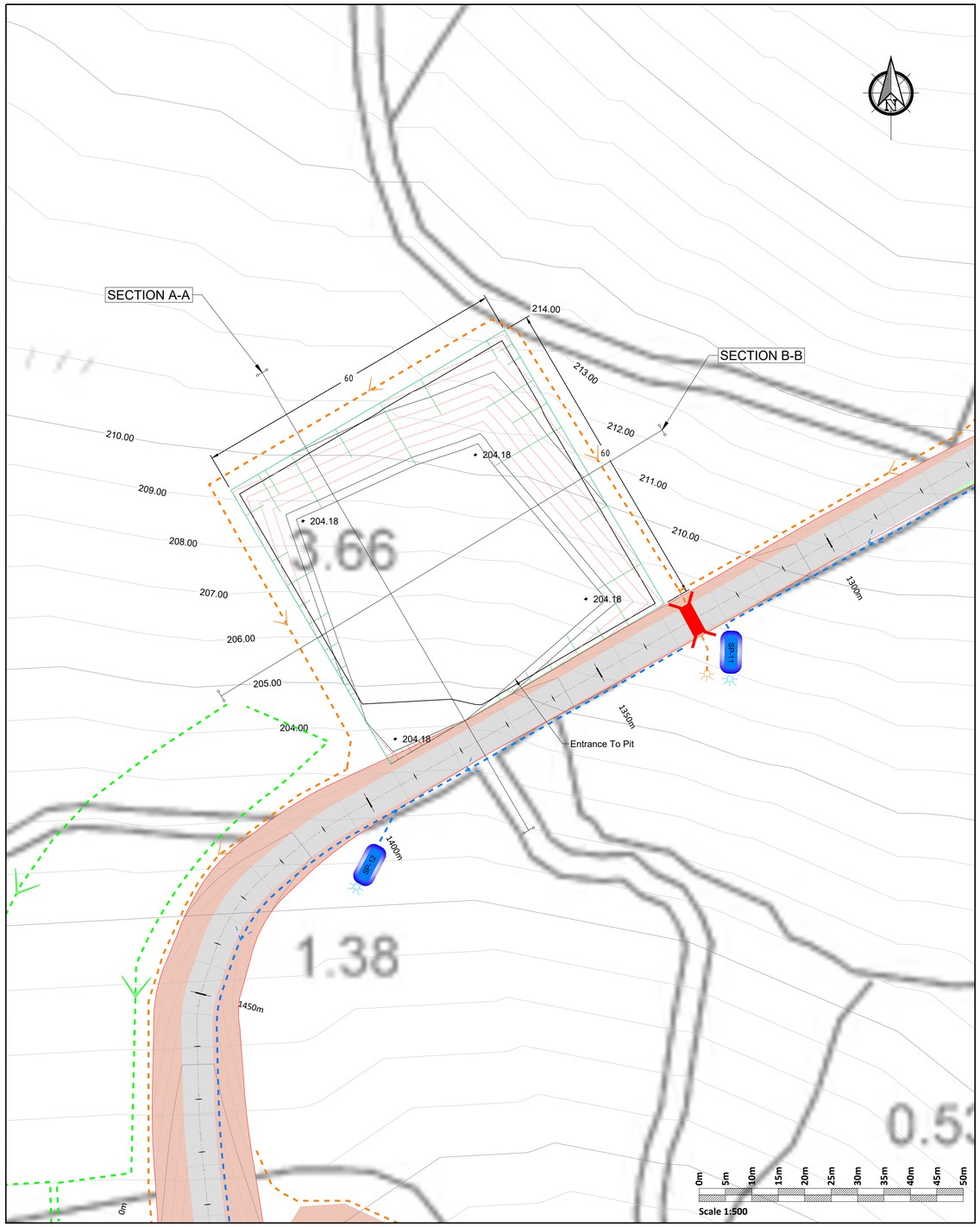
SHEET: PROPOSED WIND FARM ACCESS ROAD CONSTRUCTION DETAILS SHEET 1 OF 1

Date: 08.03.23	Project number: P21-143	Scale (@ A1): 1:25	
Drawn by: POR	Drawing Number: P21-143-0200-0005		Rev: A
Checked by: CC			

O:\ACAD\2021\P21-143\P21-143-0200-0005

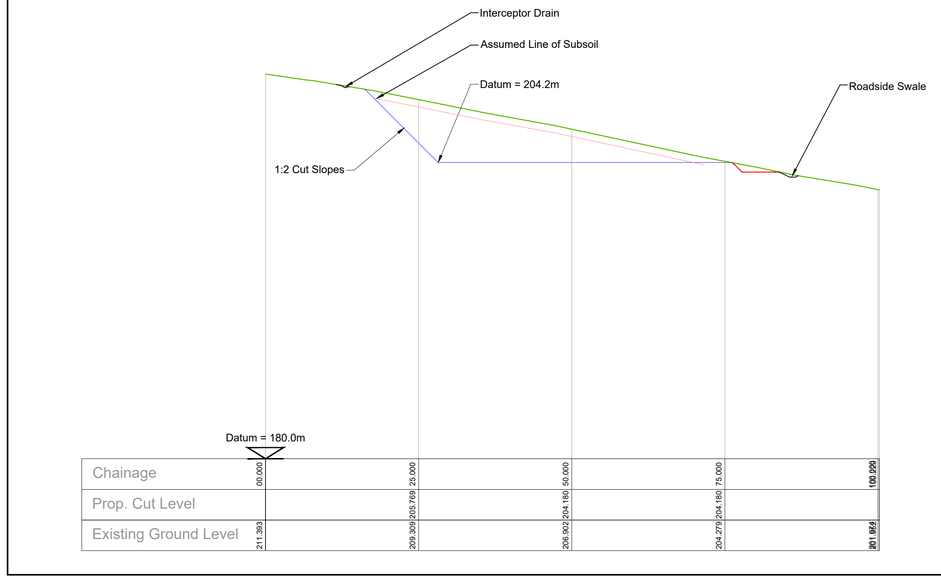
08 March 2023

Intentionally blank



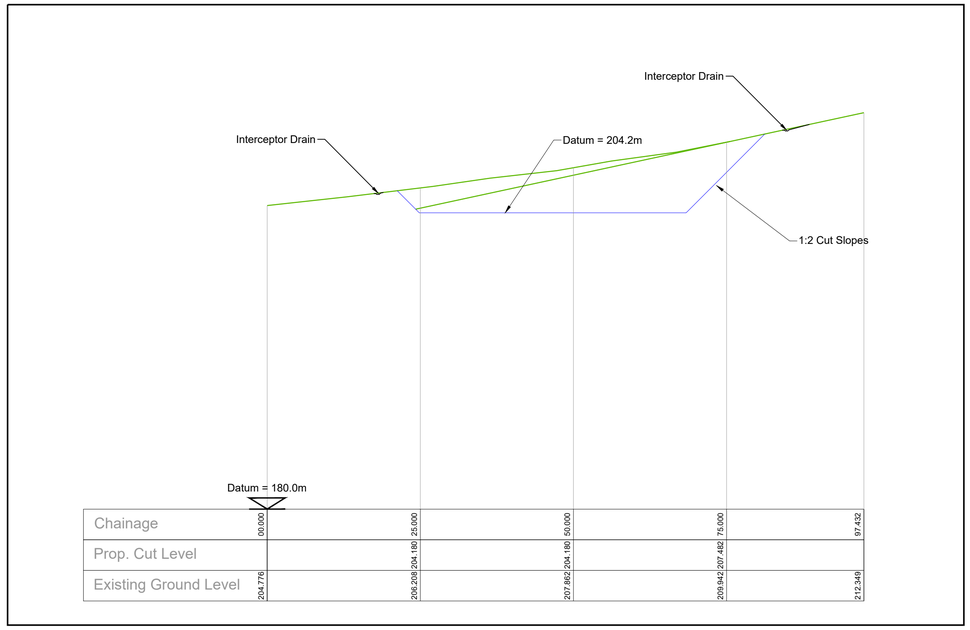
PLAN

Scale 1:500



SECTION A - A

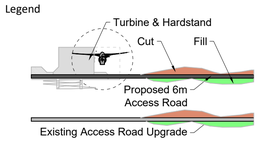
Scale 1:500



SECTION B - B

Scale 1:500

Legend



Planning Boundary

Lands in Control of Applicant

Existing Ground Contour

110kV Overhead Line Wayleave

'PMM' DENOTES: PERMANENT METEOROLOGICAL MAST

Proposed Spoil Desposition Area

Hydrology 100m Watercourse Buffer

Drainage Legend

Roadside Swale

Interceptor Ditch With Diffuse Outflow

Silt Fencing

Stilling Pond With Diffuse Outflow

Extents of Existing Track or Public Road where Existing Drainage to be maintained

Proposed Location Cross Drain or Culvert

Proposed Drain to be Connected to Existing Drainage Network

Existing Drain to be Connected to Proposed Drainage Network

French Drain / Filter Drain

FEHILY TIMONEY

Cork | Dublin | Carlow

www.fehilytimoney.ie

Rev.	Description	App By	Date
A	ISSUE FOR PLANNING	JH	08.03.23

PROJECT: BARNADIVANE WIND FARM UPDATED EIAR

CLIENT: BARNA WIND ENERGY (B.W.E.) LTD

SHEET: PROPOSED WIND FARM BORROW PIT DETAILS SHEET 1 OF 1

Date: 08.03.23

Project number: P21-143

Scale (@ A1): 1:500

Drawn by: POR

Checked by: CC

Drawing Number: P21-143-0200-0006

Rev: A

O:\ACAD\2021\P21-143\P21-143-0200-0006

08 March 2023

7. ESTIMATED EXCAVATION VOLUMES

7.1 General

The excavation volumes presented in the sections below are indicative and for information purposes only, and subject to detailed design.

Spoil volumes were determined using AutoCAD Civil 3D 2021.

7.2 Proposed Access Tracks

It is assumed that all proposed access tracks will require a 5m running surface with 6m wide development footprint.

Excavation volumes along the proposed access tracks have been estimated at 36,852m^3. After a bulking factor of 15% and a contingency of 5% is taken into consideration the final estimated excavation volume for the proposed access tracks is 44,222m^3.

7.3 Internal Cable Trenches

The width of the internal cable trench with a trefoil formation will be 600mm, a flat formation will require a wider trench width. The depth of cover to the ducts carrying the cables will be 750mm to the top of the upper ducts. The depth of trench for the cables will be 1,200mm. The trenches will follow the existing and proposed access track alignment over an approximate distance of 3.26km.

Excavation volumes along the proposed internal cable trench route have been estimated at 2,347m^3. After a bulking factor of 15% and a contingency of 5% is taken into consideration the final estimated excavation volume is 2,817m^3.

7.4 Proposed Wind Turbine and Hardstand Areas

The depth of excavation at each proposed turbine/hardstand location will vary depending on site topography. The diameter of the gravity wind turbine foundations will be approx. 22m and will have a minimum foundation depth of 3m. Each hardstand will have an area of 2,620m^2 and a minimum excavation depth of 0.50m.

The total excavation volumes for both the proposed wind turbine foundations and the proposed hardstand areas have been estimated at 23,968m^3. After a bulking factor of 15% and a contingency of 5% is taken into consideration the final estimated excavation volume is 28,762m^3.

7.5 Proposed Substation

The Proposed Substation will have an approximate footprint of 9,288m^2 and a typical excavation depth of 1.5m below existing ground level.

Initial excavation volumes for the Proposed Substation have been estimated at 16,530m^3. After a bulking factor of 15% and a contingency of 5% is taken into consideration the final estimated excavation volume is 19,837m^3.

7.6 Proposed Temporary Construction Compound

A temporary construction compound (TCC) will be located along the proposed access track immediately south of turbine T3 (Figure 1-1) and will be used during the construction phase of the Proposed Development. The TCC will have an approximate area of 3,600m^2 and will be excavated to a depth of 0.3m below existing ground level.

Initial excavation volumes have been estimated at 1,080m^3. After a bulking factor of 15% and a contingency of 5% is taken into consideration the final estimated excavation volume is 1,296m^3. This material can largely be re-used in the reinstatement of the TCC.

7.7 Permanent Meteorological Mast

The hardstanding area for the Meteorological Mast is assumed to be 900m^2. The excavation depth for the hardstanding area will be 0.3m, giving an approximate excavation volume of 270m^3. The foundation footprint for the meteorological mast will be 100m^2. Excavation depth for the foundation will be 1.5m giving an approximate excavation volume of 150m^3. Therefore, the total unfactored excavation volume for the meteorological mast is approximately 420m^3.

After a bulking factor of 15% and a contingency of 5% is taken into consideration the final estimated excavation volume is 504m^3.

7.8 Proposed On-Site Borrow Pit

An on-site borrow pit is proposed to the immediate west of the proposed access track between turbines T5 and T6 (Figure 1-1). Details of the proposed borrow pit are presented in Figure 6-4 and show a maximum excavation depth of approximately 6m below existing ground level (along the borrow pits north-western face). The excavation has an approximate surface area of 3,585m^2 and will be constructed with 1:2 cut slopes.

Total excavation volumes have been estimated at 9,575m^3. After a bulking factor of 15% and a contingency of 5% is taken into consideration the final estimated excavation volume is 11,489m^3.

Findings from the walkover survey completed in October 2022 indicate shallow bedrock at and adjacent to the proposed borrow pit location. It is assumed that there is an average cover soil depth of 0.5m across the area of the proposed borrow pit resulting in total rock and soil excavation volumes of 9,696m^3 and 1,793m^3 respectively. Rock excavated from the proposed borrow pit will be used for Class 1 fill across the site.

7.9 Total Estimated Volume Summary

As detailed in Sections 7.1 to 7.8, the total estimated excavation volume, when taking into consideration a 15% bulking factor an 5% contingency, is approximately 108,927m^3, of which approximately 99,231m^3 is anticipated to be soil (clay/mineral soil) and approximately 9,696m^3 is anticipated to be rock. A breakdown of the excavation volumes are presented in Table 7-1 below:

Table 7-1: Summary of Excavation Volumes

Infrastructure Element	Total Factored Volume (m^3)	Total Soil (m^3)	Total Rock (m^3)
Access Tracks	44,222	44,222	-
Internal Cable Trenches	2,817	2,817	-
6 no. Wind Turbines/Hardstand Areas	28,762	28,762	-
Proposed Substation Note 1	19,837	19,837	-
Temporary Construction Compound	1,296	1,296	-
Permanent Meteorological Mast	504	504	-
On-Site Borrow Pit	11,489	1793	9,696
Total =	108,927	99,231	9,696

If the Proposed Substation currently under consideration by An Bord Pleanála (Case reference: PL04.308208) proves not to be viable for the project, the consented 38kV grid connection cable route *'alternative grid connection route'* (AGCR) between the permitted Carrigarierk and Proposed Development will be developed (CCC reference: 15/730; ABP reference: PL04.246353). In this instance, no excavation will be required at the Proposed Substation location. This would reduce the total soil excavation volume (Table 7-1) from 96,027m^3 to 76,190m^3.

8. RE-USE OF EXCAVATED MATERIAL

8.1 General

There is approximately 96,027m^3 of excavated soil that will need to be re-used on site. It is proposed to re-use this material by means of:

- Borrow pit reinstatement
- Access track berms
- Turbine ballast
- Spoil deposition areas

8.2 Proposed Borrow Pit Reinstatement

It is anticipated that approximately 9,575m^3 of excavated soil will be used as backfill to the borrow pit. On completion of backfilling, the reinstated ground will be finished with topsoil and allowed to vegetate.

8.3 Proposed Access Track Bunds

Low height and vegetated berms will be constructed along both sides of the proposed access tracks. The total anticipated length of access tracks across the site is 3,850m, which would give a possible length of berms of 7,700m. Each berm will have a cross-sectional area (CSA) of 2.5m^2 (approximately 4m wide at base, 1m high and 1m wide at top). The subsoil will be used for the core of each berm and each berm will be finished in topsoil and allowed to vegetate. These berms are anticipated to provide approximately 19,250m^3 of storage.

The total volume of soil to be excavated for access tracks is estimated at 29,242m^3, which indicates there will be a deficit of 9,992m^3 of spoil that will need to be stored on site elsewhere (spoil deposition areas, turbine ballast, borrow pit).

8.4 Proposed Turbine Ballast

It is anticipated the approximately 2,400m^3 of excavated soil will be used as backfill to the gravity foundations at the six proposed turbine locations (approximately 400m^3 per turbine).

8.5 Proposed Spoil Deposition Areas

Six spoil deposition areas are proposed across the site . Their locations are shown in Figure 1-1 and approximate volumes are presented in Table 8-1 below:

Table 8-1: Estimated Berm Volumes

Spoil Deposition Area (nearest element)	CSA (m^2)	Berm Length (m)	Berm width (m) (base/top)	Berm Height (m)	Storage Volume achieved (m^3)
1 (T2)	56	360	30/26	2	20,160

Spoil Deposition Area (nearest element)	CSA (m^2)	Berm Length (m)	Berm width (m) (base/top)	Berm Height (m)	Storage Volume achieved (m^3)
2 (T4)	56	390	30/26	2	21,840
3 (T5)	96	165	50/46	2	15,840
4 (T6)	46	95	25/21	2	4,370
5 (Substation)	35	75	25/21	1.5	2,625
6 (Substation)	35	170	25/21	1.5	5,950
Total Volume Achieved					70,785

8.6 Summary of On-Site Spoil Storage Volume

The following table (Table 8-2) summarises the available on site spoil storage capacity as described in Sections 8.2 to 8.5.

Table 8-2: Summary of Available On-Site Spoil Storage

Proposed Storage Areas	Available Storage Volume (m^3)
Borrow Pit Reinstatement	9,575
Access track berms	19,250
Turbine ballast	2,400
Spoil deposition areas	70,785
Total Storage Volume	102,010

As the total soil excavation volume (96,027m^3) for the site is less than the total storge volume (102,010m^3) it is anticipated that there will be no requirement for off-site transportation of excavated soil generated during the construction stage of the Proposed Development.

As described in Section 7.8, if the Proposed Substation proves not to be viable and the AGCR between the permitted Carrigarierk and Proposed Development site is developed as an alternative, there will be no requirement for Spoil Deposition Areas 5 and 6. This would reduce the overall storage volume from 102,010m^3 to 93,435m^3. This could be further reduced to 76,577m^3 and still have sufficient storage volume for site excavated spoil.

8.7 Anticipated Re-Use of Excavated Material

The following table (Table 8-3) summarises the anticipated spoil management arrangements for re-use of excavated materials and associated volumes.

Table 8-3: Summary of Spoil Management Arrangements

Excavation Area	Spoil Volume (m3)	Re-Use
Access Tracks	44,222	19,250m^3 for re-use in track side berms. 24,927m^3 to spoil deposition areas (1-4) and borrow pit.
6 no. Wind Turbines/Hardstand Areas	28,762	2,400m^3 for re-use as ballast to turbine foundations. 26,362m^3 to designated spoil deposition areas 1-4 (adjacent to turbines).
Proposed Substation [Note 1]	19,837	8,575m^3 for re-use in spoil deposition areas 5 and 6. 11,262m3 to the remaining spoil deposition areas (1-4) and borrow pit.
Temporary Construction Compound	1,296	1,296m^3 to reinstate TCC.
Permanent Meteorological Mast	504	504m^3 to spoil deposition areas (1-4) and borrow pit.
On-Site Borrow Pit (soil excavated from top 0.50m)	1793	1,793m^3 to be reinstated back into the borrow pit.
Total Spoil Volume	96,027	

Note 1 - spoil management arrangements dependant on the availability of the Proposed Substation.

9. SUMMARY AND RECOMMENDATIONS

9.1 Summary

No deposits of peat were identified during the site walkover.

Findings from the desktop study review coupled with observations made during the site walkover indicate that there is a low risk of slope instability across the Proposed Development site.

Due to the sloping topography of the site, excavation depths at the different infrastructure locations will vary and will be dependent on the amount of cut that is required to achieve finished foundation levels.

Given the absence of peat on the site, all infrastructure will be founded.

The total excavation volume anticipated during the construction stage of the development is approximately 96,027m^3. Total rock excavation volume from the borrow pit is anticipated to be 9,696m^3.

All spoil excavated during the construction stage is anticipated to be re-used on site with no requirement for off-site transportation of spoil. The total available volume for spoil storage on site is estimated at 96,120m^3.

If the Proposed Substation proves not to be viable and the AGCR between the permitted Carrigarierk and Proposed Development site is developed as an alternative, the total spoil deposition volumes can be reduced from 96,120m^3 to 76,190m^3, an overall storage volume reduction of approximately 21%.

9.2 Recommendations

If required, the proposed spoil deposition areas can be redesigned with greater dimensions to provide additional storage capacity for spoil material.

Made Ground and contaminated ground was not identified during the desktop review or site walkover. However, as the site is predominantly used for agricultural purposes there is the possibility of waste/contamination associated with farm machinery, existing and historic agricultural buildings and agrichemical waste. If during the construction stage Made Ground or contaminated ground is encountered, it shall be appropriately tested and removed off-site to a licenced waste facility.

10. REFERENCES

i. Sleeman, A.G. & Pracht, M. (1994) 'Geology of South Cork. A Geological Description of South Cork and Adjoining Parts of Waterford to Accompany the Bedrock Geology 1:100,000 Scale Map Series, Sheet 25, South Cork'

ii. Sleeman, A.G. & Pracht, M. (2002) 'Geology of West Cork. A Geological Description of West Cork and Adjacent Parts of Kerry to Accompany the Bedrock Geology 1:100,000 Scale Map Series, Sheet 24, West Cork'

iii. Cork County (Southern Division) Groundwater Protection Scheme (2002). https://secure.dccae.gov.ie/GSI_DOWNLOAD/Groundwater/Reports/GWPS/CK_South_GWPS_MainReport_Apr2002.pdf

iv. OSI. Online Historic Maps. Ordnance Survey of Ireland OSI. http://map.geohive.ie/.

v. Cork County Development Plan 2022-2028. https://www.corkcoco.ie/en/resident/planning-and-development/cork-county-development-plan-2022-2028

vi. Department of Environment, Heritage and Local Government. Wind Farm Planning Guidelines. s.l. : DoEHLG, 2006.

vii. Irish Wind Energy Association. Best Practice Guidelines for the Irish Wind Energy Industry. s.l. : IWEA Wind Skillnet, 2012.

viii. FloodInfo. Flood Risk Data – Interactive Map Viewer. https://www.floodinfo.ie/map/floodmaps/#

ix. NPWS. NPWS Map Viewer. http://webgis.npws.ie/npwsviewer/

x. GSI. Online Data Viewer. Geological Survey of Ireland. https://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228

xi. EPA. Online Database Viewer. Environmental Protection Agency Ireland. https://gis.epa.ie/EPAMaps/

xii. EU. European Union. Digital Elevation Model over Europe. https://data.europa.eu/euodp/en/data/dataset/data_eu-dem

xiii. Scotland, Natural. Peat Landslide Hazard and Risk Assessments. Best Practice Guidelines for Proposed Electricity Generation Developments. : The Scottish Executive, Second Edition, April 2017.

FEHILY TIMONEY

**CONSULTANTS IN ENGINEERING,
ENVIRONMENTAL SCIENCE
& PLANNING**

www.fehilytimoney.ie

Cork Office

Core House
Pouladuff Road,
Cork, T12 D773,
Ireland
+353 21 496 4133

Dublin Office

J5 Plaza,
North Park Business Park,
North Road, Dublin 11, D11 PXT0,
Ireland
+353 1 658 3500

Carlow Office

Unit 6, Bagenalstown Industrial
Park, Royal Oak Road,
Muine Bheag,
Co. Carlow, R21 XW81,
Ireland
+353 59 972 3800