Sure Partners Limited

ARKLOW BANK WIND PARK PHASE 2 ONSHORE GRID INFRASTRUCTURE

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

VOLUME II

Chapter 9 Land and Soils

ARUP

sse Renewables

Contents

9 Land and Soils

9.1 Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) has considered the potential land, soil, geology and hydrogeology (hereafter referred to as land and soils) effects associated with the construction, operational and decommissioning phases of the the Arklow Bank Wind Park Phase 2 Onshore Grid Infrastructure Development (hereafter referred to as the proposed development).

The assessment has been carried out according to guidelines relating to land and soils, and in the context of similar large-scale infrastructural projects. An assessment is made of the likely significant effects associated with the construction, operational and decommissioning phases of the proposed development on these resources. Measures are presented to mitigate or eliminate the effects of the proposed development on the land, soils, subsoils, bedrock, geological resources and heritage and hydrogeology.

Chapter 5 *Description of Development* provides a full description of the proposed development whilst **Chapter 6** *Construction Strategy* describes the proposed construction strategy for the proposed development.

The proposed development will comprise of the following:

- Landfall for two offshore export cable circuits from the High Water Mark (HWM) to two Transition Joint Bays (TJB) at Johnstown North, located approximately 4.5km northeast of Arklow Harbour;
- Connection by two underground 220kV high voltage alternating current cable circuits, and fibre optic cables over a distance of c. 6km, from the landfall to the new onshore 220kV substation;
- A new onshore 220kV substation, to be located at Shelton Abbey, north of the Avoca River, approximately 2.1km northwest of Arklow town consisting of two connected compounds:
    1. The transmission compound with the infrastructure to physically connect to the NETN, and
    2. The connection compound with the infrastructure to allow the connection of the windfarm in accordance with EirGrid grid code requirements.
- Flood defence improvement works to the existing Avoca River Business Park flood defences located c. 500m west of the substation site;
- A 220kV overhead line connection from the new 220kV substation at Shelton Abbey to the existing 220kV transmission network located c. 200m from the substation site.

For the assessment provided in this chapter the proposed development will often be referred to in terms of the four distinct elements required to facilitate the development:

- The **Landfall** – In the townland of Johnstown North, where the nearshore cable from the offshore infrastructure comes onshore (using HDD technology). The landfall will also be used to facilitate the development (temporary construction compounds) and to construct the necessary transition joint bays.
- The **Cable Route** – the circa 6.0km cable corridor connecting the landfall (at Johnstown North) to the new substation at Shelton Abbey. The two cable circuits will be installed underground within this cable corridor in trenches (each of the trenches being typically 0.8m to 1.825m in width and typically up to 2m in depth).
- The **Substation** – the land at Shelton Abbey for the proposed substation including flood defence works.
- The **Connection to the NETN**– which refers to the overhead line connection from the new proposed 220kV transmission compound to the existing 220kV National Electricity Transmission Network (NETN).

9.2 Methodology

The following sections outline the legislation and guidelines considered, and the adopted methodology for defining the baseline environment and undertaking the assessment in terms of land and soils.

The potential effects of the proposed development on land and soils has been assessed by classifying the importance of the relevant attributes and quantifying the likely magnitude of any effect on these attributes.

9.2.1 Study Area

The land and soils study area for the proposed development extends to a radius of 2km from the planning (red line) boundary of the proposed development which is in line with the Guidelines for the Preparation of Soil, Geology and Hydrogeology Chapters of Environmental Impact Statements (Institute of Geologists of Ireland (IGI) 2013) (hereafter referred to as the IGI Guidelines).

9.2.2 Guidance and Legislation

The primary legislation and guidance documents that have been followed for the preparation of the land and soils assessment are:

- Guidelines for the Preparation of Soil, Geology and Hydrogeology Chapters of Environmental Impact Statements (Institute of Geologists of Ireland, IGI 2013);
- National Roads Authority (NRA) (NRA 2008) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes, (hereafter referred to as the NRA Guidelines).
- Environmental Protection Agency (EPA 2017). Guidelines on the Information to be contained in Environmental Impact Assessment Reports. Draft;

- European Communities (Water Policy) Regulations 2014 (S.I. No. 350 of 2014);
- European Communities Environmental Objectives (Groundwater) Regulations 2010 (S.I. No. 9 of 2010), as amended by the European Communities Environmental Objectives (Groundwater) (Amendment) Regulations 2011 (S.I. No. 389 of 2011), the European Communities Environmental Objectives (Groundwater) (Amendment) Regulations 2012 (S.I. No. 149 of 2012) and the European Union Environmental Objectives (Groundwater) (Amendment) Regulations 2016 (S.I. No. 366 of 2016);
- European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I. No. 272 of 2009) as amended by the European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations 2012 (S.I. No. 327 of 2012);
- European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2015 (SI No. 386 of 2015);
- European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003) as amended by the European Communities (Water Policy) (Amendment) Regulations, 2005 (S.I. No. 413 of 2005);
- European Communities (Water Policy) (Amendment) Regulations, 2008 (S.I. No. 219 of 2008);
- European Communities (Water Policy) (Amendment) Regulations, 2010 (S.I. No. 93 of 2010);
- European Communities (Drinking Water) Regulations 2014 (S.I. No 122 of 2014), as amended by the European Union (Drinking Water) (Amendment) Regulations 2017 (S.I. No. 464 of 2017);
- European Communities (Quality of Salmonid Waters) Regulations 1988 (SI no. 293 of 1988);
- European Union (Water Policy) (Abstractions Registration) Regulations 2018 (SI no. 261 of 2018)
- National Roads Authority (NRA 2008). Environmental Impact Assessment of National Road Schemes – A Practical Guide;
- Directive 2000/60/EC Water Framework Directive (WFD);
- Directive 2006/118/EC Groundwater Directive;
- Water Services Acts (2007 – 2017);
- Environmental Protection Agency (2011) Evaluating the Influence of Groundwater Pressures on Groundwater-Dependent Wetlands. EPA Strive Programme 2007-2013;
- Environmental Protection Agency (2008) A Framework for the Assessment of Groundwater-Dependent Terrestrial Ecosystems under the Water Framework Directive. EPA Strive Programme 2007-2013;
- CL:AIRE, 2010, Soil Generic Assessment Criteria for Human Health Risk Assessment;

- CL:AIRE/SuRF, 2010, A Framework for Assessing the Sustainability of Soil and Groundwater Remediation;
- CL:AIRE (2017) Petroleum Hydrocarbons in Groundwater: Guidance on assessing petroleum hydrocarbons using existing hydrogeological risk assessment methodologies;
- Environmental Protection Agency, 1999, Landfill Manuals, Landfill Restoration and Aftercare;
- Environmental Protection Agency, 2000, Landfill Manuals, Landfill Site Design;
- Environmental Protection Agency Ireland, 2003, Landfill Monitoring, 2nd Edition;
- Environmental Protection Agency Ireland, 2007, CODE OF PRACTICE: Environmental Risk Assessment for Unregulated Waste Disposal Sites;
- Environmental Protection Agency Ireland, 2011, Guidance on the Authorisation of Discharges to Groundwater;
- Environmental Protection Agency, 2013, Guidance on the Management of Contaminated Land and Groundwater at EPA Licenced Sites;
- The EU Floods Directive, 2007/60/EC; and
- European Communities (Assessment and Management of Flood Risks) Regulations 2010 (S.I. No. 122/2010).
- Regulation 15 of S.I. No. 323/2020 – European Union (Waste Directive) Regulations 2020.

9.2.3 Impact Assessment Methodology

The likely significant effects have been assessed by classifying the importance of the relevant attributes and quantifying the magnitude of any likely significant effects on these attributes. This has been undertaken in accordance with the IGI guidance which outline a 13-step methodology that is divided across four distinct elements:

- Initial Assessment;
- Direct and Indirect Site Investigation;
- Mitigation Measures, Residual Effects and Final Impact Assessment; and
- Completion of the Land, Soils, Geological and Hydrogeological Sections of the EIAR.

Initial Assessment

The ‘Initial Assessment’ presents a description of the past and present uses of the land across the relevant sites and route which may have a bearing on the proposed development. This includes a detailed description of the nature of the ground conditions beneath the relevant sites and route based on existing literature as well as site specific and neighbouring site investigation data.

Direct and Indirect Site investigation

Section 9.2.4.1 provides a summary of the data available from the historic and site-specific investigations carried out in relation to the proposed development. The information gathered on the baseline environment during ground investigations corresponds to the second element of the methodology, 'Direct and Indirect Site Investigation and Studies'.

Mitigation Measures, Residual Effects and Final Impact Assessment

A step by step process then follows to allow the identification of the likely significant effects, the appropriate mitigation measures, the residual effects and the final impact assessment.

The outcome from examining this available data is a Conceptual Site Model (CSM). The CSM is a summary of geological conditions beneath the proposed development that considers the likely significant effects of the proposed development.

Based on the derived CSM the area across the study area has been classified as a Type B Environment which corresponds to a naturally dynamic hydrogeological environment – examples include groundwater discharge areas, areas underlain by regionally important aquifers, nearby spring rises areas underlain by permeable soils.

A 'Feature Importance Ranking' is then assigned to each feature (likely to be affected by the proposed development based on guidance from the NRA and IGI). This facilitates the assessment of likely significant effects which has been undertaken in accordance with the guidance outlined in **Section 9.6.**

This facilitates the assessment of likely significant effects which has been undertaken in accordance with the guidance outlined in **Section 9.2.2.**

Section 9.7 outlines the "Mitigation Measures" associated with the works in accordance with the above methodology.

Completion of the Land and Soils Section of the EIAR

This section has been prepared iteratively whilst undertaking the first three elements. Upon finalisation of the preceding steps, this information has been documented accordingly (i.e. as part of this Chapter) which corresponds to the final element of the methodology 'Completion of Soils, Geological and Hydrogeological Sections of the EIAR'.

9.2.4 Categorisation of the Baseline Environment

As part of the desk study that was undertaken to establish the baseline conditions (i.e. land, soils, geological and hydrogeological environment), the following sources of information were reviewed as shown in **Table 9.1**.

Table 9.1 Publicly Available Datasets

Source	Name	Description
Ordnance Survey Ireland Geohive (OSI)	Current and historical ordnance survey maps	Current and historical survey maps produced by the OSI.
Ordnance Survey Ireland Geohive (OSI, 2019)	Aerial photography	Current and historical survey maps produced by the OSI.
Google	Aerial photography	Current aerial imagery produced by Google
Bing	Aerial photography	Current aerial imagery produced by Bing
Teagasc	Teagasc Soils Data	Surface soils classification and description
Geological Survey Ireland (GSI)	Quaternary Mapping	Geological maps of the site area produced by the GSI and also available on GSI online map viewer.
	Bedrock Mapping	
	Aggregate Potential Mapping	
	Mineral Localities	
	Geotechnical viewer	
	Groundwater Mapping	
	Groundwater viewer	
	National Landslide Database	
	Karst Database	
	Historic Mine Sites – Inventory and Risk Classification	
	Active Quarries and pits	
	County Geological Sites and Geological Heritage Areas	
	GSI, Memoirs	
	Historic Mine Sites – Inventory and Risk classification	
Environmental Protection Agency (EPA)	Corine Land Cover 2018	These datasets are based on interpretation of satellite imagery and national in-situ vector data.
	Historic Mine Sites – Inventory and Risk classification	
	River Network Map	
	EPA Licence & Permit Databases	Information on any EPA IE/IPC licences and Permits in the area
	EPA HydroNet	Reports of Groundwater level monitoring points.

Source	Name	Description
National Parks and Wildlife Service	Designated Natural Heritage Areas (NHA), Special Protection Areas (SPA), Special Areas of Conservation (SAC) Sites	This dataset provides information on national parks, protected sites and nature reserves
National Monuments Service (2018) (Archaeological Survey of Ireland)	State Mining and Prospecting Facilities	This dataset provides all recorded archaeological monuments
Department of Communications, Energy and Natural Resources	Minerals Ireland	A booklet contains a list of all current and prospecting mining facilities.

9.2.4.1 Ground Investigation

The details of the existing/historical ground investigation (GI) reports located within the study area which have been used in the assessment of the baseline conditions are presented in **Table 9.2**. These reports are publicly available from the 'EXT GSI Geotechnical Sites' layer of the Geological Survey of Ireland (GSI) Spatial Resources Map Viewer.

Table 9.2 Existing Ground Investigations

Title	Contractor	Year	Location	Scope
Environmental Site Assessment. Avoca River Park, Arklow, Co. Wicklow.	OCM (2020)	September 2020	Avoca River Park	Environmental site assessment based on the findings of GII ground investigations
Avoca River Park, FT Squared, Phase 3 Environmental Assessment Factual Report	Ground Investigation Ireland	September 2020	Avoca River Park	• 23 no. trial pits, • Slit trenching • 8 no. gas monitoring wells
Avoca River Park, FT Squared, Phase 2 Environmental Assessment Factual Report	Ground Investigation Ireland	September 2020	Avoca River Park	• 30 no. trial pits, • 16 no. cable percussion boreholes, • 7 no. rotary core boreholes
Avoca River Park, FT Squared, Phase 1 Environmental Assessment Factual Report	Ground Investigation Ireland	January 2020	Avoca River Park	• 30 no. trial pits, • 18 no. Transport Research Laboratory (TRL) probes, • 18 no. cable percussion boreholes,

Title	Contractor	Year	Location	Scope
				• 7 no. rotary core boreholes
Avoca River Park, FT Squared, Ground Investigation Report	Ground Investigation Ireland	August 2020	Avoca River Park	• 30 no. trial pits, • 18 no. TRL probes, • 18 no. cable percussion boreholes, • 7 no. rotary core boreholes
Arklow by-pass (GSI Report ID 1736)	IGSL	1991	Arklow by-pass	• 17 no. cable percussion boreholes

The project specific ground investigations carried out to inform the proposed development and EIAR are listed in **Table 9.3.** These provide useful verification for the data already compiled relating to the baseline environment. The project specific ground investigation reports carried out are included in **Appendix 9.1** in **Volume 3**.

Table 9.3 Project Specific Ground Investigations

Title	Contractor	Year	Location	Scope
Arklow Bank Wind Park Onshore Ground Investigation, Substation Site Investigation Factual Report	Irish Drilling	January 2021	Substation	• 5 no. boreholes • 25 no. trial pits
Arklow Bank Wind Park Onshore Ground Investigation, Cable Route Site Investigation Factual Report	Irish Drilling	January 2021	Cable Route	• 3 no. boreholes • 9 no. trial pits
Arklow Bank Wind Park Onshore Ground Investigation, Landfall Site Investigation Factual Report	Irish Drilling	January 2021	Landfall	• 5 no. boreholes • 12 no. trial pits
Arklow Bank Wind Park, Onshore Cable Route, Geophysical Survey	Minerex Geophysics	January 2021	Landfall, Cable Route, Substation	Geophysical survey consisting of Electromagnetic (EM) Survey, Electrical Resistivity Tomography (ERT), Seismic Refraction, Multi-Channel Analysis of Surface Waves (MASW)
Topographical Survey	Scantech Geoscience Limited	November 2020	Landfall, Cable Route, Substation	Topography survey

Title	Contractor	Year	Location	Scope
Pavement Construction Investigation at the Arklow Bank Cable Route, Co. Wicklow	Scantech Geoscience Limited	November 2020	Cable Route	Ground Penetrating Radar, Road Pavement Assessment

9.2.4.2 Site Walkover

Several site walkover surveys were carried out between July and November 2020 to verify and confirm the findings of the desktop study.

The findings of the site walkover survey including photos and site walkover survey notes are included in **Appendix 9.2** in **Volume 3.**

9.2.5 Technical Limitations

The baseline data described and considered in this assessment includes existing data from desk study information available at the time in the region as well as dedicated field surveys commissioned specifically for the proposed development. The data collected provides comprehensive information on land and soils within the study area.

The baseline data from the intrusive investigation provides valuable information on the existing land and soils environment at point locations within the study area. Between each point the baseline data from the intrusive investigation has been assessed by conservative interpretation. While land and soils can vary, the exploratory locations have been selected following the completion of the comprehensive review of all existing information available at the time.

This review was completed by studying local geological maps, aerial photography, historic ground investigation and completing site walkovers to provide an understanding of the study area.

The locations and the spacing of the exploratory locations used as part of the intrusive investigation were chosen in order to gain an understanding of the land and soils. The findings from the investigations for most cases compared favourably with the desk study of existing information on the baseline conditions.

As is common in most construction projects, ground models for proposed developments are based upon numerous information sources such as, but not limited to geological maps, historic investigations in the area and overburden mapping. By examining the existing landforms and understanding the geological history and geomorphology of a site, these can all be used to assist in constructing a robust ground model. This ground model should then be assessed and confirmed through the project specific ground investigation.

Based on the comparability of the results from the investigations commissioned specifically for the proposed development and the desk study of existing information on the baseline conditions, the information on the baseline conditions (as described in **Section 9.2.4**) is deemed sufficient.

9.3 Baseline Conditions

This section describes the existing conditions and important features in terms of the land and soils associated with the proposed development. A regional overview is followed by a description of site-specific baseline conditions and a CSM. Features are then identified, and their importance ranked in accordance with the NRA Guidelines.

Chapter 5 *Description of Development* outlines the full details of the proposed development.

9.3.1 Regional Overview

The regional geomorphology, topography, soils and subsoils, bedrock geology and hydrogeology are discussed in this section.

9.3.1.1 Regional Topography and Geomorphology

Arklow town is located in the catchment of the Avoca River, which rises in the Wicklow Mountains and flows down into Arklow where it enters the Irish Sea. Arklow lies to the south-east of the proposed development.

The topography of the region is dominated by the Wicklow Mountains to the northwest. The topography varies between 800m Ordnance Datum (OD) at Tonelagee to an elevation of almost 0.0mOD in Arklow town.

The landscape principally reflects the erosional and depositional legacy of the last period of glaciation. Glacial erosion of pre-existing topographic features and deposition of thick glacial drift deposits, mainly till (boulder clay), resulted in areas of rather subdued post-glacial topography away from the topographic highs of the Wicklow mountains.

The post-glacial landscape also reflects the effects of fluvial (river) processes that have altered the topography, albeit only to a small extent in this area, since the ice sheet retreat.

A number of buried meltwater channels are located in this area and roughly follow the path of various streams and part of the Avoca River.

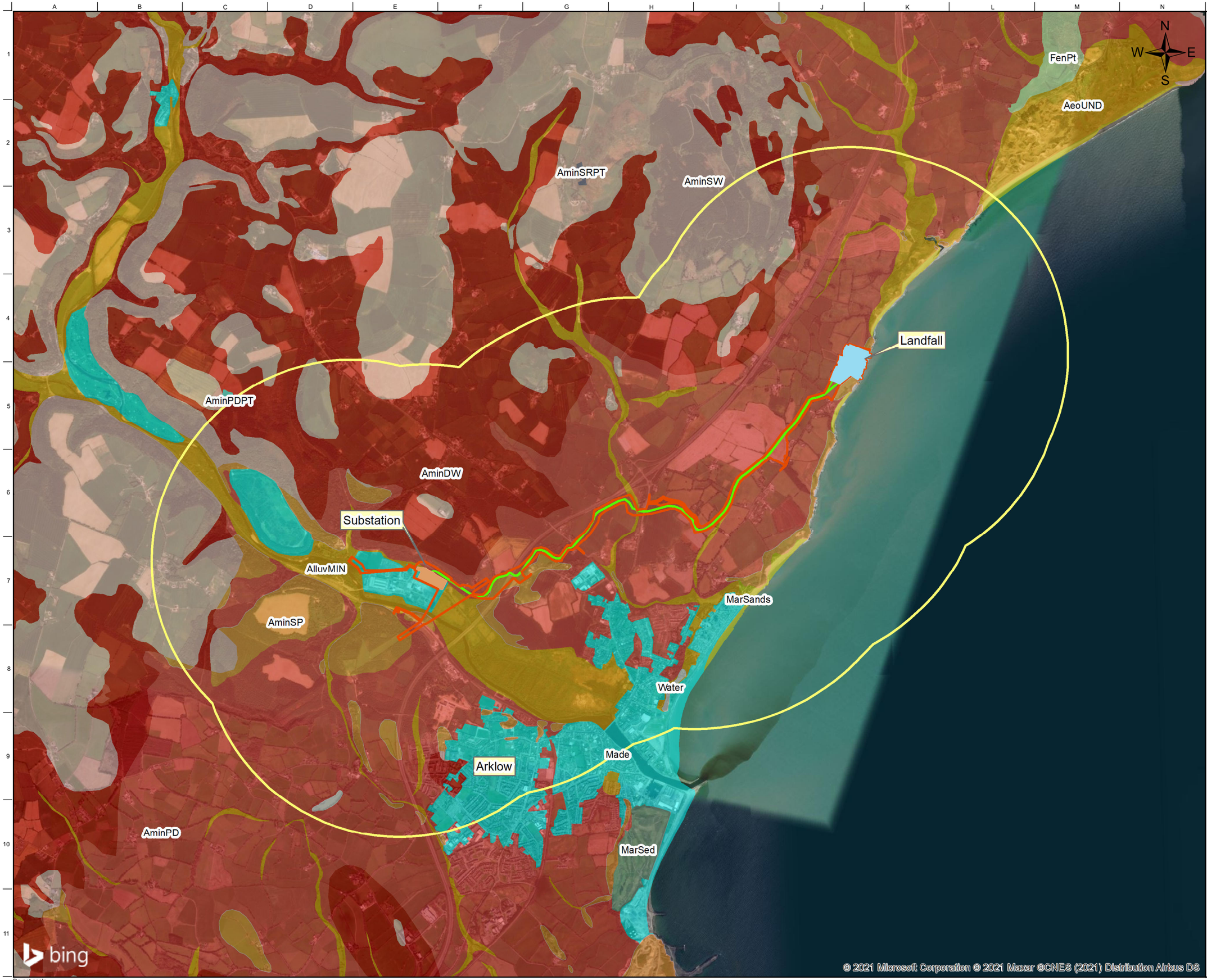
As noted above, the geomorphology of the proposed development is predominantly that of a post glaciation environment. The topography is generally undulating with steep elevation changes noted by river and stream crossings. In addition, the proposed development is crossed locally in places by surrounding roads.

The coastline in the vicinity of the proposed development is characterised by sandy beaches interspersed with low glacial till and rocky promontories towards Arklow Harbour with rock cliffs to the south of the Harbour at Arklow Head.

9.3.1.2 Regional Soils (Teagasc Classification)

The majority of the study area is underlain by surface water gleys (AminPD) and deep well drained mineral soils (AminDW) with areas of alluvial and marine sand deposits present that may be associated with recent and ancient water bodies. Made ground deposits are located to the south of the region and are associated with the urban development of Arklow harbour and town.

The main soils, as classified by Teagasc (**Figure 9.1**) within the region have been summarised in **Table 9.4**.



LEGEND:

- AeoUND - Aeolian Undifferentiated
- AlluvMIN - Mineral alluvium
- AminDW - Acid Brown Earths / Brown Podzolics
- AminPD - Surface water Gleys / Ground water Gleys Acidic
- AminPDPT - Peaty Gleys Acidic
- AminSP - Surface water Gleys / Ground water Gleys Shallow
- AminSRPT - Podzols Peaty
- AminSW - Lithosols / Regosols
- FenPT - Fen peat
- Made
- MarSands
- MarSed
- Water
- Red Line Boundary
- Substation
- Landfall
- Cable route
- 2km Buffer

Rev	Date	By	Chkd	Appd
F1	2021-04-01	CF	GB	GB

ARUP
50 Ringsend Road
Dublin 4
D04 T6X0
Ireland

Client
SURE PARTNERS LIMITED.

Project Title
Arklow Bank Wind Park Phase 2
Onshore Grid Infrastructure

Drawing Title
Soil Deposits

Scale at A3 1:35,000
Role EIAR
Suitability FOR INFORMATION
Arup Job No 271715
Rev F1
Name Figure 9.1

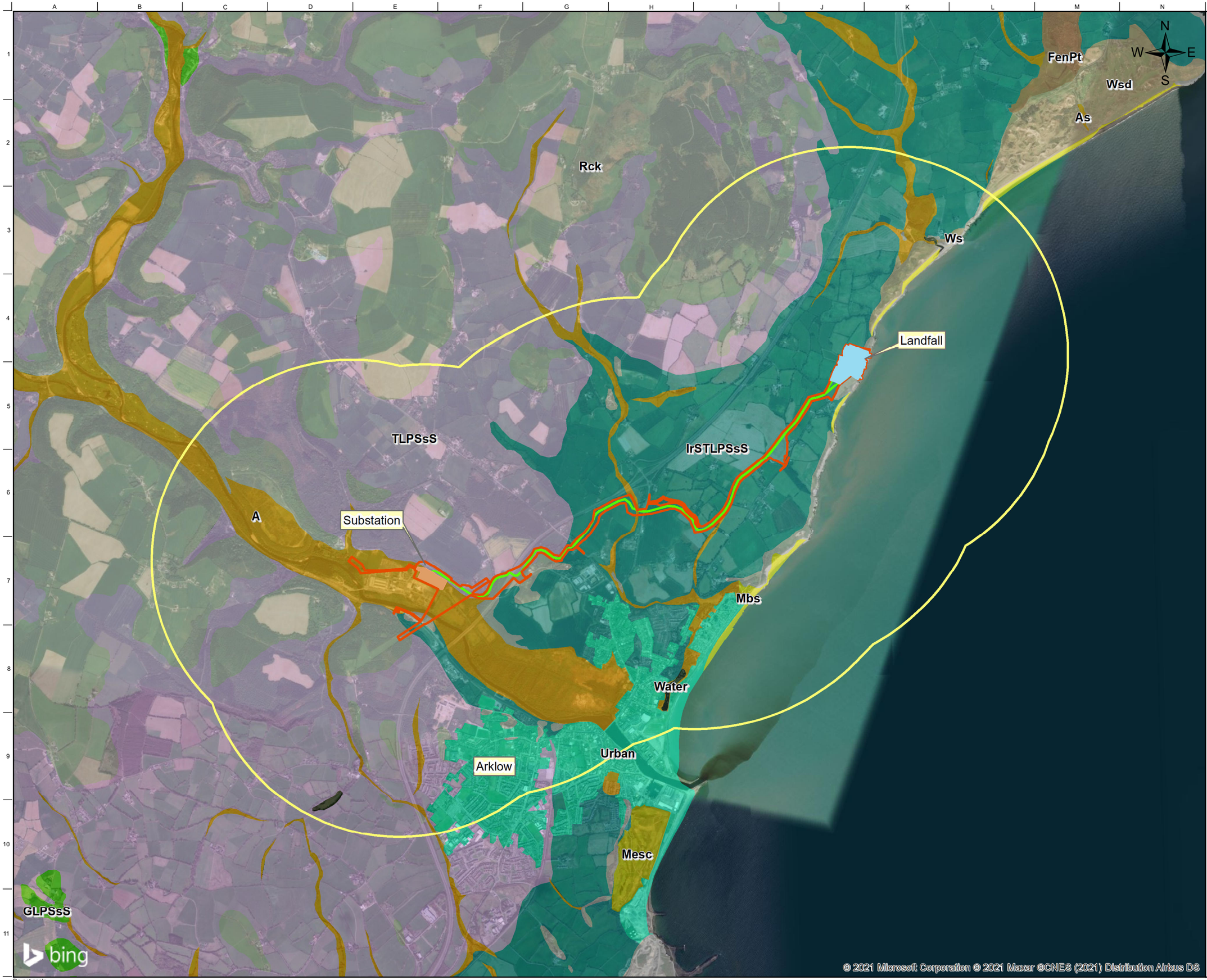
Do not scale

Table 9.4 Summary of Soil Types in the Region

Soil Code	Description	Importance
Made Ground	Associated with urban development.	Low
AeoUND	Aeolian undifferentiated	High
AlluvMIN	Mineral alluvium	Medium
Topsoil -AminDW	Acid Brown Earths/ Brown Podzolic Deep Well drained mineral (Mainly acidic)	High
Topsoil -AminPD	Surface water gleys/groundwater gleys acidic	Low
Topsoil -AminSP	Surface water gleys/groundwater gleys shallow	Low
Topsoil -AminSW	Lithosols / Regosols Shallow well drained	Low
MarSands	Marine Sands	Low

9.3.1.3 Regional Subsoils (GSI Quaternary Classification)

Superficial deposits (subsoil) comprise the unconsolidated geological deposits which overlie the solid geology. These soils, as classified by the GSI Quaternary mapping are presented on the Regional Subsoils Map (**Figure 9.2**).



LEGEND:

- A, Alluvium
- As, Alluvium (sandy)
- FenPt, Fen Peat
- GLPSsS, Gravels derived from Lower Palaeozoic sandstones and shales
- IrSTLPSsS, Irish Sea Till derived from Lower Palaeozoic sandstones and shales
- Mbs, Marine beach sands
- Mesc, Esturine silts and clays
- Rck, Bedrock outcrop or subcrop
- TLPSsS, Till derived from Lower Palaeozoic sandstones and shales
- Urban
- Water
- Ws, Windblown sands
- Wsd, Windblown sands and dunes
- Red Line Boundary
- Substation
- Landfall
- Cable route
- 2km Buffer

Rev	Date	By	Chkd	Appd
F1	2021-04-01	CF	GB	GB

ARUP
50 Ringsend Road
Dublin 4
D04 T6X0
Ireland

Client
SURE PARTNERS LIMITED.

Project Title
Arklow Bank Wind Park Phase 2
Onshore Grid Infrastructure

Drawing Title
Subsoil Deposits

Scale at A3 1:35,000

Role EIAR

Suitability FOR INFORMATION

Arup Job No 271715

Rev F1

Name
Figure 9.2

Do not scale

During the Pleistocene epoch of the Quaternary, two glaciations covered County Wicklow which gave rise to the deposition of glacial till. Typically, during the ice advance, boulder clays were deposited sub-glacially as lodgement till over the eroded bedrock surface, whilst moraine granular deposits were laid down at the glacier margins.

Subsequently, with the progressive retreat of the ice sheets from the region, granular fluvio-glacial deposits were laid down in places by melt waters discharging from the front of the glacier which are generally encountered as sand and gravel lenses within the glacial till deposits. The glacial deposits can exhibit significant lateral and vertical variations in grain size distributions over short distances.

This glacial till is the predominant subsoil of the region and described as Irish Sea till derived from Lower Palaeozoic sandstones and shales in the area. This glacial till extends both north and south of the proposed development along the coastline. It extends west beyond the M11 motorway.

The subsoils of the region may also be comprised of made ground where development has occurred. River alluvium deposited from historic flooding events is mapped by the GSI along the banks of the Avoca River and along the Avoca River paleochannel.

Outcropping and sub cropping rock is indicated towards the coastline and localised pockets within the study area where the topography rises. Marine beach sands are shown along the coast.

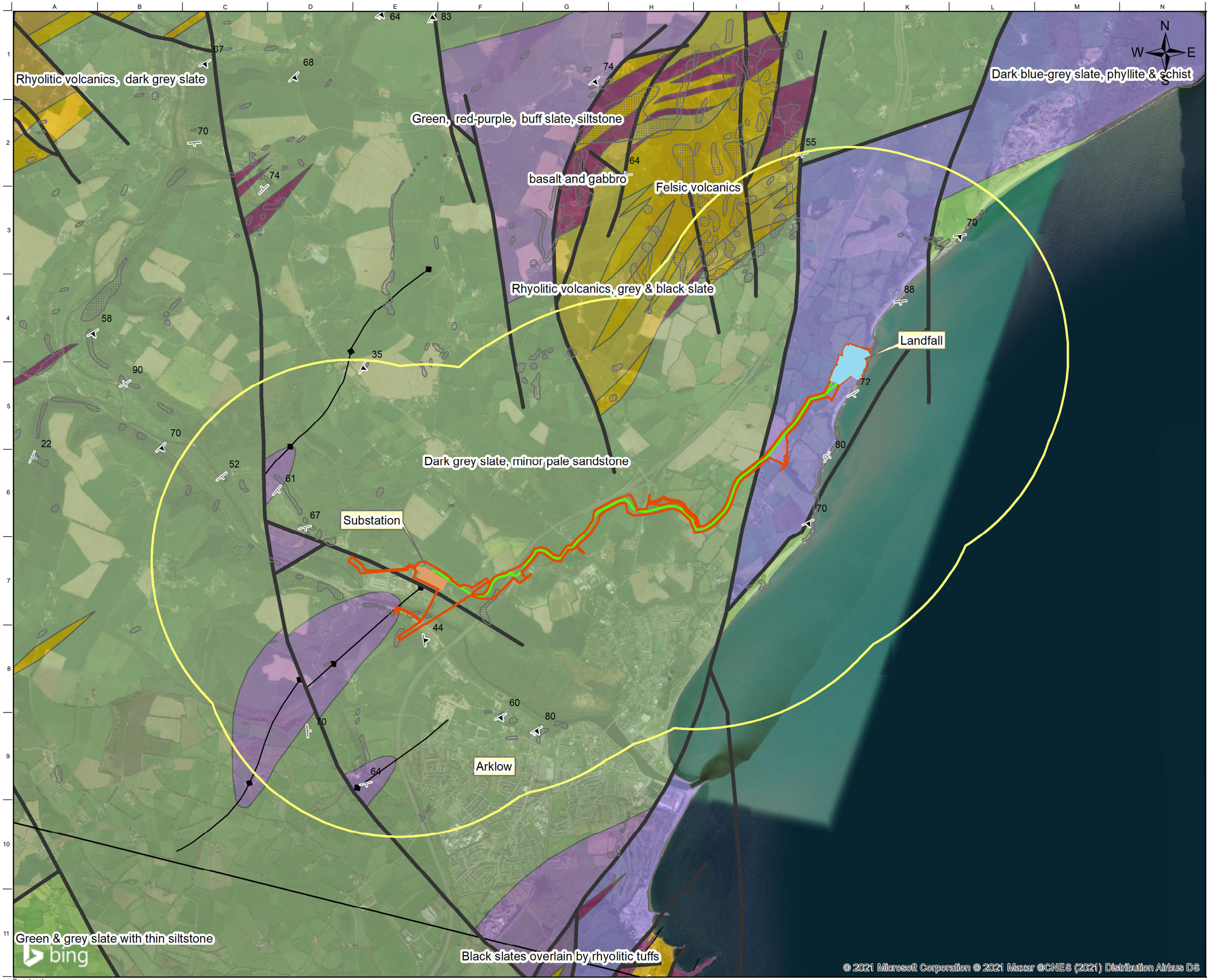
The list of soil types as classified by the GSI Quaternary mapping are listed in **Table 9.5**.

Table 9.5 List of Subsoils (Quaternary within the Region)

Soil Type	Description	Location
A	Alluvium	Avoca River and stream crossings
IrSTLPSsS	Irish Sea Till derived from Lower Palaeozoic sandstones and shales	Widespread
Mbs	Marine Beach Sands	Coastline
MEsc	Estuarine silts and clays	South of Arklow town
Rck	Bedrock outcrop or subcrop	Coastline and localised pockets within the study area.
TLPSsS	Till derived from Lower Palaeozoic sandstones and shales	Widespread
Urban	Urban	Arklow town & environs
Ws/Wsd	Windblown sand/Windblown sand and dunes	Coastline

9.3.1.4 Regional Bedrock Geology

The regional geology of the study area derived from the GSI's bedrock mapping (**Figure 9.3**) and memoirs indicates that the study area is predominantly underlain by the Ordovician Metasediments and to a lesser degree Ordovician Volcanics. The main formations present are the Kilmacrea Formation and the Ordovician Maulin Formation which are located within the study area. To the northwest of the region on the extents of the study area are the Ballymoyle Formation, Oaklands Formation and Dolerite. The Arklow Head Formation is located in the south-east of the region.



LEGEND:

- First foliation parallel to bedding
- Strike and dip of bedding, way up unknown
- Strike and dip of first foliation
- Strike and dip of overturned bedding
- Strike and dip of second foliation
- Strike of vertical bedding/foliation
- Bedrock Outcrops 100 ITM 2018
- Anticlinal Axis
- Fault
- Lithological boundary offshore
- X-Section
- Dolerite
- Ballylane Formation
- Oaklands Formation
- Arklow Head Formation
- in Arklow Head Formation
- Avoca Formation
- in Avoca Formation
- Ballymoyle Formation
- in Ballymoyle Formation
- Kilmacrea Formation
- in Kilmacrea Formation
- Maulin Formation
- Red Line Boundary
- Substation
- Landfall
- Cable route

Rev	Date	By	Chkd	Appd
F1	2021-04-01	CF	GB	GB

ARUP
50 Ringsend Road
Dublin 4
D04 T6X0
Ireland

Client
SURE PARTNERS LIMITED.

Project Title
Arklow Bank Wind Park Phase 2
Onshore Grid Infrastructure

Drawing Title
Bedrock Geology

Scale at A3	1:35,000
Role	EIAR
Suitability	FOR INFORMATION
Arup Job No	Rev
271715	F1
Name	
Figure 9.3	

Do not scale

The Kilmacrea Formation is described by the GSI as dark grey slates and minor pale sandstones. The Maulin Formation is described as dark blue-grey slates and phyllites.

Additionally, the Ordovician Oaklands Formation is located within the study area near the substation site and in the northernmost extremity of the study area and is described as green, red-purple, buff slate, siltstone. The Ballymoyle Formation (Ordovician Volcanics) occurs to the northwest of the study area and is described as rhyolitic volcanics, grey & black slate along with the Dolerite which is described as basalt and gabbros. The Arklow Head Formation is described as black slates overlain by rhyolitic tuffs.

The structural geology within the area is highly variable and complex and is heavily folded and faulted. A number of faults are shown trending generally north/south throughout the site and are generally associated with a change in bedrock lithology. The south of the region is characterised by a large anticline with a north east to south west trending fault axis as shown on **Figure 9.3**.

According to the GSI Groundwater Data Viewer (2017), there are no karst features present in close proximity to the site or the surrounding area.

A summary of the geological formations within the region is shown in **Table 9.6**.

Table 9.6 Rock Formations within the Region

Geological period	Formation	Description	Location
Ordovician	Oaklands Formation	Green, red-purple, buff slate, siltstone	Substation/ Northernmost extremity
	Dolerite	Basalt and gabbros	Northwest
	Arklow Head Formation	Black slates overlain by rhyolitic tuffs	Southeast
	Ballymoyle Formation	Rhyolitic volcanics, grey & black slate.	Northwest
	Kilmacrea Formation	Dark grey slate, minor pale sandstone	Widespread
	Maulin Formation	Dark blue-grey slate, phyllite and schist	East of the study area along the coastline and to the southwest of the study area outside Arklow

9.3.1.5 Regional Aquifer Type and Classification

The GSI system for classifying the aquifers in Ireland is based on the hydrogeological characteristics, size and productivity of the groundwater resource. There are three principal types of aquifer, corresponding to whether they are major, minor or unproductive resources whereby:

- Regionally Important Aquifers are capable of supplying regionally important abstractions (e.g. large public water supplies), or excellent yields (>400m^3/d);

- Locally Important Aquifers are capable of supplying locally important abstractions (e.g. smaller public water supplies, group schemes), or good yields (100-400m^3/d); and
- Poor Aquifers are capable of supplying small abstractions (e.g. domestic supplies), or moderate to low yields (<100m^3/d).

The lower permeability glacial till soils which overlay the bedrock (gravelly clay/ boulder clay) mean slow infiltration and restricted recharge to bedrock aquifers. The glacial till is not classified as an aquifer by the GSI.

A summary of the aquifers present within the study area are outlined in **Table 9.7** and presented in **Figure 9.4**.

LEGEND:

- LI - Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones
- Pl - Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones
- Pu
- Sand and Gravel Aquifer
- Red Line Boundary
- Substation
- Landfall
- Cable route
- 2km Buffer

Rev	Date	By	Chkd	Appd
F1	2021-04-01	CF	GB	GB

ARUP
50 Ringsend Road
Dublin 4
D04 T6X0
Ireland

Client
SURE PARTNERS LIMITED.

Project Title
Arklow Bank Wind Park Phase 2
Onshore Grid Infrastructure

Drawing Title
Aquifers

Scale at A3 1:35,000

Role EIAR

Suitability FOR INFORMATION

Arup Job No 271715

Rev F1

Name
Figure 9.4

Do not scale

Table 9.7 Aquifer Types within the Region

Aquifer Type	Location	Description	Code
Locally Important Aquifer	Widespread	Bedrock which is Moderately Productive only in Local zones	(Ll)
	Avoca River	Locally important gravel aquifer	(Lg)
Poor Aquifer	North of the region	Bedrock which is Generally Unproductive except for Local zones	(Pl)

Groundwater bodies (GWBs) were delineated and described by the GSI in 2004 (GSI, 2004) as Water Framework Directive (WFD) groundwater management units to manage and protect groundwater and linked surface waters. There is one GWB present which covers the study area:

- Wicklow GWB, European code IE_EA_G_076.

The Wicklow GWB covers the Leinster Granites, Ordovician Metasediments and Cambrian Metasediments and a small amount of Ordovician Volcanics (0.7%). According to the GWB description, groundwater flow will take place in the upper 3m of the rocks. This will be lateral flow towards discharge points such as rivers, streams and the sea along coastal areas. Deeper flow is possible (with strikes encountered between 10 and 40m below ground level), but they are isolated features along open fractures.

The WFD status for the groundwater body within the study area is ‘good’ and is currently under ‘review’ regarding the risk of not maintaining that status. The water quality status and risk for these water features is summarised in **Table 9.8**.

Table 9.8 EPA WFD Groundwater Body status and risk

Water Feature	WFD Status (2013-2018)	WFD Risk
Wicklow GWB	Good	Review

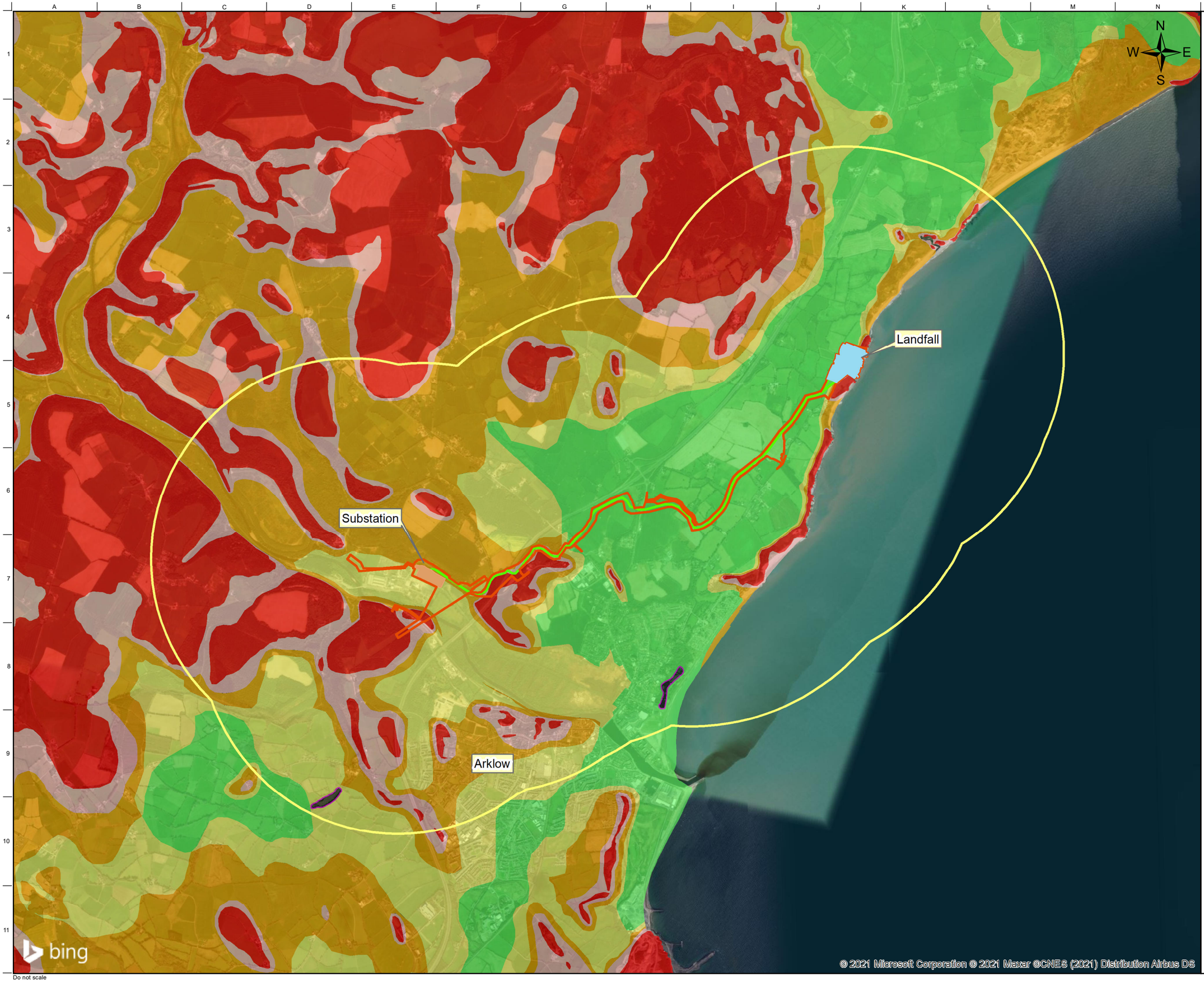
9.3.1.6 Regional Aquifer Vulnerability

Aquifer vulnerability of a groundwater body is the term used to describe the intrinsic geological and hydrogeological characteristics which determine the ease with which a groundwater body may be contaminated by human activities.

The vulnerability is determined by the travel time and the attenuation capacity of the overlying deposits. The groundwater vulnerability is determined mainly by the permeability and thickness of the subsoils that underlie the topsoil.

For example, bedrock with a thick, low permeability overburden is less vulnerable than bedrock with a thin high permeability, gravel overburden.

Aquifer vulnerability classification guidelines, as published by the GSI, are given in **Table 9.9** and presented on **Figure 9.5**.



LEGEND:

VULNERABILITY

- E -- Extreme
- H - High
- L - Low
- M - Moderate
- Water
- X - Rock at or near surface or karst
- Red Line Boundary
- Substation
- Landfall
- Cable route
- 2km Buffer

Rev	Date	By	Chkd	Appd
F1	2021-04-01	CF	GB	GB

ARUP

50 Ringsend Road
Dublin 4
D04 T6X0
Ireland

Client
SURE PARTNERS LIMITED.

Project Title
Arklow Bank Wind Park Phase 2
Onshore Grid Infrastructure

Drawing Title
Groundwater Vulnerability

Scale at A3 1:35,000

Role EIAR

Suitability FOR INFORMATION

Arup Job No 271715 | Rev F1

Name
Figure 9.5

Do not scale

The regional groundwater vulnerability varies significantly across the study area, ranging from areas of extreme vulnerability, which correspond to areas of bedrock outcrop, to low vulnerability where there are thicker deposits of moderate to low permeability subsoil.

Table 9.9 Aquifer Vulnerability

Vulnerability Rating	**Hydrogeological Conditions**				
	Subsoil Permeability (Type) and Thickness			**Unsaturated Zone**	**Karst Features**
	High permeability (sand/gravel)	**Moderate permeability (e.g. Sandy subsoil)**	**Low permeability (e.g. Clayey subsoil, clay, peat)**	**Sand/gravel aquifers only)**	**(<30m radius)**
Extreme (E)	0 – 3.0m	0 – 3.0m	0 – 3.0m	0 – 3.0m	-
High (H)	>3.0m	3.0 – 10.0m	3.0 – 5.0m	>3.0m	Not applicable
Moderate (M)	Not applicable	>10.0m	5.0-10.0m	Not applicable	Not applicable
Low (L)	Not applicable	Not applicable	>10.0m	Not applicable	Not applicable

9.3.1.7 Regional Recharge

Recharge is the amount of rainfall that replenishes the aquifer. It is a function of the effective rainfall (i.e. rainfall minus evaporation and run off), the permeability and thickness of the subsoil and the aquifer characteristics.

Recharge for the poor aquifer (Pl) within the study area is capped at 100mm/yr, which reflects the low permeability of the aquifer and its limited capacity for water storage. The recharge for the locally important aquifer (Ll) is capped at 200mm/yr. The locally important gravel aquifer (Lg) within the study area also generally has a recharge rate below 200mm/yr.

The range of annual groundwater recharge across the study area is presented in **Figure 9.6**.

LEGEND:

Groundwater Recharge (mm/yr)

- 1-50
- 101-150
- 151-200
- 201-250
- 251-300
- 451-500
- 51-100
- water
- Red Line Boundary
- Substation
- Landfall
- Cable route
- 2km Buffer

Rev	Date	By	Chkd	Appd
F1	2021-04-01	CF	GB	GB

ARUP
50 Ringsend Road
Dublin 4
D04 T6X0
Ireland

Client
SURE PARTNERS LIMITED.

Project Title
Arklow Bank Wind Park Phase 2
Onshore Grid Infrastructure

Drawing Title
Groundwater Recharge

Scale at A3 1:35,000

Role EIAR

Suitability FOR INFORMATION

Arup Job No **271715** | Rev **F1**

Name **Figure 9.6**

Do not scale

9.3.1.8 Regional Groundwater Abstractions

Groundwater resources describe any large spring, well or borehole which is used as a groundwater abstraction source by domestic, agricultural, commercial, industrial, local authority or group water scheme users.

The GSI keeps a record of groundwater wells drilled, however the record does not state which wells are currently used for abstraction.

Groundwater resources for the region are shown on **Figure 9.7**. The GSI lists thirty-nine wells or springs within the region. The potential well yield for these ranges between $3m^3$/day and $440m^3$/day.

LEGEND:

- Red Line Boundary
- Substation
- Landfall
- Cable route
- 2km Buffer
- River Network
- Wells10-50 - Location of Well/Spring - Size of the circle denotes the uncertainty of the location
- Wells100-200 - Location of Well/Spring - Size of the circle denotes the uncertainty of the location
- Wells50-100 - Location of Well/Spring - Size of the circle denotes the uncertainty of the location
- Wells250-500 - Location of Well/Spring - Size of the circle denotes the uncertainty of the location
- Wells 500-1km - Location of Well/Spring - Size of the circle denotes the uncertainty of the location

Rev	Date	By	Chkd	Appd
F1	2021-04-01	CF	GB	GB

ARUP

50 Ringsend Road
Dublin 4
D04 T6X0
Ireland

Client
SURE PARTNERS LIMITED.

Project Title
Arklow Bank Wind Park Phase 2
Onshore Grid Infrastructure

Drawing Title
Groundwater Resources

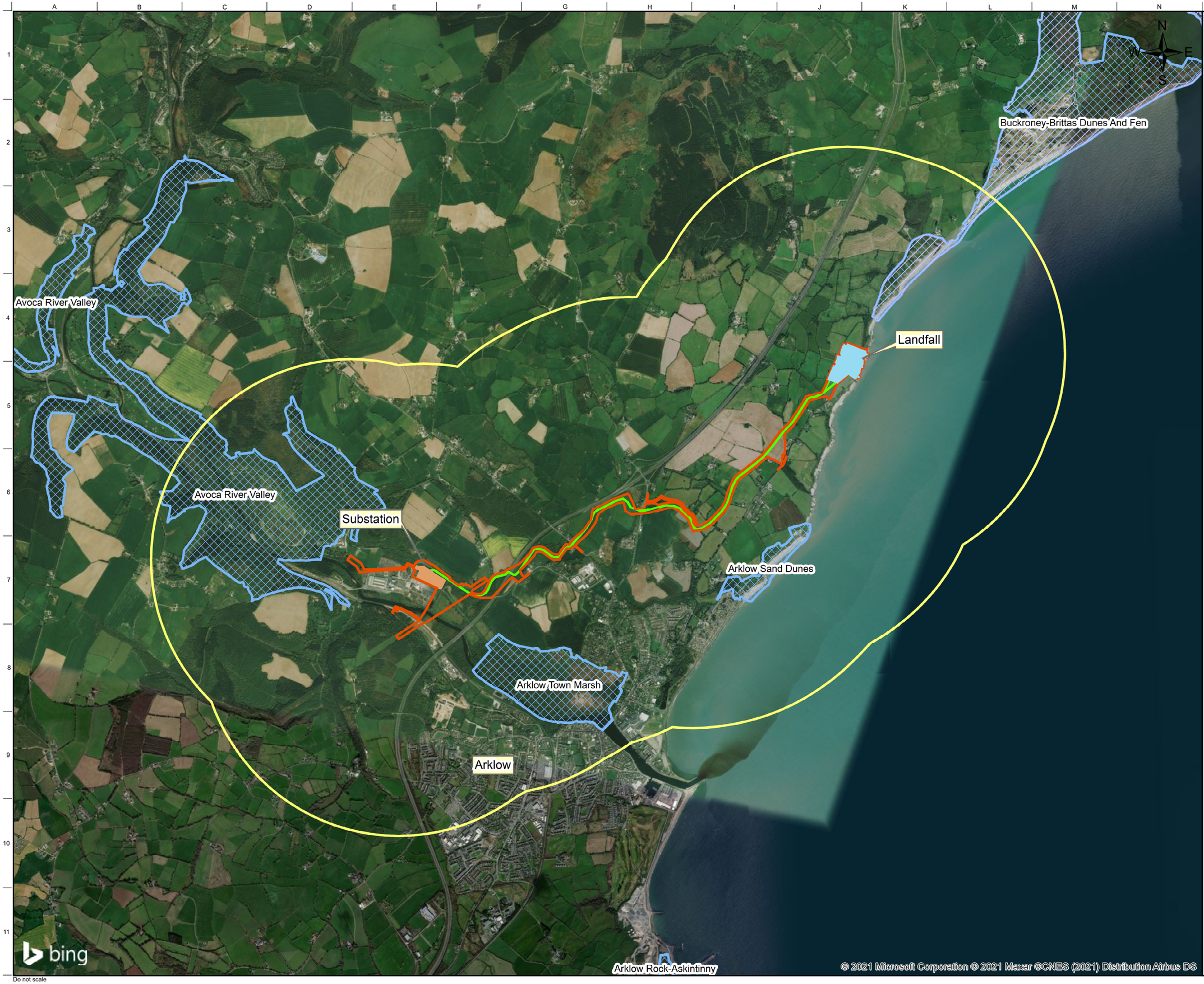
Scale at A3 1:35,000
Role EIAR
Suitability FOR INFORMATION
Arup Job No 271715
Rev F1
Name Figure 9.7

Do not scale

9.3.1.9 Regional Hydro-ecology Designated Sites

The National Parks and Wildlife Services (NPWS) is responsible for the designation of environmentally protected sites in Ireland and maintains a publicly available database of these sites. These sites include Special Areas of Conservation (SACs), Special Protection Areas (SPAs) and Natural Heritage Areas (NHAs). In addition to these sites, the NPWS also maintains a database of proposed Natural Heritage Areas (pNHAs).

Further information regarding the designated sites within the region are detailed in **Chapter 12** *Biodiversity* and shown on **Figure 9.8**. Note, only protected sites which are groundwater dependant are assessed within this chapter.



LEGEND:

- Candidate Special area of Conservation (cSAC)
- Proposed Natural Heritage Area (pNHA)
- Red Line Boundary
- Substation
- Landfall
- Cable route
- 2km Buffer

Rev	Date	By	Chkd	Appd
F1	2021-02-26	GaB	OM	MF

ARUP
50 Ringsend Road
Dublin 4
D04 T6X0
Ireland

Client
SURE PARTNERS LIMITED.

Project Title
Arklow Bank Wind Park Phase 2
Onshore Grid Infrastructure

Drawing Title
Hydro-ecology designated sites

Scale at A3	1:35,000
Role	EIAR
Suitability	FOR INFORMATION
Arup Job No	Rev
271715	F1
Name	
Figure 9.8	

Do not scale

There is one SAC and four pNHA sites located within the study area which are listed in **Table 9.10**. Conservatively, these sites are considered to be sensitive to groundwater contribution.

Table 9.10 Designated sites within the Region

Designated Site	Designation code	Status	Description	Groundwater Dependant*
Arklow Sand Dunes	001746	pNHA	Sand dunes and wet woodland, located approximately 500m east	Yes - some trees in the wet woodland
Avoca River Valley	001748	pNHA	Mixed woodland, located approximately 200m northwest	Yes – some of the trees in the woodland
Arklow Town Marsh	001931	pNHA	Wetland are, located approximately 750m southeast	Yes
Buckroney-Brittas Dunes and Fen cSAC	000729	cSAC / pNHA	Dune and alkaline fen system, located approximately 320m northeast	Yes

9.3.2 Site Specific Environment

The following section discusses the site-specific conditions within the study area for the proposed development as defined in **Section 9.2.1**. Where applicable the importance of the attributes for which the effect of the proposed development is to be assessed is also reported in this section.

For the purpose of this report the site-specific environment of the study area has been described in sections in line with the project description given in **Section 9.1**.

A summary of the key aspects of the proposed development with regard to land and soils is outlined below.

A full description of the proposed development is provided in **Chapter 5** *Description of Development*. The construction strategy is detailed in **Chapter 6** *Construction Strategy*.

Landfall

- Horizontal directional drilling (HDD) at the Landfall location;
- Two temporary construction compounds at Johnstown North. One temporary construction compound will support HDD operations (HDD compound). The other temporary construction compound (Cable Construction Compound) will support the construction of the eastern end of the onshore export cable. There are two options for the location of these compounds, one in each of the two adjacent fields, which are located on the western side of the R750 road. The HDD Compound may be in the northern field and the cable compound in the southern field, or vice versa.

- A temporary access track will be formed from the western side of the R750 public road to each compound location with areas of localised widening located along the access track in the form of passing places which will generally be up to 30m long and 5m wide.

Cable Route

- Public road crossings and watercourse crossings will be undertaken by open cut trench methods (where HDD method is not appropriate).
- HDD is currently proposed at the R772 crossing which includes the Templerainy watercourse.
- Two options are being considered to cross the M11 motorway. One option been considered utilises the HDD technique. A temporary HDD working area will be excavated up to 8m below existing ground level west of the Sheepwalk watercourse which will also include the construction of temporary access tracks. The HDD working, access and hardstand excavations may be temporarily shored up using sheet piling or other appropriate supports. The second option being considered is to cross the M11 via an existing underpass, with the cable laid within a concrete box-culvert underpass;
- Temporary construction compounds will be required for the HDD operations at the crossings of the M11 and R772 roads and the location of each compound is specific to the orientation of the route crossings of the roads;
- The excavation of two (typically) 0.8 –1.825m wide trenches along the onshore cable route (c. 6.0km long) within a typical 30m temporary cable construction corridor width to install the cable circuits between the landfall and the substation including joint bays and access tracks where the joint bays are not located adjacent to the existing tracks.

Substation

- A temporary construction compound will be established within the footprint of the permanent works at the Shelton Abbey substation site;
- Flood defence improvement works to the existing Avoca River Business Park flood defences located approximately 500m west of the substation site;
- Excavation of existing asphalt covering, installation of a remedial capping layer to minimise rainfall percolation through made ground; and
- Construction and operation of the substation and related buildings including the installation of piles and ground improvement works.

NETN Connection

- A 220kV overhead line connection from the new 220kV substation at Shelton Abbey to the existing 220kV national electricity transmission network (NETN) located c. 200m from the Shelton Abbey site which includes the construction of two new towers.
- Temporary access routes capable of accommodating construction plant, construction materials and personnel are required for the construction of each tower, the installation of the overhead line and the setting up of temporary guarding positions.

9.3.2.1 Current and Historic Land Use of the Proposed Development

The current and historic land use is discussed in order to give context to any potential changes to land and soils that could influence the importance of a feature and the magnitude of any effects. The current land use is based on current aerial imagery and mapping available from OSI Geohive (OSI 2019), Google (Google 2019) and Bing (Bing 2019) and the Corine Land Cover maps (EPA 2018). The historic land use is based on the following OSI (OSI 2019) historic aerial imagery and historic maps:

- OSI 6-inch mapping produced between 1837 and 1842;
- OSI 25-inch mapping produced between 1888 and 1913;
- OSI 6-inch Cassini mapping produced between 1830 and 1930s;
- OSI 1995 aerial photography;
- OSI 2000 aerial photography;
- OSI 2005 aerial photography; and
- GeoAerospace Lidar data.

Landfall

The proposed landfall site is currently used as agricultural land. The landfall site lies either side of the R750. The eastern side of the landfall site is adjacent to approximately 10m high sea cliffs which rise above a steeply sloping shingle beach.

Historically this area of the proposed development was used for agricultural purposes with limited changes to field boundaries noted on the OSI 6-inch mapping and OSI 25-inch mapping.

The aerial photography (OSI 2019) for the landfall site also shows the site to be agricultural land with limited changes noted to the land boundaries since 1995.

Cable Route

The cable route is used as agricultural land. Dwellings are located nearby and there are localised areas zoned for residential development in the vicinity of the cable route.

The historical maps indicate that the land along the cable route was primarily used as agricultural land. Further, the aerial photography (OSI 2019) also shows the cable route corridor to be agricultural land with limited changes noted to the land boundaries since 1995.

Substation

The substation site forms part of the Avoca River Business Park and it is a brownfield site with most of the site paved with asphalt.

The OSI 6-inch (1837-1842) and OSI 25-inch (1888-1913) historical maps indicate that the substation site was primarily used as agricultural land and the surrounding land formed part of the Shelton Abbey estate.

The OSI 6-inch (1837-1842) historical map identifies a weir and ford within the Avoca River and indicates that the banks of the river were wider at the time of mapping.

The OSI 25-inch map (1888-1913) shows the construction of a rail line to the south of the site and show alterations to the banks of the Avoca River particularly to the west of the proposed development.

The aerial photography (OSI 2019) for the substation area shows the site to be primarily used for industrial purposes and the site appears to have been paved in asphalt and concrete since at least 1995. The site was used as a storage yard between 1995 and 2000.

The Avoca River Business Park was occupied by the Irish Fertiliser Industries (IFI) manufacturing plant from the mid 1960's until 2003. The IFI plant was the subject of an EPA licence (Register Number: P0031-02). The substation site is not within the licence boundary of the existing licence area (Register Number: P0031-02), therefore there are no obligations under the licence, relevant to the proposed development.

Connection to the NETN

The connection to the NETN lies south and east of the Avoca River Business Park for two new overhead line tower locations.

The OSI 6-inch (1837-1842) and OSI 25-inch (1888-1913) historical maps indicate that the lands surrounding the connection to the NETN site were primarily used as agricultural land and the surrounding land formed part of the Shelton Abbey estate.

The OSI 6-inch (1837-1842) historical map identifies a weir and ford within the Avoca River and indicates that the banks of the river were wider at the time of mapping.

The 25-inch map (1888-1913) shows the construction of a rail line to the south of the site and show alternations to the banks of the Avoca River particularly to the west of the proposed development.

9.3.2.2 Geomorphology and Topography

The geomorphology and topography are discussed in order to give context to any potential changes land and soils that could influence the importance of a feature and the magnitude of any effects. A project specific topography survey was carried out and is included in **Appendix 9.1** in **Volume 3**.

Landfall

No notable geomorphological features were identified within this section of the study area.

A detailed topography survey was carried out at the landfall site. The topography of the site is undulating and ranges from approximately 10mOD to 25mOD. The east of the landfall site is bounded by the rocky cliffs with a thin covering of Irish Sea Till. The beach is a shingle beach with outcropping rock interspersed along the shoreline.

The proposed cable will be brought onshore via HDD process and will cross under one road, namely the R750.

Cable Route

The geomorphology within this section of the study area is characterised by glacial meltwater channels associated with the Kilbride stream, Templerainy stream and Coolboy stream.

The topography of the cable route corridor is gently undulating with topographic lows associated with river and stream crossings. The topography according to the Ordnance Survey Ireland (OSI) ranges from approximately 10mOD to 41mOD and this was confirmed during the topography survey for the cable route.

The proposed cable route will cross several public roads (one of which is the M11 motorway crossing). The route will also cross eight watercourses, namely the Johnstown North, Johnstown South, Ticknock, Coolboy, Templerainy, Kilbride, Kilbride Church and Sheepwalk Streams.

A Horizontal Directional Drilling (HDD) crossing is currently being proposed at the R772. The topography at the R772 crossing ranges from approximately 35mOD to the east of the R772 crossing with a steep drop in elevation to approximately 25mOD towards the Templerainy stream to the west of the R772. Two options are being considered for the M11 crossing, installation in an existing underpass or using a trenchless HDD drilling method. The topography on the eastern side of the M11 crossing ranges from approximately 27mOD to 35mOD and on the western side from approximately 22mOD to 28mOD. The topography on both sides of the M11 generally falls towards the motorway.

Substation

The geomorphology within this section of the study area is characterised by glacial meltwater channels now associated with the Avoca River. Flood defence embankments lie to the south adjacent to the Avoca River.

The topography of the substation site area is generally flat with the site lying between approximately 1.3mOD and 2.5mOD.

Connection to NETN

The geomorphology within this section of the study area is characterised by glacial meltwater channels now associated with the Avoca River. Flood defence embankments are located to the north adjacent to the Avoca River.

The topography within this section of the study area according to the OSI ranges from approximately 30mOD to 0mOD sloping from north to south.

9.3.2.3 Soils (Teagasc Soil Classification)

The majority of the soils expected to be encountered within the study area are topsoils and other soils for which there are a number of classifications on the Teagasc Soil Map (Teagasc *et al*. 2017). Made ground is predominantly located at the substation site and at road crossings, where it comprises hardstanding material such as asphalt. The main soils within the study area, as classified by Teagasc (Teagasc *et al*. 2017) are presented on **Figure 9.1** and are listed in **Table 9.11** along with their importance with respect to drainage and fertility as determined by 'Box 4.1' in the NRA Guidelines (NRA 2008). Where these soils are important features with respect to possible soft soils or contamination their importance is detailed in **Section 9.3.2.8** and **Section 9.3.2.9**.

Landfall

The soils encountered within the study area for the landfall are predominantly topsoils consisting of surface water gleys (AminPD) associated with agricultural lands.

The intrusive investigation indicated the topsoil across the site had an average thickness of 0.3m and was generally described as brown slightly gravelly silty Clay with rootlet and a low cobble content.

Cable Route

The soils encountered within the study area for the cable route are predominantly underlain by AminPD deposits which are described as surface water gleys or groundwater gleys acidic. Water or stream crossings are characterised by alluvial deposits. Made ground deposits are located to the southern extents of the cable route.

The intrusive investigation indicated the topsoil across the site had an average thickness of 0.2m and was generally described as brown slightly gravelly silty Clay with rootlet and a low cobble content.

The non-intrusive surveys identified the pavement thickness at each of the road crossings to be approximately 0.1m.

Substation

The soils encountered within the study area for the substation are predominantly made ground.

Made ground desposits were encountered during the project specific ground investigation.

These desposits are generally described as blue red or grey brown sandy clayey gravel with occasional plastic, concrete, wood, steel, wires and red bricks. A red clay was also identified which is likely to be a by-product of the past industrial use of the site. This red clay layer has an average thickness of 0.5m but ranges in thickness from <0.2m to 1.9m thick. The made ground has an average thickness of 1.60m.

Connection to NETN

The soils encountered within the study area for the NETN connection are predominantly made ground and AlluvMIN deposits according to the GSI.

Table 9.11 Summary of Soils within the Study Area

Strata	Description	Location	Importance	Justification for Importance rating
Made Ground	Associated with industrial and urban development.	Substation	Medium	Previous industrial use at Avoca River Park
AlluvMIN	Mineral alluvium	Avoca River, River crossings along cable route	Medium	Moderately drained and/or moderate fertility soils.
Topsoil - AminDW	Acid Brown Earths/ Brown Podzolic Deep Well drained mineral (Mainly acidic)	North of the cable route	High	Well drained and/or high fertility soils
Topsoil - AminPD	Surface water gleys/groundwater gleys acidic	Cable route	Low	Poorly drained and or low fertility soils

9.3.2.4 Subsoils (GSI Quaternary Classification)

Superficial deposits (subsoil) comprise the unconsolidated geological deposits which overlie the solid geology. The subsoils within the study area, as classified by the GSI Quaternary mapping (GSI 2016) are presented on **Figure 9.2** and are listed in **Table 9.12** along with their importance with respect to feature quality and significance as determined by Table C2 Criteria for Rating Site Importance of Geological Features (NRA, 2008) (IGI, 2003). Where these subsoils are important features with respect to possible soft soils or contamination, their importance is detailed in **Section 9.3.2.8** and **Section 9.3.2.9**.

The main subsoils encountered within the study area are Irish Sea Tills. Additionally, there are areas of made ground (Urban), alluvium, gravels and glacial tills derived from Lower Palaezoic sandstone and shales as discussed below.

Landfall

The subsoils encountered within the study area for the landfall are predominantly Irish Sea Tills derived from Lower Palaeozoic sandstones and shales. Rock outcropping or sub cropping and Marine Beach Sand is noted along the sea front.

Glacial till deposits were encountered during the project specific ground investigation and have been interpreted as firm to very stiff orange, brown and grey slightly gravelly to gravelly, slightly sandy to sandy silty Clay with rootlets, a low cobble content and shell fragments. The top of the glacial till varies from 0.2m to 9.0m.

The geophysical investigation indicated that the subsoils consists of sandy gravelly clay and silt.

Cable Route

The subsoils encountered within the study area for the cable route are predominately Irish Sea Tills derived from Lower Palaeozoic sandstones and shales apart from stream or water crossings which are characterised by alluvial deposits. Rock outcropping or subcropping is noted near the M11 crossing along with tills derived from Lower Palaeozoic sandstones and shales.

Glacial till deposits were encountered during the project specific ground investigation and have been interpreted as firm grey mottled orange brown slightly gravelly silty sandy Clay with a low cobble content to firm to very stiff orange, blue, brown grey slightly gravelly, slightly sandy to sandy silty Clay with rootlets, a low cobble content and shell fragments. The glacial till encountered varies from 0.2m to 29.4m with pockets of orangish brown slightly gravelly fine to coarse Sand and orange brown fine to coarse Gravel.

The geophysical investigation indicated that the overburden consists of sandy gravelly clay and silt over the first approximately 600 m of the cable route, and from here the overburden is generally described as sandy gravelly clay and silt or clayey silty sand and gravel with some smaller areas of clay and silt overburden. The sand and gravels are generally located on the higher ground across the route.

Substation

Made ground desposits were encountered during the project specific ground investigation and are described in **Section 9.3.2.3**.

The subsoils encountered within the study area for the substation are predominately alluvial deposits associated with the Avoca River. The lands adjacent to the substation are underlain by tills derived from Lower Palaeozoic sandstones and shales.

The made ground is underlain by silts and clays which in places includes organic peat like material and this was confirmed during the project specific ground investigation and has been interpreted as very soft to firm grey brown slightly sandy to sandy slightly gravelly slightly peaty Silt and very soft to soft black slightly silty slightly sandy fibrous Peat with wood and rootlets. These deposits had an average thickness of 6.0m.

Coarse grained alluvial (sand and gravel) deposits were identified underlying the fine grained alluvial deposits during the project specific GI and have been interpreted as medium dense to very dense dark grey and brown slightly sandy subangular to sub-rounded fine to coarse Gravel with various lithologies and dense grey and brown slightly silty slightly gravelly fine to medium Sand. The thickness of these deposits ranged from 0.10m to 14.50m.

Connection to NETN

The subsoils encountered within the study area for the connection to the NETN include Irish Sea Tills derived from Lower Palaeozoic sandstones, alluvial deposits and bedrock outcrop or subcrop.

Table 9.12 Summary of Subsoils within the Study Area

Strata	Description	Location	Importance	Justification for Importance rating
A	Alluvium	Cable route & Landfall	Low	Uneconomically extractable mineral resource
A	Alluvium	Substation & Connection to NETN	Medium	Previous industrial use at Avoca River Business Park
IrSTLPSsS	Irish Sea Till derived from Lower Palaeozoic sandstones and shales	Cable Route	Medium	Medium value on a local scale
Mbs	Marine Beach Sands	Beaches	Low	Low value on a local scale
Urban	Urban	Substation & Connection to NETN	Medium	Previous industrial use at Avoca River Business Park
TLPSsS	Till derived from Lower Palaeozoic sandstones and shales	North and south of cable route	Low	Low value on a local scale
Rck	Bedrock outcrop or subcrop	Southern extents of the cable route, Substation, Connection to the NETN	Low	Low value on a local scale

9.3.2.5 Bedrock Geology

The bedrock geology of the study area, as classified by the GSI 1:100,000 Bedrock Geology Map (GSI 2018) is presented on **Figure 9.3** with the various formations listed in **Table 9.13** along with their importance with respect to feature quality and significance as determined by 'Box 4.1' in the NRA Guidelines (NRA 2008). Where the bedrock is an important feature with respect to economic geology its importance is detailed in **Section 9.3.2.10**.

Landfall

The bedrock encountered within the study area for the landfall comprises the Maulin Formation which is described as dark blue-grey slate, phyllite and schist (GSI 2018).

No major structural bedrock features were identified within this section of the study area.

The geophysical investigation highlighted areas of shallow bedrock across the landfall site which was confirmed by the intrusive ground investigation.

The bedrock encountered during the project specific GI can be described as medium strong locally strong thinly laminated greenish blueish grey and grey fissile fine grained shale with fine to coarse gravel sized white quartz clasts and strong locally very strong thinly laminated brown and greenish grey fine to coarse sandstone. The depth to top of rock ranged between 2.3m and 9.0m.

Cable Route

Based on the GSI 2018 the bedrock encountered within the study area for the cable route comprises of the Maulin Formation which consists of a dark blue-grey slate, phyllite and schist. The cable route corridor study area also comprises the Kilmacrea Formation which consists of a dark grey slate and minor pale sandstone.

Possible weathered rock was encountered in BH206 on the cable route. It was recovered as angular fine to coarse gravel sized clasts of strong fine and medium grained siltstone with surficial orange and orangish brown iron stain. The top of strata was 13.5 mbgl.

The geophysical investigation identified areas of shallow bedrock adjacent or near watercourses along the cable route at Johnstown. The depth to rock at this location ranged from 3m to 5m. Shallow rock was also identified near Ticknock stream where the rock is as shallow as 2.5m below ground level (bgl) but generally ranges from 4m to 6mbgl. The ground conditions identified around the M11 underpass show the rock to be approximately 6.5mbgl.

East of the M11 underpass the ground elevation and rock elevation drop to a depth ranging between 7m and 10mbgl. Highly weathered rock is identified towards the end of the cable route approaching the substation.

Figure 9.3 indicates a major structural bedrock fault is located between the boundary of the Maulin Formation and the Kilmacrea Formation between the townlands of Ballymoney and Johnstown South.

Substation

Based on the GSI 2018 the bedrock encountered within the study area for the substation comprises of the Kilmacrea Formation which consists of a dark grey slate and minor pale sandstone and the Oaklands Formation which is described as a green, red-purple, buff slate and siltstone.

A major structural bedrock fault is located between the boundary of the Oaklands Formation and the Kilmacrea Formation.

The limb of a large anticline with a north east to south west trending axis is located to the south west of the proposed development.

The bedrock encountered during the project specific GI can be described as weak to medium strong thinly bedded grey to dark grey very fine-grained slate with occasional quartz veins and brown staining and medium strong to strong fine grained thinly laminated grey sandstone with quartz veins. The top of rock encountered ranged from 9.8m to 22.10m.

Connection to NETN

Based on the GSI 2018 the bedrock encountered within the study area for the connection to the NETN comprises of the Kilmacrea Formation which consists of a dark grey slate and minor pale sandstone and the Oaklands Formation which is described as a green, red-purple, buff slate and siltstone.

A major structural bedrock fault is located between the boundary of the Oaklands Formation and the Kilmacrea Formation.

The limb of a large anticline with a north east to south west trending axis is located to the south west of the proposed development.

Table 9.13 Rock Formations within the Study Area

Formation	Description	Location	Importance	Justification for Importance rating
Kilmacrea Formation	Dark grey slate, minor pale sandstone	Cable Route	Low	Low value on a local scale
Maulin Formation	Dark blue-grey slate, phyllite and schist	Landfall	Low	Low value on a local scale
Oaklands Formation	Green, red-purple, buff slate and siltstone	Connection to the NETN	Low	Low value on a local scale

9.3.2.6 Historic and Project Specific Ground Investigation

A summary of the ground conditions encountered by historical ground investigations adjacent to the proposed development (listed in **Section 9.2.4.1**) and the project specific ground investigations is presented in **Table 9.14** to **Table 9.17.**

Table 9.14 Summary of ground conditions expected to be encountered by the proposed development at the Landfall

Strata	Description	Top of Strata (mBGL)	Average Thickness of Strata (m)
Topsoil	Brown slightly gravelly to gravelly slightly sandy silty Clay/Silt with some rootlets and a low cobble content	0	0.25
Glacial Till	Firm to very stiff orange, brown and grey slightly gravelly to gravelly, slightly sandy to sandy silty Clay with rootlets, a low cobble content and shell fragments.	0.2 to 0.3	3.90
Bedrock	Medium strong locally strong thinly laminated greenish blueish grey and grey fissile fine grained Shale with fine to coarse gravel sized white quartz clasts and strong locally very strong thinly laminated brown and greenish grey fine to coarse Sandstone.	2.3 to 9.0	Not Proven

Table 9.15 Summary of ground conditions expected to be encountered by the proposed development at the Cable Route

Strata	Description	Top of Strata (mBGL)	Average Thickness of Strata (m)
Topsoil	Brown slightly gravelly silty Clay with rootlet and a low cobble content.	0	0.25
Asphalt	n/a	0	0.1
Glacial Till	Brown silty gravelly Sand	1.8 to 4.7	Not proven
	Orangish brown slightly gravelly fine to coarse Sand and orange brown fine to coarse Gravel.		
	Firm grey mottled orange brown slightly gravelly silty sandy Clay with a low cobble content to firm to very stiff orange, blue, brown grey slightly gravelly, slightly sandy to sandy silty Clay with rootlets, a low cobble content.	0.2 to 0.6	Not proven
Weathered Rock	Possible weathered rock recovered as angular fine to coarse gravel sized clasts of strong fine and medium	13.5	Not proven

Strata	Description	Top of Strata (mBGL)	Average Thickness of Strata (m)
	grained siltstone with surficial orange and orangish brown iron stain.		

Table 9.16 Summary of ground conditions expected to be encountered by the proposed development at the Substation

Strata	Description	Top of Strata (mBGL)	Average Thickness of Strata (m)
Made Ground	Asphalt or 804 Gravel type material consisting of light red, yellowish orange brown slightly sandy to sandy, slightly clayey, slightly silty angular to subangular medium to coarse Gravel with a low cobble content. Blue, red or grey brown sandy clayey Gravel with occasional plastic, concrete wood, steel, wires, red bricks, cobbles and boulders Red, brown mottled orange slightly gravelly to gravelly sandy Clay with red brick fragments Red Clay fertilizer by product and soft greyish white Silt	0	1.6
Fine grained alluvial deposits	Very soft for firm grey brown slightly sandy to sandy slightly gravelly slightly peaty Silt Very soft to soft black slightly silty slightly sandy fibrous Peat with wood and rootlets	0.80 to 3.0	6.0
Coarse grained alluvial deposits	Medium dense to very dense dark grey and brown slightly sandy subangular to sub-rounded fine to coarse Gravel with various lithologies Dense grey and brown slightly silty slightly gravelly fine to medium Sand	4.80 to 8.8	9.8
Bedrock	Weak to medium strong thinly bedded grey to dark grey very fine grained Slate with occasional quartz veins and brown staining Medium strong to strong fine grained thinly laminated grey Sandstone with quartz veins	9.80 to 22.10	Not confirmed

Table 9.17 Summary of ground conditions expected to be encountered by the proposed development at the Connection to the NETN

Strata	Description	Top of Strata (mBGL)	Thickness of Strata (m)
Glacial Till	Loose brown Sand	0	0 to 3.90m

Strata	Description	Top of Strata (mBGL)	Thickness of Strata (m)
Glacial Till	Firm to stiff brown slightly sandy slightly gravelly Silt/Clay	3.90 to 7.9	4.0
Bedrock	Weathered Shale rock recovered as angular to fine coarse gravel and boulder sized clasts of strong laminated greyish brown fine grained Mudstone	7.9	Not confirmed

9.3.2.7 Karst

Karst is a type of geological feature characterised by caves, caverns and other types of underground drainage resulting from the dissolution of the underlying bedrock. This typically occurs in areas of high rainfall with soluble rock.

There are no karst features identified within the study area in the GSI Karst database.

Consequently, due to the geology of the region not being known to contain karst features, the risk of karst is deemed negligible and will not be further assessed.

9.3.2.8 Soft and/or Unstable Ground

Soft soils consist of peat, fine grained alluvium or very soft cohesive material and their presence within the study area could result in an effect if they require, for example, excavation and are therefore considered important features. Various sources of information were consulted in establishing these areas within the study area namely:

- Teagasc soil map (Teagasc *et al*. 2017);
- GSI Quaternary Map (GSI 2016);
- Geohive Aerial imagery and mapping (Geohive 2019);
- Project Specific Ground Investigation data; and
- Site Walkover Survey

The GSI database shows no recorded landslide events within the study area and therefore unstable ground is not considered further in this assessment.

The soft soils identified within the study area are detailed in **Table 9.18.**

Table 9.18 Soft soils within the Study Area

Feature	Description	Location	Importance	Justification for Importance rating
Alluvial deposits	Typically found along current and historic watercourses	Cable Route and Landfall	Low	Volume of soft soil underlying the proposed development is small and of a local scale.

Feature	Description	Location	Importance	Justification for Importance rating
Alluvial deposits	Typically found along current and historic watercourses	Substation, Connection to the NETN	Medium	Previous industrial use at Avoca River Business Park

9.3.2.9 Contaminated Land

Considering the urban fabric of the study area, there are likely to be some sources of contamination within the made ground throughout the study area. The assessment of contaminated land is focused on the footprint of the proposed development, unless there is likely to be a pathway connecting a possible source of contamination to the development footprint.

Various sources of information were consulted in assessing the proposed development for locations of potential contaminated land:

- CORINE land cover mapping (EPA 2018);
- Teagasc soil map (Teagasc *et al*. 2017);
- EPA (EPA 2019);
- OSI mapping (OSI 2019); and
- The project specific ground investigations carried out to inform the proposed development and EIAR are listed in **Table 9.14** to **Table 9.17**. These provide useful verification for the data already compiled relating to the baseline environment.

The known potential sources of contamination relevant to the proposed development identified within the study area are detailed in **Table 9.19** along with their importance as determined by the NRA Guidelines Box 4.1 (NRA 2008).

Table 9.19 Summary of Potential Sources of Contaminated Land Adjacent to the Proposed Development

Feature	Description	Importance	Justification for Importance rating
Historic Quarry	A number of disused quarries have been identified on the OSI maps which have been backfilled. One has been located to the south of the proposed development at Glenart adjacent to the Avoca River and others located within Arklow town	Low	Degree or extent of soil contamination is low on a local scale
Closed Landfills	Adjacent to the Substation site	Medium	Degree or extent of soil contamination is moderate on a local scale

Feature	Description	Importance	Justification for Importance rating
Fertilizer Plant	Substation	High	Degree or extent of soil contamination is high on a local scale

The IFI fertiliser plant was the subject of an EPA licence (Register Number: P0031-02). The substation site is not within the licence boundary of the existing licence area (Register Number: P0031-02). One of the towers to be decommissioned (connection to NETN) is within the licence area, but the decommissioning will not involve any ground disturbance (the tower will be removed down to ground level, but the foundations will remain in place). As a result, there are no obligations under the licence, relevant to the proposed development.

Landfall

No features associated with contaminated land were identified at the landfall.

Based on the samples recovered during the project specific ground investigation, there was no evidence of elevated contaminants within the shallow sediments.

Cable Route

No features associated with contaminated land were identified along the cable route corridor.

Based on the samples recovered during the project specific ground investigation, there was no evidence of elevated contaminants within the shallow sediments.

Substation

Soil analysis was carried out on samples retrieved during the ground investigations at depths ranging from 0.5mbgl to 3.6mbgl.

The main findings of the soil analysis carried out within the substation site are as follows:

- The soil can be classified as inert to hazardous;
- Asbestos was not detected in any of the recorded results during the project specific GI carried out by IDL;
- Elevated concentrations of metals were recorded across the site. Mineral oil was identified in TP315 and TP322.
- A red clay fertiliser by-product was identified within the trial pits. Soil analysis of this material indicates it should be classified as hazardous. Exceedances of Arsenic, Molybdenum, Cadium, Zinc and Copper were noted within this material.
- A white material was identified within the trial pits. This material displayed similar visual characteristics to phosphogypsum. In addition elevated sulphate concentrations would further corroborate this description.

A radiological survey was carried out on discovery of this material and the results are discussed in more detail below.

All materials requiring disposal off-site are classified as wastes. The steps in the waste classification process are as follows and are only applicable to material to be disposed off site:

1. Classify the material according to the EPA document "Waste Classification, List of Waste & Determining if Waste is Hazardous or Non-hazardous, Valid from July 2018". The HazWasteOnline cloud-based software is used to perform this classification.
2. If the material is classified as 17 05 03* as defined in the EPA 2018 guidance referenced above, the material is hazardous under the Waste Framework Directive 2008/98/ EC and must comply with the Regulation (EC) No 1013/2006 on shipment of waste (Waste Shipment Regulations) requirements for hazardous waste.
3. Alternatively, if the material is classified as '17 05 04 – Soil and Stones excluding those included in 17 05 03*'. The material is non-hazardous under Waste Framework Directive 2008/98/ EC and Waste Shipment Regulations and must comply with the Waste Shipment Regulations requirements for non-hazardous waste.
4. Classify all of the materials in accordance with the Council Decision 2003/33/EC establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC (Waste Acceptance Criteria). This classification will determine the type of landfill at which the material will be accepted.

A radiological survey was also carried during the project specific GI, the results of which are included in **Appendix 9.1** in **Volume 3.**

The radiological survey consisted of a walkover survey and *in-situ* monitoring of intrusive investigation that identified radiation slightly above background levels in the area containing possible phosphogypsum deposits but was well below the annual threshold, at four trial pit locations (TP301, TP302, TP312 and TP 310). One sample was taken for laboratory analysis and tested at the EPA laboratory and the results concluded that no significant radiological contamination at the surface or immediate subsurface was identified.

Due to the historical land use at the substation site and the results of the soils analysis, a remediation strategy has been prepared for the substation site.

The proposed remediation strategy for the site is to cap the made ground with a barrier layer to minimise the percolation of rainwater through the contaminated material which will minimise leachate generation, act as a gas barrier and also form a physical barrier for site users to prevent dermal contact with the hazardous made ground during site operation. A summary of the remediation strategy is outlined below and further detail is provided in **Chapter 6** *Construction Strategy*.

The proposed capping system outlined in the remediation strategy includes the following (from the base upwards):

- Removal of the asphalt;
- Where required, made ground will be locally excavated. The made ground will be compacted to form an even working platform. Following this a geotextile layer will cover the entire area to prevent migration of fines up from the made ground into the overlying granular fill;
- A gas drainage layer for ventilation of natural granular material will be placed;
- A geosynthetic clay liner (e.g. GCL) which provides a suitable hydraulic barrier will then be placed over the gas drainage layer;
- A drainage layer will be provided, with perforated filtration pipes which will route the percolated rainfall to a storm water collection system;
- Finishing layer (the composition of this layer will vary across the site based on the requirements at that particular location).

The potential for ground gas was also considered at the substation site, in the context of the remediation strategy. Ground Gas monitoring has been completed at the site on six occasions in 2020 by GII and on one occasion by IDL (for confirmation purposes only as it was deemed a low risk given the findings from GII previously). While elevated methane and carbon dioxide and trace levels of hydrogen sulphide were initially detected in all of the GII wells these levels have gradually reduced over the subsequent monitoring rounds by both GII and IDL. Overall, concentration levels are low and do not exceed the relevant thresholds (CIRIA C665). The results indicate that while ground gases are present, they are unlikely to migrate into the building structure. The building foundations will include measures to mitigate radon risk which will be sufficient to mitigate any residual ground gas risk.

The purpose of the gas drainage layer and ventilation system, integrated with the capping system, is to ensure there is no ponding of gas in undulations under the proposed GCL liner that could lead to a more concentrated localised build-up over a long period of time.

9.3.2.10 Mineral Aggregate Resources

The following datasets were consulted in order to assess the effect of the proposed development on the economic geology of the study area:

- GSI: aggregate potential mapping (GSI 2016);
- GSI: mineral localities (GSI 2014); and
- GSI active quarries (GSI 2019).

There are no active pits, mines or quarries and no mineral localities identified within the study area.

Localised pockets of moderate granular potential are noted within the study area as shown on **Figure 9.9**.

Landfall

Substation

Arklow

bing

© 2021 Microsoft Corporation © 2021 Maxar ©CNES (2021) Distribution Airbus DS, CC-BY Geological Survey Ireland, CC-BY 4.0
Geological Survey Ireland, Lally, GSI

N
W
E
S

LEGEND:

Granular Aggregate Potential

- Very High potential
- High potential
- Moderate potential
- Low potential
- Very Low potential
- Red Line Boundary
- Substation
- Landfall
- Cable route
- 2km Buffer

External Geotechnical Boreholes

Hole Depth (metres)

- 0-5m Bedrock Met
- 5-10m Bedrock Met
- 10-20m Bedrock Met
- 20-30m Bedrock Met
- 30-1000m Bedrock Met
- 0-5m Bedrock Not Met
- 5-10m Bedrock Not Met
- 10-20m Bedrock Not Met
- 20-30m Bedrock Not Met
- 30-1000m Bedrock Not Met

Rev	Date	By	Chkd	Appd
F1	2021-04-01	CF	GB	GB

ARUP
50 Ringsend Road
Dublin 4
D04 T6X0
Ireland

Client
SURE PARTNERS LIMITED.

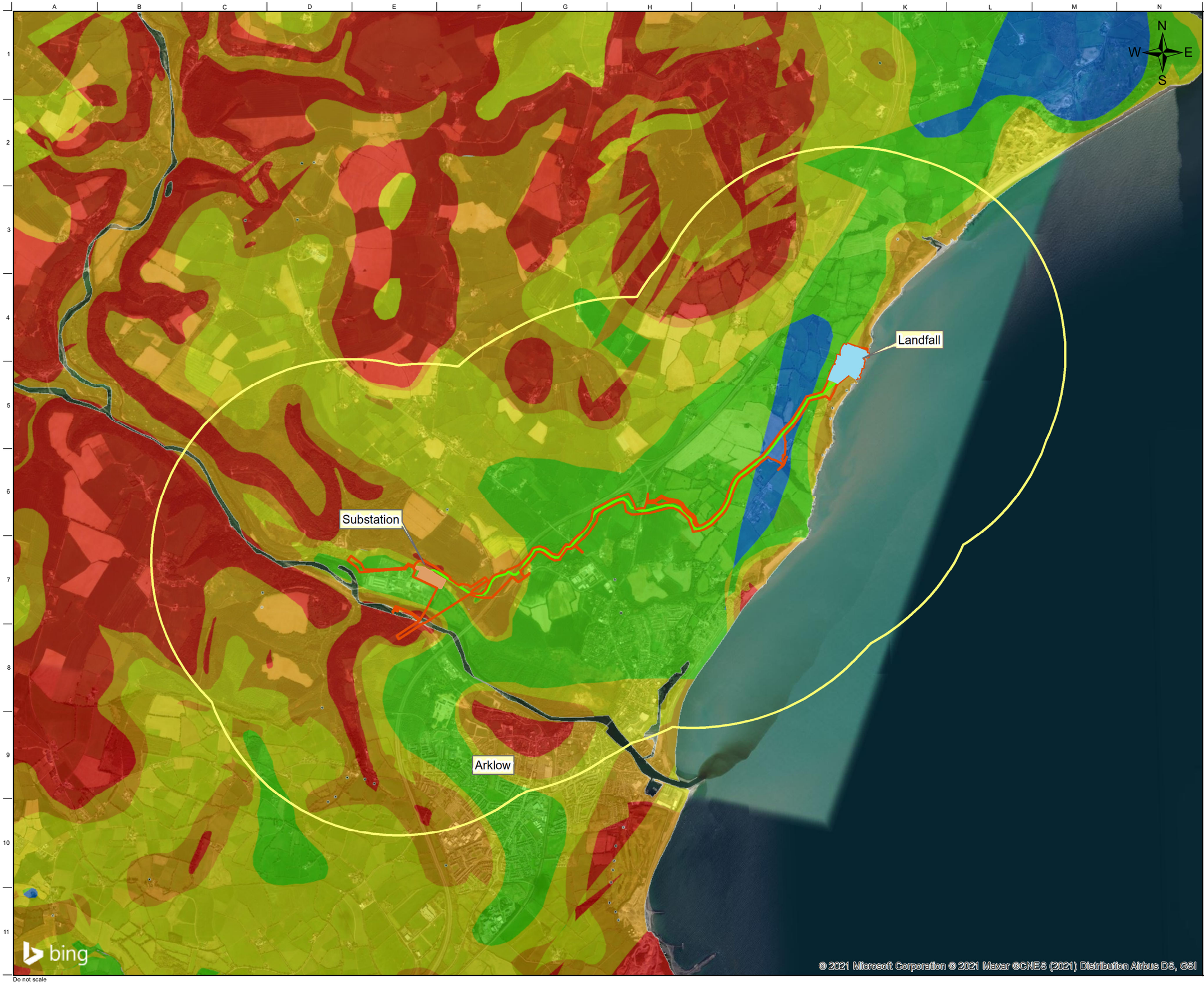
Project Title
Arklow Bank Wind Park Phase 2
Onshore Grid Infrastructure

Drawing Title
Project Specific Features

Scale at A3 1:35,000
Role EIAR
Suitability FOR INFORMATION
Arup Job No 271715
Rev F1
Name Figure 9.9

Do not scale

The crushed rock aggregate potential is predominately low. The northern section of the cable route near the landfall site ranges from very low to high potential and the approach from the M11 motorway to the substation ranges from moderate to high potential as shown on **Figure 9.10** and summarised in **Table 9.20**.



LEGEND:

Crushed Rock Final Scores

- Very High potential
- High potential
- Moderate potential
- Low potential
- Very Low potential
- Red Line Boundary
- Substation
- Landfall
- Cable route
- 2km Buffer

Rev	Date	By	Chkd	Appd
F1	2021-04-01	CF	GB	GB

ARUP

50 Ringsend Road
Dublin 4
D04 T6X0
Ireland

Client
SURE PARTNERS LIMITED.

Project Title
Arklow Bank Wind Park Phase 2
Onshore Grid Infrastructure

Drawing Title
Crushed Rock Aggregate Potential

Scale at A3 1:35,000

Role EIAR

Suitability FOR INFORMATION

Arup Job No 271715

Rev F1

Name Figure 9.10

Do not scale

Landfall

The GSI aggregate potential mapping shows the crushed rock aggregate potential within this section of the study area generally ranges from moderate to high potential.

No granular aggregate potential was noted within the landfall site.

Cable Route

The GSI aggregate potential mapping shows the crushed rock aggregate potential along the cable route corridor is generally low. An area of very low crushed rock aggregate potential was identified near the landfall site and an area of moderate to high crushed rock aggregate potential was identified at the approach from the M11 motorway to the substation site.

An area of moderate granular aggregate potential was noted along the cable route at the R772 crossing and north of the landfall site.

Substation

The GSI aggregate potential mapping shows the crushed rock aggregate potential along this section of the study area generally ranges from low to high.

No granular aggregate potential was noted within the substation site.

Connection to NETN

The GSI aggregate potential mapping shows the crushed rock aggregate potential in this section of the study area generally ranges from low to high.

Table 9.20 GSI Aggregate potential for the Study Area

Feature	Potential	Location	Importance	Justification for Importance rating
Crushed rock aggregate potential	Very low	Cable Route	Low	Uneconomically extractable mineral resource
Crushed rock aggregate potential	Low	Cable Route	Low	Uneconomically extractable mineral resource
Crushed rock aggregate potential	Moderate	Landfall/ Substation	Medium	Sub-economic extractable mineral resource
Crushed rock aggregate potential	High	Landfall/ Substation	Medium	Extractable mineral resource
Granular aggregate potential	Moderate	R772 crossing Cable Route	Medium	Sub-economic extractable mineral resource

9.3.2.11 Geological Heritage Areas

Geological Heritage Areas are designated as part of the Irish Geological Heritage Programme; a partnership with the GSI (2019c) and the (then) Department of Environment, Heritage and Local Government.

No Geological Heritage Areas were identified within the study area.

9.3.2.12 Aquifer Type and Classification

The GSI Bedrock Aquifer mapping (2019b) for the study area (**Figure 9.4**) indicates that there are three aquifer types within the study area as summarised in **Table 9.21** along with their importance as determined by the NRA Guidelines Box 4.3.

The landfall and cable route are underlain by the locally important bedrock aquifer (Ll) and the substation and connection to the NETN are underlain partially by the Ll aquifer in the northern area of the site and the gravel aquifer (Lg) towards the south of the site.

Table 9.21 Summary of Aquifer Types within the Study Area

Feature	Potential	Location	Importance	Justification for Importance rating
Locally Important Aquifer	Bedrock which is moderately productive only in local zones (LI)	Throughout	Medium	Attribute has a medium quality or value on a local scale
Locally Important Gravel Aquifer	Gravel which is moderately productive only in local zones (Lg)	Substation, Connection to the NETN	Medium	Attribute has a medium quality or value on a local scale
Poor Aquifer	Bedrock which is generally unproductive except for in local zones (Pl)	North extents of the Study Area	Low	Attribute has a low quality or value on a local scale

9.3.2.13 Groundwater Vulnerability

Groundwater vulnerability (2019b) within the study area ranges from ‘Extreme’ where bedrock is close or at the surface to ‘Low’ vulnerability in areas where thick subsoil deposit is present as shown on **Figure 9.5**.

Landfall

The GSI groundwater vulnerability mapping shows the groundwater vulnerability within this section of the study area ranges from rock at or near the surface to low groundwater vulnerability.

Cable Route

The GSI groundwater vulnerability mapping shows the groundwater vulnerability along the cable route corridor is generally low. The southern extent of the cable route near the M11 crossing ranges from rock at or near the surface to low groundwater vulnerability.

Substation

The GSI groundwater vulnerability mapping shows the vulnerability of the underlying gravel aquifer within the substation study area ranges from moderate to high groundwater vulnerability.

Connection to NETN

The GSI groundwater vulnerability mapping shows the groundwater vulnerability within this section of the study area ranges from moderate to high groundwater vulnerability.

9.3.2.14 Groundwater Resources

Groundwater is not used extensively for residential or industrial purposes in the area. The GSI lists thirty-nine wells or springs within the study area. The potential well yield for these ranges between 3 m^3/day and 440 m^3/day. As it is expected that these potential water sources supply less than 50 homes, they are all considered to be of low importance as based on NRA Guidelines Box 4.3 and as summarised in **Table 9.22**. No wells or springs were identified within the planning (red line) boundary of the proposed development (**Figure 9.7**).

Source Protection Zone (SPZ) reports have been produced by the GSI and the EPA for groundwater sources, particularly public water supplies, group water schemes or important industrial supplies. The reports aim to guide development planning and regulation to provide protection to groundwater sources. To date no SPZ reports have been produced for any location within the study area.

Table 9.22 Summary of Groundwater resources within the Study Area

Feature	Importance	Justification for Importance rating
GSI listed wells/springs	Low	Supply <50 homes

9.3.2.15 Groundwater Quality and Levels

The national groundwater monitoring network is maintained by the EPA. There are no active groundwater level monitoring points within the study area.

As part of the project-specific GI carried out by IDL, one set of groundwater readings were taken post fieldworks. A summary of the groundwater readings across the proposed development is outlined in **Table 9.23**.

Table 9.23 Groundwater monitoring data

Location	Hole ID	Ground Level (mOD)	Groundwater Level (mBGL)	Groundwater Level (MOD)
Landfall	BH01	13.97	3.10	10.8
	BH03	9.18	1.00	8.18
	BH04	19.64	7.94	11.70
Cable Route	BH201	34.18	7.81	26.29
	BH202	34.89	8.62	26.27
Substation	BH301	2.20	0.90	1.30
	BH302	2.00	0.75	1.25
	BH303	1.84	0.63	1.21
	BH304	1.49	0.40	1.09

Groundwater quality sampling and analysis was completed from groundwater monitoring boreholes drilled in the substation site as part of the project-specific GI. The boreholes are screened in the gravel aquifer underlying the substation site. The results were compared to a suite of Generic Assessment Criteria (GACs) including:

- Groundwater Threshold Values from the Groundwater Regulations;
- Drinking Water Standards from the Drinking Water Regulations; and
- Thresholds for Petroleum Hydrocarbons in Groundwater - CL:AIRE 2017 (WHO TPHCWG fractions in drinking water).

The results are presented in **Table 9.24** and full analysis presented in **Appendix 9.3** in **Volume 3.** The results show there are exceedances of ammoniacal nitrogen, sulphate, arsenic, manganese, iron and some hydrocarbons. The exceedances of arsenic, manganese and iron are significant in comparison to their relative thresholds. Iron and manganese are naturally occurring minerals which can occur in elevated concentrations under anoxic groundwater conditions. A review of the results shows the very high results for ammoniacal nitrogen in BH301 (19.1mg/l) and BH303 (9.12mg/l) correlate with very low nitrate concentrations, which is indicative of denitrification confirming the anoxic conditions.

Table 9.24 Groundwater Quality monitoring data

Test	Units	LOD	GAC	Max	Exceedance Locations	Standard
Ammoniacal Nitrogen as N	mg/l	<0.2	0.175	19.1	BH301 BH302 BH303 BH304	Groundwater Threshold Value 2016
Sulphate	mg/l	<2	187.5	605	BH301	
Arsenic	µg/l	<0.5	7.5	10.2	BH303	

Test	Units	LOD	GAC	Max	Exceedance Locations	Standard
Manganese	µg/l	<3.0	50	30500	BH301 BH302 BH303 BH304	Drinking Water Standards (2014)
Iron	mg/l	<0.019	0.2	13.7	BH301 BH303 BH304	
Aromatic Hydrocarbons >EC21-EC35 (aq)	µg/l	<10	90	100	BH304	CL:AIRE 2017

9.3.2.16 Groundwater Recharge

The rate of groundwater recharge corresponds to the soil type as shown in **Figure 9.6**. The study area predominately has an annual recharge range of 1-50mm/yr. The southern extent of the cable route near the M11 crossing and substation shows an annual recharge range of 151-200mm/yr.

9.3.2.17 Hydro-ecology

Groundwater dependant habitats within the study area that have the status of SPA, SAC, NHA and pNHA are listed in **Table 9.25** along with their importance as determined by the NRA Guidelines Box 4.3. and as shown on **Figure 9.8**.

Table 9.25 Groundwater Dependant Habitats within the Study Area

Feature	Description	Designation code	Status	Importance	Justification for Importance rating
Buckroney-Brittas Dunes and Fen cSAC	Dune and alkaline fen system, located approximately 320m north east	000729	cSAC	Extremely High	Groundwater supports wetland and/or surface water body ecosystem of international importance.
Arklow Sand Dunes	Sand dunes and wet woodland, located approximately 500m east	001746	pNHA	Very High	Groundwater supports wetland and/or surface water body ecosystem with a high value on a regional or national scale
Arklow Town Marsh	Mixed woodland, located approximately 750m southeast	001931	pNHA	Very High	Groundwater supports wetland and/or surface water body ecosystem with a high value on a

Feature	Description	Designation code	Status	Importance	Justification for Importance rating
					regional or national scale
Avoca River Valley	Mixed woodland, located approximately 200m northwest	001748	pNHA	Very High	Groundwater supports wetland and/or surface water body ecosystem with a high value on a regional or national scale

9.3.2.18 Summary of Features of Importance

The feature importance ranking based on the NRA Guidelines established for the baseline conditions has been summarised below.

Features with an importance ranking of low are not considered further as they will not result in a significant effect according to Box 5.4 of the NRA Guidelines. These are however summarised in **Table 9.26** for completeness. Features with an importance ranking of medium or higher are summarised in **Table 9.27** and the effect of the proposed development on these features will be assessed in **Section 9.6.**

Table 9.26 Summary of Land, Soils, Geology and Hydrogeology Features with Low Importance within the Study Area

Category	Feature	Location	Description	Importance	Justification for Importance rating
Soil Fertility	Topsoil - AminPD	Cable route	Surface water gleys/groundwater gleys acidic	Low	Poorly drained and or low fertility soils
Subsoils quality and significance	A	Cable route & Landfall	Alluvium	Low	Low value on a local scale
Subsoils quality and significance	Mbs	Beaches	Marine Beach Sands	Low	Low value on a local scale
Subsoils quality and significance	TLPSsS	North and south of cable route	Till derived from Lower Palaeozoic sandstones and shales	Low	Low value on a local scale
Subsoils quality and significance	Urban	Substation/Connection to the NETN	Urban	Low	Low value on a local scale

Category	Feature	Location	Description	Importance	Justification for Importance rating
Subsoils quality and significance	Rck	Southern extents of the cable route, Substation, Connection to the NETN	Bedrock outcrop or subcrop	Low	Low value on a local scale
Bedrock quality and significance	Kilmacrea Formation	Cable Route	Dark grey slate, minor pale sandstone	Low	Low value on a local scale
Bedrock quality and significance	Maulin Formation	Landfall	Dark blue-grey slate, phyllite and schist	Low	Low value on a local scale
Bedrock quality and significance	Oaklands Formation	Substation/Connection to the NETN	Dark blue-grey slate, phyllite and schist	Low	Low value on a local scale
Soft soils	Alluvial deposits	Substation	Typically found along current and historic watercourses	Low	Volume of soft soil underlying the Proposed Development is small and of a local scale.
Contaminated Land	Historic Quarry	Glenart adjacent to the Avoca River and others located within Arklow town	A number of disused quarries have been identified on the OSI maps which have been backfilled. One has been located to the south of Proposed Development at Glenart adjacent the Avoca River and others located within Arklow town	Low	Degree or extent of soil contamination is low on a local scale
Mineral aggregate resources	Crushed rock aggregate potential	Cable Route	Very low	Low	Uneconomically extractable mineral resource
Mineral aggregate resources	Crushed rock aggregate potential	Cable Route	Low	Low	Uneconomically extractable mineral resource
Groundwater resources	GSI wells and springs	Cable route	n/a	Low	Potable water source supplying >50 homes

Table 9.27 Summary of Land, Soils, Geology and Hydrogeology Features with Medium to High Importance within the Study Area.

Category	Feature	Location	Description	Importance	Justification for Importance rating
Soil Fertility	AlluvMIN	Avoca River, River crossings along cable route	Mineral alluvium	Medium	Moderately drained and/or moderate fertility soils.
Soil Fertility	Topsoil - AminDW	North of the cable route	Acid Brown Earths/ Brown Podzolic Deep Well drained mineral (Mainly acidic)	High	Well drained and/or high fertility soils
Subsoils quality and significance	A	Substation	Alluvium	Medium	Previous industrial use at Avoca River Park
Subsoils quality and significance	IrSTLPSsS	Cable Route	Irish Sea Till derived from Lower Palaeozoic sandstones and shales	Medium	Medium value on a local scale
Subsoils quality and significance	Urban	Substation/Connection to the NETN	Urban	Medium	Previous industrial use at Avoca River Park
Soft soils	Alluvial deposits	Substation	Typically found along current and historic watercourses	Medium	Previous industrial use at Avoca River Park
Mineral aggregate resources	Crushed rock aggregate potential	Landfall/ Substation	Moderate	Medium	Sub-economic extractable mineral resource
Mineral aggregate resources	Crushed rock aggregate potential	Landfall/ Substation	High	Medium	Extractable mineral resource
Mineral aggregate resources	Granular aggregate potential	R772 crossing Cable Route	Moderate	Medium	Sub-economic extractable mineral resource
Aquifer	Bedrock - locally Important Aquifer (LI)	Throughout	Bedrock which is moderately productive only in local zones	Medium	Medium value on a local scale
Aquifer	Gravel - locally Important Aquifer (Lg)	Substation, Connection to the NETN	Gavel which is moderately productive only in local zones	Medium	Medium value on a local scale

Category	Feature	Location	Description	Importance	Justification for Importance rating
Contaminated Land	Closed Landfill	Adjacent to the Substation site		Medium	Degree or extent of soil contamination is moderate on a local scale
Contaminated Land	Fertilizer Plant	Substation		High	Degree or extent of soil contamination is high on a local scale
Hydro-ecology	Buckroney-Brittas Dunes and Fen cSAC	Located approximately 320m north east of proposed development	Dune and alkaline fen system,	Extremely High	Groundwater supports attribute with value on international scale
Hydro-ecology	Arklow Sand Dunes	Located approximately 500m east of proposed development	Sand dunes and wet woodland,	Very high	Groundwater supports attribute with value on regional or national scale
Hydro-ecology	Arklow Town Marsh	Located approximately 750m southeast of proposed development	Mixed woodland,	Very high	Groundwater supports attribute with value on regional or national scale
Hydro-ecology	Avoca River Valley	Located approximately 200m northwest of proposed development	Mixed woodland,	Very high	Groundwater supports attribute with value on regional or national scale

9.4 Conceptual Site Model

A tabulated CSM for the landfall, cable route and substation which was developed based on all publicly available data along with the project specific ground investigation data, is presented in **Table 9.28** to **Table 9.30** and graphical CSMs for the landfall and substation site are outlined in **Appendix A9.4** in **Volume 3**. The CSM includes the factual data within the study area that was gathered during the GIs. See **Appendix A9.1** in **Volume 3** for all available ground investigation data.

Table 9.28 Landfall Conceptual Site Model

Subsection	Strata*	Ground Conditions	Top of strata (mBGL)	Thickness (m)
Landfall	Topsoil	Brown slightly gravelly to gravelly slightly sandy silty	0	0.25

Subsection	Strata*	Ground Conditions	Top of strata (mBGL)	Thickness (m)
		Clay/Silt with some rootlets and a low cobble content		
	Glacial Till	Firm to very stiff orange, brown and grey slightly gravelly to gravelly, slightly sandy to sandy silty Clay with rootlets, a low cobble content and shell fragments.	0.2 to 0.3	2.3 to 6.0
	Bedrock	Medium strong locally strong thinly laminated greenish blueish grey and grey fissile fine grained Shale with fine to coarse gravel sized white quartz clasts and strong locally very strong thinly laminated brown and greenish grey fine to coarse Sandstone.	2.3 to 9.0	Not Proven

Table 9.29 Cable Route Conceptual Site Model

Subsection	Strata*	Ground Conditions	Top of strata (mBGL)	Thickness (m)
Cable Route	Topsoil	Brown slightly gravelly silty CLAY with rootlet and a low cobble content.	0	0.25
	Glacial Till	Brown silty gravelly SAND	1.8 to 4.7	Not proven
		Orangish brown slightly gravelly fine to coarse SAND and orange brown fine to coarse GRAVEL.		
		Firm grey mottled orange brown slightly gravelly silty sandy CLAY with a low cobble content to firm to very	0.2 to 0.6	Not proven

Subsection	Strata*	Ground Conditions	Top of strata (mBGL)	Thickness (m)
		stiff orange, blue, brown grey slightly gravelly, slightly sandy to sandy silty CLAY with rootlets, a low cobble content.		
	Weathered rock	Possible weathered rock recovered as angular fine to coarse gravel sized clasts of strong fine and medium grained siltstone with surficial orange and orangish brown iron stain.	13.5	Not proven

Table 9.30 Substation Conceptual Site Model

Subsection	Strata*	Ground Conditions	Top of strata (mBGL)	Thickness (m)
Substation	Made Ground	Asphalt or 804 Gravel type material consisting of light red, yellowish orange brown slightly sandy to sandy, slightly clayey, slightly silty angular to subangular medium to coarse Gravel with a low cobble content. Blue, red or grey brown sandy clayey Gravel with occasional plastic, concrete wood, steel, wires, red bricks, cobbles and boulders Red, brown mottled orange slightly gravelly to gravelly sandy Clay with red brick fragments Red Clay fertilizer by product and soft greyish white Silt	0	0.2 to 1.6
	Fine grained alluvial deposits	Very soft to firm grey brown slightly sandy to sandy slightly gravelly slightly peaty Silt	0.80 to 3.0	6.0

Subsection	Strata*	Ground Conditions	Top of strata (mBGL)	Thickness (m)
		Very soft to soft black slightly silty slightly sandy fibrous Peat with wood and rootlets		
	Coarse grained alluvial deposits	Medium dense to very dense dark grey and brown slightly sandy subangular to sub-rounded fine to coarse Gravel with various lithologies Dense grey and brown slightly silty slightly gravelly fine to medium Sand	4.80 to 8.8	9.8
	Bedrock	Weak to medium strong thinly bedded grey to dark grey very fine grained Slate with occasional quartz veins and brown staining Medium strong to strong fine grained thinly laminated grey Sandstone with quartz veins	9.80 to 22.10	Not confirmed

**Strata identified may not be present as a continuous horizon throughout the site*

9.4.1.1 Environment Type

The environment across the study area has been categorized in accordance with the IGI Guidelines.

It has been classified as a Type B Environment which corresponds to a naturally dynamic hydrogeological environment – examples include groundwater discharge areas, areas underlain by regionally important aquifers, nearby spring rises areas underlain by permeable soils.

9.4.1.2 Activities/Environment Matrix

The IGI guidelines recommend that an Activities/Environment Matrix be prepared to identify the type of investigations required, which depend on the nature of the baseline environment and the construction and operation activities proposed.

Table 9.31 outlines the required activities that would be undertaken during construction and operation, and the investigations, assessments and surveys that have been carried out to consider those activities.

Table 9.31 Details of works required under the IGI guidelines and how they were undertaken on the site.

Work required under Activity and Type Class (based on IGI guidelines)	Details of works completed to date
Earthworks	
Intrusive site works to characterise nature, thickness, permeability and stratification of soils, subsoils.	Project specific ground investigation carried out across the proposed development
Storage/ transmission of leachable and/or hazardous materials	
Establish nature and quantity of leachable materials	Collection of soil samples. Analysis for quality, including WAC and waste classification screening
Site works to fully characterise nature, thickness, permeability and stratification of soils, subsoils, bedrock geology	Project specific ground investigation carried out across the proposed development
Works to determine groundwater-surface water interaction	Collection of groundwater and surface water samples for water quality analysis within the site.
Excavation of materials above the water table	
Site works to fully characterise nature, thickness, permeability and stratification of soils, subsoils, bedrock geology and in order to define the resource volume/weight according to the Pan-European Reserves and Resources Reporting Committee (PERC) Reporting Standard	Project specific ground investigation carried out across the proposed development
Excavation of materials below the water table	
Site works to fully characterise nature, thickness, permeability and stratification of soils, subsoils, bedrock geology and in order to define the resource volume/weight according to the PERC Reporting Standard	Project specific ground investigation carried out across the proposed development
Lowering of groundwater levels by pumping or discharge	
Intrusive site works to characterise nature, thickness, permeability and stratification of soils, subsoils.	Project specific ground investigation carried out across the proposed development

9.5 Characteristics of the Proposed Development

9.5.1 Overview

A description of the proposed development is provided in **Chapter 5** *Description of Development*, and construction activities are described in **Chapter 6** *Construction Strategy*.

A summary of the characteristics of the proposed development relevant to land and soils is outlined in **Section 9.3.2**.

The re-use and processing of site material is addressed in **Chapter 16** *Resource and Waste Management.*

Any known invasive species is addressed in **Chapter 12** *Biodiversity*.

9.6 Likely Significant Effects

9.6.1 'Do-Nothing' Scenario

In the case where the proposed development does not proceed there would be no resulting effects on land and soils along the route of the proposed development. The effect would therefore be **neutral**.

9.6.2 Construction Phase

The construction activities associated with the proposed development are described in detail in **Chapter 6** *Construction Strategy*.

The potential land and soils effects during the construction phase for the relevant construction activities described in **Section 9.3.2** are presented in this section, along with their effect significance. These potential effects also relate and interact with other environmental factors which are described within the EIAR. Specific interactions are outlined in **Section 9.8**.

9.6.2.1 Landfall

- Construction activities at the landfall will have the following potential effects on land and soils as discussed below and summarised in **Table 9.32**.Loss and damage of topsoil and subsoil;
- Loss of solid geology;
- Earthworks haulage;
- Effect on the surrounding ground;
- Loss or damage of proportion of aquifer through pollution;
- Change to groundwater regime; and
- Loss or damage of a groundwater dependant habitat.

Though the magnitude of the effect may vary depending on the scale of activities and location of the activity relative to the effected important feature, only the maximum magnitude of the effect of the proposed development is discussed.

Loss and damage of topsoil and subsoil

Topsoil is a non-renewable source which if removed or damaged can result in a permanent irreversible negative effect. There are a number of ways this could happen:

- There is the potential for materials on site to be spilled resulting in the pollution of the topsoil.
- These excavated soil materials will be stockpiled using appropriate methods to minimise the impacts of weathering. Materials that are stockpiled incorrectly can be exposed to erosion and weathering which reduces the quality of the resource.
- Excavations in areas of unknown contaminated ground for the construction works may mobilise pollution contained in the soils into the nearby topsoil.
- Permanent damage of topsoil through waterlogging and erosion. This would be due to the trafficking of plant, regrading of slopes and storage of materials in areas not intended to be paved as part of the proposed development.
- Excavation and disposal of topsoil instead of its reuse or reinstatement.

Chapter 6 *Construction Strategy* highlights that excavations will be required at the landfall site. It is expected that much of the topsoil and overburden will be stripped and temporarily stored separately at a designated excavated material storage area adjacent to the temporary compound within the proposed development.

Topsoil and subsoil will be stripped at the landfall site to accommodate the construction of temporary access tracks and for the construction of temporary construction compounds to support HDD operations and cable construction along the eastern section of the cable route. Where topsoil and subsoil is stripped to accommodate the works outlined above, all of the above effects have the potential to occur at these locations.

The magnitude of this potential effect is small adverse and the significance of this potential effect is **slight**.

Loss of Solid Geology

Excavation of rock may be required to construct the HDD working platform and rock will be removed as part of the HDD process.

Where possible, excavated material will be reused in the proposed development if it can be shown to fulfil an appropriate engineering specification. If the excavated rock does not meet an appropriate engineering specification, it will be reused in landscaping.

Given the small quantity of rock which may be excavated, it is considered a medium importance, it is uneconomic to extract it and there are readily available alternative sources of similar bedrock available.

Therefore, this has been assigned a **slight** effect upon the local environment.

Earthworks Haulage

During earthworks, heavily loaded large earthmoving vehicles will travel through the proposed landfall site, causing ground vibrations, soil compaction and disturbance of natural ground on unfinished road surfaces.

This will also result in increased traffic on the roads to and from the proposed landfall site, although internal haul roads (access tracks) would be used where possible. Increased noise, dust and vibration will also be generated.

These works are expected to have a low importance given the volume of the material for removal is low on a local scale. The magnitude of the impact of this would be small adverse. The significance of the potential effect is **imperceptible**.

Chapter 7 *Air Quality* and **Chapter 11** *Noise and Vibration* provides more information on noise, dust and vibration.

Chapter 13 *Traffic and Transport* provides more information on earthworks haulage within the proposed development.

Effect on the surrounding ground

The soil and rock excavation during the construction process at the landfall site has the potential to induce movement and settlement of surrounding ground. The removal of the bedrock for the HDD compound will be carried out using mechanical excavation during the construction of the temporary construction compound for HDD operations which could result in minor ground vibrations with effects felt in the immediate vicinity of the works.

The likelihood of instability or collapse of the cliff as a result of the HDD process is considered to be low, given the distance of the HDD entry point from the edge of the cliff, the proposed depth of the HDD below the base of the cliff and in turn the proposed depth of the HDD below the coastline.

These works may also give rise to noise and vibration effects and may result in the generation of dust. **Chapter 7** *Air Quality* and **Chapter 11** *Noise and Vibration* provide more information on such effects.

These works are expected to have a low importance given the underlying soils are a firm to stiff clay and the potential soils in question during the HDD process are to be generally removed. The magnitude of the impact of this activity would be small adverse. The significance of the potential effect is **imperceptible.**

Loss or damage of proportion of aquifer

This bedrock is classified as a Locally Important Aquifer where bedrock which is moderately productive only in local zones (LI). The removal of a proportion of an aquifer can reduce its ability to provide baseflow to groundwater dependant habitats and/or water supplies and results in an irreversible loss of the in-situ characteristics of the land and soils. Likewise, the mobilisation of contaminants into the aquifer either through accidental spillage or disturbance of contaminated ground during excavation will reduce the quality of the groundwater within the aquifer.

The HDD drill bore is expected to have a maximum outer diameter of approximately 1118mm each containing a duct of approximately 800mm removing a small portion of the bedrock aquifer. Similarly, excavations required for the landfall construction will also remove or damage localised areas of the underlying bedrock.

These activities are localised and considered insufficient to affect the overall integrity of the underlying aquifer, therefore, loss of aquifer due to the HDD drilling and excavations will have a localised, permanent effect which is considered **imperceptible**.

Damage of the aquifer due to accidental spills

Potential pollutants associated with construction activities (i.e. fuel and lubricants etc.) will be stored at the temporary cable construction compound at the landfall. The HDD for the landfall will require a drilling fluid to cool and lubricate the drill head. Bentonite will be used, which comprises 95% water and 5% bentonite clay which is a non-toxic, natural substance. The bentonite effectively seals the bore maintaining a closed system throughout the drill. The bentonite drilling fluid is circulated down through the drill rods and back up outside the rods in the annulus of the borehole. It will be a closed system, with drilling fluid recirculated, the drill cuttings recovered, and drilling fluid reused.

As it is non-toxic, the bentonite would not have a significant effect on ground water quality. **Chapter 6** *Construction Strategy* provides more information on the HDD construction method.

If potential spills or leaks from the associated construction equipment do occur, they may potentially contaminate the groundwater beneath the proposed development. These are potential short-term effects.

The magnitude of this potential effect on the locally important aquifer could potentially be moderate adverse leading to a significance rating of **moderate.**

Change to groundwater regime

Localised pumping of excavations is expected to be required as part of the construction phase at structures and deep trenches in order to allow works to be carried out in dry excavations. Where excavation goes below the existing groundwater table this could lead to a temporary change in the groundwater flow or levels within the locally important aquifers underlying the proposed development.

Since the pumping is expected to be limited and localised, the magnitude of this impact is considered negligible. As the importance of the locally important aquifer is medium, the resulting significance is **imperceptible** and will not be considered further.

Loss or damage of a groundwater dependant habitat

Buckroney-Brittas Dunes and Fen cSAC is located 320m to the north east of the landfall site. Both the cSAC and landfall site are located directly on the coast. Groundwater will flow downgradient, which in the case of the landfall site and the Buckroney-Brittas Dunes and Fen cSAC is west to east towards the sea. The Buckroney-Brittas Dunes and Fen cSAC is located in a separate subcatchment to the landfall site, and is not considered to be hydraulically connected to the proposed development. There is not considered to be a potential effect to either the groundwater regime or groundwater quality associated with the cSAC from the construction phase of the works.

Reinstatement

Following the excavation at the landfall along with all other associated works during construction, the site will be reinstated to its original condition as far as practicable with the replacement of excavated materials where appropriate. If the excavated materials are not suitable for re-use, then equivalent materials may be imported for reinstatement. Acceptable materials for import may include materials classified as by products from excavations in natural soils under Regulation 15 of S.I. No. 323/2020 – European Union (Waste Directive) Regulations 2020.

Table 9.32 Summary of Predicted Construction Phase Effects at Landfall

Feature	Description	Importance	Effect	Quality	Duration	Scale	Magnitude	Significance
AlluvMIN	Mineral alluvium	Medium	Loss or damage of topsoil and subsoil	Negative	Permanent	Local	Small adverse	Slight
Topsoil	AminDW	High	Loss or damage of topsoil and subsoil	Negative	Permanent	Local	Small adverse	Slight
Subsoils quality and significance	Irish Sea Till derived from Lower Palaeozoic sandstones and shales	Medium	Loss or damage of topsoil and subsoil	Negative	Permanent	Local	Small adverse	Slight
Bedrock quality and significance	Maulin Formation, Dark blue-grey slate, phyllite and schist	Low	Loss of Solid Geology	Negative	Permanent	Local	Moderate adverse	Slight
AlluvMin, Topsoil and subsoils quality and significance	Heavily loaded vehicles moving through the site	Low	Earthworks Haulage	Negative	Temporary	Local	Small adverse	Imperceptible
AlluvMin, Topsoil and subsoils quality and significance	Ground vibrations	Low	Effect on the surrounding ground	Negative	Temporary	Local	Small adverse	Imperceptible
Bedrock -locally Important Aquifer (LI)	Bedrock which is moderately productive only in local zones	Medium	Loss or damage of proportion of aquifer through excavation	Negative	Permanent	Local	Negligible	Imperceptible
Bedrock -locally Important Aquifer (LI)	Bedrock which is moderately productive only in local zones	Medium	Loss or damage of proportion of aquifer through pollution	Negative	Temporary	Local	Moderate adverse	Moderate
Bedrock -locally Important Aquifer (LI)	Bedrock which is moderately productive only in local zones	Medium	Change to groundwater regime	Negative	Temporary	Local	Negligible	Imperceptible
Buckroney-Brittas Dunes and Fen cSAC and pNHA	cSAC/pNHA - located approximately 320m north of redline boundary	Extremely High	Loss or damage of groundwater dependent habitat	None – not hydraulically connected	NA	NA	NA	NA

9.6.2.2 Cable Route

Construction activities at the cable route corridor will have the following potential effects on the land and soils as discussed below and summarised in **Table 9.33**.

- Loss and damage of topsoil and subsoil;
- Loss of solid geology;
- Earthworks haulage;
- Effect on the surrounding ground;
- Loss of future quarry or pit reserve;
- Loss or damage of proportion of aquifer through pollution;
- Change to groundwater regime; and
- Loss or damage of a groundwater dependant habitat.

Though the magnitude of the effect may vary depending on the scale of activities and location of the activity relative to the effected important feature, only the maximum magnitude of the effect of the proposed development is discussed.

Loss and damage of topsoil and subsoil

Topsoil is a non-renewable source which if removed or damaged can result in a permanent irreversible negative effect. There are a number of ways this could happen:

- There is the potential for materials on site to be spilled resulting in the pollution of the topsoil.
- These excavated soil materials will be stockpiled using appropriate methods to minimise the effects of weathering. Materials that are stockpiled incorrectly can be exposed to erosion and weathering which reduces the quality of the resource.
- Excavations in areas of unknown contaminated ground for the construction works may mobilise pollution contained in the soils into the nearby topsoil.
- Permanent damage of topsoil through waterlogging and erosion. This would be due to the trafficking of plant, regrading of slopes and storage of materials in areas not intended to be paved as part of the proposed development.
- Excavation and disposal of topsoil instead of its reuse or reinstatement.

Chapter 6 *Construction Strategy* highlights that excavations will be required along the cable route corridor. It is expected that much of the topsoil and subsoil will be stripped and temporarily stored separately at a designated excavated material storage area or as close as possible to the excavation within the proposed development.

Topsoil and subsoil will also be stripped along the temporary cable construction corridor, to accommodate the trenches, haul roads/access tracks, platforms for the HDD compounds and temporary construction compounds and working areas.

Where topsoil and subsoil is stripped to accommodate the works outlined above, all of the above effects have the potential to occur at these locations.

The magnitude of this potential impact is small adverse and the significance of this potential effect is **slight**.

Loss of Solid Geology

Excavation of rock may be required to construct the temporary HDD working platform at the M11 crossing where ground level will be reduced by up to 8mbgl. Where possible, excavated material will be reused in the proposed development if it can be shown to fulfil an appropriate engineering specification. If the excavated rock does not meet an appropriate engineering specification, it will be reused in landscaping.

Given the small quantity of rock which may be excavated, it is considered a medium importance, it is uneconomic to extract it and there are readily available alternative sources of similar bedrock available.

Therefore, this has been assigned a **slight** effect upon the local environment.

Earthworks Haulage

During earthworks, heavily loaded large earthmoving vehicles will travel through the temporary cable construction corridor, causing ground vibrations, soil compaction and disturbance of natural ground on unfinished road surfaces. This will also result in increased traffic on the roads to and from the proposed cable route corridor. Increased noise, dust, vibration will also be generated.

These works are expected to have a low importance given the volume of the material for removal is low on a local scale. The magnitude of the effect of this would be small adverse. The significance of the potential effect is **imperceptible**.

Chapter 7 *Air Quality* and **Chapter 11** *Noise and Vibration* provides more information on noise, dust and vibration.

Chapter 13 *Traffic and Transport* provides more information on earthworks haulage within the proposed development.

Effect on the surrounding ground

The excavation of soil during the construction at the cable route corridor has the potential to induce movement and settlement of surrounding ground. Likewise the HDD process has the potential to induce minor ground vibrations. The breaking of the bedrock could result in ground vibrations and destabilisation of existing rock slopes, with effects felt in the immediate vicinity of the works.

These works may also give rise to noise and vibration effects and may result in the generation of dust. **Chapter 7** *Air Quality* and **Chapter 11** *Noise and Vibration* provides more information on such effects.

These works are expected to have a low importance given the quantity of underlying soils to be excavated is low and that settlement is likely to be small since the soil will be excavated. The magnitude of the effect of this activity would be small adverse.

The significance of the potential effect is **imperceptible.**

Loss of future quarry or pit reserve

The sterilisation of land through development or the excavation of soil and rock during construction can diminish future quarry and pit reserves. This can result in a permanent irreversible loss of the in-situ characteristics of the land and soils area. The land and soils on a local scale will be negatively effected by the construction of new facilities and the removal of soil and rock.

The magnitude of this effect is negligible as it results in an insufficient permanent irreversible change on a local scale to affect the integrity of the land and soils above the do nothing and do minimum scenario. As the aggregate potential is of medium importance the resulting significance of this negligible effect is **imperceptible** and will not be considered further.

Loss or damage of proportion of aquifer

This bedrock is classified as a Locally Important Aquifer where bedrock which is moderately productive only in local zones (LI). The removal of a proportion of an aquifer can reduce its ability to provide baseflow to groundwater dependant habitats and or water supplies and results in an irreversible loss of the in-situ characteristics of the land and soils. Likewise, the mobilisation of contaminants into the aquifer either through accidental spillage or disturbance of contaminated ground during excavation will reduce the quality of the groundwater within the aquifer.

The HDD drill bore (cable route HDD) is expected to have a maximum outer diameter of approximately 1118mm removing a small portion of the bedrock aquifer. Similarly, excavations required for the proposed development will also remove or damage localised areas of the underlying bedrock and gravel aquifer. These activities are localised and considered insufficient to affect the overall integrity of the underlying aquifer, therefore, loss of aquifer due to the HDD drilling and excavations will have a localised, permanent effect which is considered **imperceptible**.

Damage of the aquifer due to accidental spills

Potential pollutants associated with construction activities (i.e. fuel and lubricants etc.) will be stored at HDD working area compounds.

As it is non-toxic, the bentonite to be used for the HDD process, would not have a significant effect on ground water quality. **Chapter 6** *Construction Strategy* provides more information on the HDD construction method.

If potential spills or leaks from the associated construction equipment do occur, they may potentially contaminate the groundwater beneath the proposed development. These are potential short-term effects.

The magnitude of this potential impact on the locally important aquifer could potentially be moderate adverse leading to a significance rating of **moderate**.

Change to groundwater regime

Due to the relatively high water table adjacent to the Avoca River, dewatering works may be required to form the M11 HDD working platform (if HDD is used for the M11 crossing). Due to the nature of the weathered rock groundwater cut off would not be possible using trench boxes and would only be achieved if temporary sheet piles were employed on either side of the trench excavation. In all other areas across the cable route localised pumping of excavations is expected to be required as part of the construction phase at structures and deep trenches in order to allow works to be carried out in dry excavations. Where excavation goes below the existing groundwater table this could lead to a temporary change in the ground water flow or levels within the locally important aquifers underlying the proposed development.

Dewatering is considered to be a small adverse impact for the M11 HDD working platform and the significance of this effect is **moderate/slight**.

Since the pumping is expected to be limited and localised for the remainder of the cable route, the magnitude of this impact is considered negligible. As the importance of the locally important aquifer is medium, the resulting significance is **imperceptible**.

Loss or damage of a groundwater dependant habitat

The Avoca River Valley pNHA is too far from the proposed development for there to be a potential effect to either the groundwater regime or groundwater quality for this habitats from the construction phase of the works. The effect of the proposed development on these habitats is considered **negligible** and will not be considered further.

Note, the Avoca River is currently classed as ‘polluted’ and in ‘unsatisfactory’ condition by the EPA. Water quality sampling of the Avoca River carried out both upstream and downstream of the proposed development as part of the ground investigation confirms the poor river quality (GII 2020), (see further details in **Chapter 10** *Water*).

Groundwater quality in the gravel aquifer which lies south of the cable route may be altered in the short term, due to accidental spillage during construction related activities (i.e. fuels or lubricants) or temporarily due to mobilisation of contaminants during the removal of contaminated soil. In addition, the Arklow Town Marsh pNHA is in hydraulic connectivity with the Avoca River, which is already classed as ‘polluted’ by the EPA and the recent ground investigation (GII 2020). However considering the distance from the site (750m to Arklow Town Marsh pNHA) the magnitude of this potential temporary impact on the water quality of the marsh is considered to be small adverse. The Arklow Town Marsh is of very high importance; therefore this leads to a significance rating of **moderate.**

Arklow Sand Dunes is a pNHA and is located approximately 500m east of the cable route planning (red line) boundary. The cable route will require minimum intrusive works in the form of two trenches, therefore the quantity of machinery required, and likelihood of accidental spills is considered very low.

In addition, further dilution of any contamination will occur within the aquifer before reaching the habitat. The magnitude of this potential temporary impact on the Arklow Sand Dunes, which is of very high importance is considered to be small adverse leading to a significance rating of **moderate**.

Localised pumping of excavations required as part of the construction phase for the installation of the cable could result in a temporary change in groundwater levels or supply to the habitat area, however considering the distance from the site (c. 750m to Arklow Town Marsh pNHA and c. 500m to Arklow Sand Dunes), and the temporary and localised nature of the dewatering required, the effect on groundwater supply is considered **negligible**.

Reinstatement

Following the excavations required for the cable route along with all other associated works during construction, the temporary cable construction corridor will be reinstated to its original condition as far as practicable with the replacement of excavated materials where appropriate. If the excavated materials are not suitable for re-use, then equivalent materials may be imported for reinstatement. Acceptable materials for import may include materials classified as by products from excavations in natural soils under Regulation 15 of S.I. No. 323/2020 – European Union (Waste Directive) Regulations 2020.

Table 9.33 Summary of Predicted Construction Phase Effects in relation to the cable route

Feature	Description	Importance	Effect	Quality	Duration	Scale	Magnitude	Significance
AlluvMIN	Mineral alluvium	Medium	Loss or damage of topsoil and subsoil	Negative	Permanent	Local	Small adverse	Slight
Topsoil	AminDW	High	Loss or damage of topsoil and subsoil	Negative	Permanent	Local	Small adverse	Slight
Subsoils quality and significance	Irish Sea Till derived from Lower Palaeozoic sandstones and shales	Medium	Loss or damage of topsoil and subsoil	Negative	Permanent	Local	Small adverse	Slight
Bedrock quality and significance	Kilmacrea Formation, Dark grey slate, minor pale sandstone	Low	Loss of Solid Geology	Low	Permanent	Local	Moderate adverse	Slight
AlluvMin, Topsoil and subsoils quality and significance	Heavily loaded vehicles moving through the site	Low	Earthworks Haulage	Negative	Temporary	Local	Small adverse	Imperceptible
AlluvMin, Topsoil and subsoils quality and significance	Ground vibrations	Low	Effect on the surrounding ground	Negative	Temporary	Local	Small adverse	Imperceptible
Granular aggregate potential	Moderate granular aggregate potential	Medium	Loss of future quarry or pit reserve	Negative	Permanent	Local	Negligible	Imperceptible
Bedrock -locally Important Aquifer (LI)	Bedrock which is moderately productive only in local zones	Medium	Loss or damage of proportion of aquifer through excavation	Negative	Permanent	Local	Negligible	Imperceptible

Feature	Description	Importance	Effect	Quality	Duration	Scale	Magnitude	Significance
Bedrock -locally Important Aquifer (LI)	Bedrock which is moderately productive only in local zones	Medium	Loss or damage of proportion of aquifer through pollution	Negative	Temporary	Local	Moderate adverse	Moderate
Bedrock -locally Important Aquifer (LI)	Bedrock which is moderately productive only in local zones	Medium	Change to groundwater regime (dewatering)	Negative	Temporary	Local	Small adverse	Moderate/Slight
Bedrock -locally Important Aquifer (LI)	Bedrock which is moderately productive only in local zones	Medium	Change to groundwater regime	Negative	Temporary	Local	Negligible	Imperceptible
Arklow Sand Dunes	pNHA – Located approximately 500m east of the red line boundary	Very high	Loss or damage of groundwater dependant habitat	Negative	Temporary	Local	Small adverse	Moderate
Arklow Town Marsh	pNHA - Located approximately 750m southeast of the red line boundary	Very high	Loss or damage of groundwater dependant habitat	Negative	Short Term/Temporary	Local	Small adverse	Moderate
Avoca River Valley	pNHA - Located approximately 200m northwest of the red line boundary	Very high	Loss or damage of groundwater dependant habitat	NA – feature is upstream of development	NA	NA	NA	NA

9.6.2.3 Substation

Construction activities at the Substation will have the following potential effects on the land and soils as discussed below and summarised in **Table 9.34**.

- Excavation of made ground;
- Earthworks haulage;
- Soil improvement for platform works;
- Improvement work for flood defences;
- Effect on the surrounding ground;
- Change to groundwater regime;
- Loss or damage of proportion of aquifer through pollution; and
- Loss or damage of a groundwater dependant habitat.

Though the magnitude of the effect may vary depending on the scale of activities and location of the activity relative to the effected important feature, only the maximum magnitude of the effect of the proposed development is discussed.

Excavation of made ground

Made ground will be encountered at the substation site. The excavation of made ground may result in the production of excess material that requires removal off-site and/or the mobilisation of possible contaminants. The mobilisation of contaminants will be limited by the underlying low permeability silts and clays and the surrounding made ground. The land and soils on a local scale will be negatively affected by the permanent removal of a small proportion of made ground to allow for the construction of pavements and structures. The re-use and processing of site material is addressed in **Chapter 16** *Resource and Waste Management.*

The remediation strategy which is outlined in **Section 9.3.2.9** has been proposed to minimise the requirement for localised excavation of any made ground during construction with the exception of the removal of the existing asphalt.

The preferred piling method is displacement piling which will minimise the excavation of made ground within the substation site.

The magnitude of this effect is small adverse as it results in a permanent excavation of a small proportion of made ground on a local scale. As the made ground is of medium importance the resulting significance of this small adverse effect is **slight.**

The effect of the production of excess material for removal offsite is discussed in **Chapter 16** *Resource and Waste Managment*.

Earthworks Haulage

Importation of material is required to raise the platform level at the substation site and also for the removal of any soils from site.

This will result in increased traffic on the roads to and from the proposed Substation. Increased noise, dust, vibration will also be generated.

These works are expected to have a low importance given the volume of the material for removal is low on a local scale. The magnitude of the effect of this would be small adverse. The significance of the potential effect is **imperceptible**.

Chapter 7 *Air Quality* and **Chapter 11** *Noise and Vibration* provides more information on noise, dust and vibration.

Chapter 13 *Traffic and Transport* provides more information on earthworks haulage within the proposed development.

Effects on the surrounding ground

The installation of displacement piles, sheet piles, soil improvement piles, construction of temporary access tracks and importation of material for the works may result in ground vibrations and induce movement and settlement of the surrounding ground.

Infilling will induce a large stress on the existing ground which has the potential to induce movement and settlement of the surrounding ground.

These works may also give rise to noise and vibration effects and may result in the generation of dust. **Chapter 7** *Air Quality* and **Chapter 11** *Noise and Vibration* provides more information on such effects.

These works are expected to have a low importance given the underlying soils are to undergo soil improvement techniques in order to minimise settlement and movement.

The significance of the potential effect is **imperceptible.**

Soil improvement piling for platform works

The substation works will have various reinforced foundations to provide support to buildings and external electrical equipment. The foundations for the buildings and heavier equipment will be supported on displacement piles such as precast driven piles. In addition due to the presence of soft silts/peat layers beneath the site, soil improvement piling techniques such as vibro concrete columns will be installed. All piling will be carried out following the placement of the deeper granular gas drainage layer which will serve as a piling mat.

The magnitude of this effect is small adverse given the volume of the material for soil improvement is low on a local scale resulting in a significance of potential effect of **slight.**

Improvement works for flood defences

A short section of the existing Avoca River Business Park flood defences requires improvement works to protect the substation buildings and associated ancillary external equipment. These improvement works will comprise localised raising of the existing flood defence embankment level (see further details in **Chapter 10** *Water*).

This may be achieved by driving a sheet pile through the centre of the embankment and shoring either side with appropriate earth material, placed and compacted and subsequently finished with rock armour, to prevent scouring and erosion.

Alternatively, the embankment will be raised with an appropriate impermeable or cohesive material, placed and compacted by excavator at a stable angle of repose and, if required, finished with rock armour, to prevent scouring and erosion.

It is also proposed to raise the platform level across the substation site to offer protection against flooding.

Silt mitigation measures will need to be implemented to minimise the transfer of sediment into the adjacent Avoca River.

The magnitude of this effect is small adverse resulting in a significance of **slight.**

Change to groundwater regime

The installation of driven sheet piles required for flood defences (if this methodology is used) will lead to a localised permanent change in the groundwater flow and levels within the locally important aquifers in the vicinity of the proposed flood defence structure. These groundwater cut offs will result in a minor increase in groundwater levels upstream of the defence and a minor decrease downstream of the cut off structure.

The localised change in groundwater is expected to be limited and localised, the magnitude of this impact is considered negligible. As the importance of the locally important aquifer is medium, the resulting significance is **imperceptible** and will not be considered further.

Loss or damage of proportion of aquifer

This bedrock is classified as a Locally Important Aquifer where bedrock which is moderately productive only in local zones (LI) in the northern area of the site and is underlain by the gravel aquifer (Lg) towards the south of the site. Piling on site may result in the displacement of a very small portion of the underlying gravel aquifer. The displacement of a proportion of an aquifer can reduce its ability to provide baseflow to groundwater dependant habitats and or water supplies and results in an irreversible loss of the in-situ characteristics of the land, soils, geology and hydrogeology.

The localised loss of aquifer potential is expected to be very small and localised, the magnitude of this effect is considered negligible. As the importance of the locally important aquifer is medium, the resulting significance is **imperceptible** and will not be considered further.

Damage of the aquifer due to mobilisation of contaminated ground

As detailed in **Section 9.3.2.9**, the proposed remediation strategy for the site is to cap the made ground with a barrier layer to prevent the percolation of rainwater through the contaminated material which will minimise leachate generation, act as a gas barrier and also form a physical barrier for site users to prevent dermal contact with the hazardous made ground during site operation.

The remedial measures will be designed to facilitate the buried services for the proposed development, and any future buried services and to ensure the function of both the remedial measures and buried services are met.

Localised excavations in areas of contaminated ground for the construction works may mobilise pollution contained in the soils into the nearby topsoil and into the underlying aquifer with the potential to alter groundwater quality in the area. The potential impact on the gravel aquifer will be very small as the subsoil underlying the made ground and confining the gravel aquifer is comprised of low permeability silts and clays.

As detailed above, excavation of made ground will be kept to a minimum in line with the proposed remediation strategy.

Any excavated contaminated material will be removed and disposed of in accordance with the Irish waste management legislation, the duration of the effect is considered temporary. The magnitude of this potential temporary effect on the locally important aquifer is considered to be small adverse leading to a significance rating of slight.

Loss or damage of a groundwater dependant habitat

The Avoca River Valley pNHA is upgradient from the proposed development. As such the effect of the proposed development on the habitat is considered negligible and will not be considered further.

The Arklow Town Marsh is a pNHA located approximately 750m downstream of the proposed substation site. The Avoca River forms the southern boundary of this large wetland area. The Arklow Town Marsh is likely to be in hydraulic connection with the both the Avoca River and the substation site as the area is underlain by gravels.

Note, the Avoca River is currently classed as ‘polluted’ and in ‘unsatisfactory’ condition by the EPA. Water quality sampling of the Avoca River carried out both upstream and downstream of the proposed development as part of the ground investigation confirmed the poor quality of the river (GII 2020), (see further details in **Chapter 10** *Water*). The poor water quality in the Avoca is a result of acid mine drainage impacts from the Avoca Mine which results in elevated cadmium, copper and zinc in the river. The average concentrations in the upstream EPA river monitoring point (Avoca_020 RS10A031050) are higher (0.28, 7.42 and 104ug/l respectively) than the average recorded from the groundwater monitoring boreholes on site (<0.08, 2.15 and 53.4ug/l).

Groundwater quality in the gravel aquifer which underlies the substation site may be altered in the short term, due to accidental spillage during construction related activities (i.e. fuels or lubricants) or temporarily due to mobilisation of contaminants during the removal of contaminated soil. However considering that the marsh is in hydraulic connectivity with the Avoca River and the flow in the Avoca River is very large in comparison to groundwater discharges from the site footprint, the magnitude of this potential temporary effect on the water quality of the marsh is considered to be small adverse. The Arklow Town Marsh is of very high importance; therefore this leads to a significance rating of **moderate.**

Localised pumping of groundwater from excavations required as part of the construction phase at structures at the substation site or installation of the cable could result in a temporary change in groundwater levels or supply to the habitat area, however considering the distance from the site (750m to Arklow Town Marsh and ~200m to Arklow River Valley), and the temporary and localised nature of the dewatering required, the effect on groundwater supply is considered **negligible** and will not be considered further.

Table 9.34 Summary of Predicted Construction Phase Effects at Substation

Feature	Description	Importance	Effect	Quality	Duration	Scale	Magnitude	Significance
Subsoils quality and significance	Urban (Substation)	Medium	Excavation of Made Ground	Negative	Permanent	Local	Small adverse	Slight
Subsoils quality and significance	Alluvial deposits (Substation)	Medium	Excavation of contaminated ground	Negative	Permanent	Local	Small adverse	Slight
Subsoils quality and significance	Heavily loaded vehicles moving through the site	Medium	Earthworks Haulage	Negative	Temporary	Local	Small adverse	Imperceptible
Subsoils quality and significance	Ground vibrations	Medium	Effect on surrounding ground	Negative	Temporary	Local	Small adverse	Imperceptible
Construction	Piling and soil improvement	Medium	Soil Improvement piling for platform works	Negative	Permanent	Local	Small adverse	Slight
Construction	Improvement Works for Flood Defences	Medium	Improvement works for Flood Defences	Negative	Permanent	Local	Small adverse	Slight
Bedrock -locally Important Aquifer (LI)	Bedrock which is moderately productive only in local zones	Medium	Loss or damage of proportion of aquifer through excavation	Negative	Temporary	Local	Negligible	Imperceptible
Bedrock -locally Important Aquifer (LI)	Bedrock which is moderately productive only in local zones	Medium	Loss or damage of proportion of aquifer through pollution	Negative	Temporary	Local	Moderate adverse	Moderate
Bedrock -locally Important Aquifer (LI)	Bedrock which is moderately productive only in local zones	Medium	Change to groundwater regime	Negative	Temporary	Local	Negligible	Imperceptible
Gravel - locally Important Aquifer (Lg)	Gravel which is moderately productive only in local zones	Medium	Loss or damage of proportion of aquifer through excavation	Negative	Temporary	Local	Negligible	Imperceptible
Gravel - locally Important Aquifer (Lg)	Gravel which is moderately productive only in local zones	Medium	Loss or damage of proportion of aquifer through pollution	Negative	Temporary	Local	Small adverse	Slight

Feature	Description	Importance	Effect	Quality	Duration	Scale	Magnitude	Significance
Gravel - locally Important Aquifer (Lg)	Gravel which is moderately productive only in local zones	Medium	Change to groundwater regime	Negative	Temporary	Local	Negligible	Imperceptible
Fertilizer Plant	Substation	High	Excavation of Contaminated Ground	Negative	Permanent	Local	Small adverse	Slight
Arklow Town Marsh	pNHA - Located approximately 750m southeast of the red line boundary	Very high	Loss or damage of groundwater dependant habitat	Negative	Short Term/Temporary	Local	Small adverse	Moderate
Avoca River Valley	pNHA - Located approximately 200m west of the red line boundary	Very high	Loss or damage of groundwater dependant habitat	NA – feature is upstream of development	NA	NA	NA	NA

9.6.2.4 Connection to the NETN

Construction Activities at the connection to the NETN will have the following potential effects on the land and soils as discussed below and summarised in **Table 9.35**.

- Loss and damage of topsoil;
- Excavation of made ground;
- Loss of solid geology;
- Loss of future quarry or pit reserve;
- Loss or damage of proportion of aquifer through pollution;
- Change to groundwater regime; and
- Loss or damage of a groundwater dependant habitat.

Though the magnitude of the effect may vary depending on the scale of activities and location of the activity relative to the effected important feature, only the maximum magnitude of the effect of the proposed development is discussed.

Loss and damage of topsoil and subsoil

Topsoil is a non-renewable resource which if removed or damaged can result in a permanent irreversible negative effect. There are a number of ways this could happen:

- There is the potential for materials on site to be spilled resulting in the pollution of the topsoil.
- These excavated soil materials will be stockpiled using appropriate methods to minimise the effects of weathering. Materials that are stockpiled incorrectly can be exposed to erosion and weathering which reduces the quality of the resource.
- Excavations in areas of contaminated ground for the construction works may mobilise pollution contained in the soils into the nearby topsoil.
- Permanent damage of topsoil through waterlogging and erosion. This would be due to the trafficking of plant, regrading of slopes and storage of materials in areas not intended to be paved as part of the proposed development.
- Excavation and disposal of topsoil instead of its reuse or reinstatement.

Topsoil will be stripped as part of the clearance works, construction of any access tracks and levelling works as part of the tower foundation clearance and enabling works. Where topsoil is stripped to accommodate the works outlined above, all of the above effects have the potential to occur at these locations.

The magnitude of this potential effect is small adverse and the significance of this potential effect is **slight**.

Chapter 16 *Resource and Waste Management* highlights that excavations will be required at the connection to the NETN. It is expected that much of the topsoil and overburden will be stripped and temporarily stored separately at a designated excavated material storage area, to be mutually agreed with the landowner for re-use in the reinstatement works.

Excavation of Made Ground

The excavation of made ground results in the production of excess material that requires removal off-site and/or the mobilisation of possible contaminants. The land and soils on a local scale will be negatively affected by the permanent removal of a small proportion of made ground to allow for the construction of pavements and structures.

All excavations shall be monitored to ensure that the soils excavated are consistent with the descriptions and classifications determined during design.

Any dewatering in areas of contaminated ground shall be designed to minimise the mobilisation of contaminants into the surrounding environment. There will be no potential effect with the decommissioning of the tower within the licensed area as no ground works are envisaged as the tower will be removed to ground level and the existing foundation left in place.

The magnitude of this impact is small adverse as it results in a permanent excavation of a small proportion of made ground on a local scale. As the made ground is of medium importance the resulting significance of this effect is **slight**. The effect of the production of excess material for removal offsite is discussed in **Chapter 16** *Resource and Waste Management*.

Loss of Solid Geology

Excavation of rock may be required to construct the foundation for the new tower 5A and tower 6B at the connection to the NETN. The excavated material will be reused elsewhere in the proposed development if it can be shown to fulfil an appropriate engineering specification. If the excavated rock does not meet an appropriate engineering specification, it will be reused in landscaping.

Given the small quantity of rock which will be removed, it is considered a moderate adverse importance, it is uneconomic to extract it and there are readily available alternative sources of similar bedrock available.

Therefore, this has been assigned a **slight** effect upon the local environment.

Effects on the surrounding ground

The construction of new towers and installation of tension cables could result in ground vibrations and induce movement and settlement of the surrounding ground along with any works associated with access and working areas.

These works may also give rise to noise and vibration effects and may result in the generation of dust. **Chapter 7** *Air Quality* and **Chapter 11** *Noise and Vibration* provides more information on such effects.

The significance of the potential effect is **imperceptible.**

Change to groundwater regime

Localised pumping of excavations is expected to be required as part of the construction phase at structures. This could lead to a temporary change in the ground water flow or levels within the locally important aquifers underlying the proposed development.

Since the pumping is expected to be limited and localised, the magnitude of this effect is considered negligible. As the importance of the locally important aquifer is medium, the resulting significance is **imperceptible** and will not be considered further.

Loss or damage of a groundwater dependant habitat

The Avoca River Valley pNHA is too far upgradient from the proposed development for there to be a potential effect to either the groundwater regime or groundwater quality for these habitats from the construction phase of the works. The effect of the proposed development on these habitats is considered **negligible** and will not be considered further.

The Arklow Town Marsh is a pNHA located approximately 750m downstream of the proposed connection to the NETN. The Avoca River forms the southern boundary of this large wetland area. The Arklow Town Marsh is likely to be in hydraulic connection with the both the Avoca River and the connection to the NETN as the area is underlain by gravels.

Note, the Avoca River is currently classed as 'polluted' and in 'unsatisfactory' condition by the EPA. Water quality sampling of the Avoca River carried out both upstream and downstream of the proposed development as part of the ground investigation (GII 2020) confirmed the poor quality of the river, (see further details in **Chapter 10** *Water*).

As described in **Section 9.3.2.15**, groundwater quality in the gravel aquifer which underlies the connection to the NETN site may be altered in the short term, due to accidental spillage during construction related activities (i.e. fuels or lubricants) or temporarily due to mobilisation of contaminants during the removal of contaminated soil. In addition, the marsh is in hydraulic connectivity with the Avoca River which is already classified as polluted. The magnitude of this potential temporary effect on the water quality of the marsh is considered to be small adverse. The Arklow Town Marsh is of very high importance; therefore this leads to a significance rating of **moderate.**

Reinstatement

Following the excavation at the connection to the NETN along with all other associated works during construction, the temporary cable construction corridor will be reinstated to its original condition with the replacement of excavated materials where appropriate. If the excavated materials are not suitable for re-use, then equivalent materials may be imported for reinstatement. Acceptable materials for import may include materials classified as by products from excavations in natural soils under Regulation 15 of S.I. No. 323/2020 – European Union (Waste Directive) Regulations 2020.

Table 9.35 Summary of Predicted Construction Phase Effects for Connection to NETN

Feature	Description	Importance	Effect	Quality	Duration	Scale	Magnitude	Significance
AlluvMIN	Mineral alluvium	Medium	Loss or damage of topsoil and subsoil	Negative	Permanent	Local	Negligible	Imperceptible
Topsoil	AminDW	High	Loss or damage of topsoil and subsoil	Negative	Permanent	Local	Small adverse	Slight
Subsoils quality and significance	Alluvium	Medium	Loss or damage of topsoil and subsoil	Negative	Permanent	Local	Small adverse	Slight
Subsoils quality and significance	Irish Sea Till derived from Lower Palaeozoic sandstones and shales	Medium	Loss or damage of topsoil and subsoil	Negative	Permanent	Local	Small adverse	Slight
Subsoils quality and significance	Urban	Medium	Excavation of Made Ground	Negative	Permanent	Local	Small adverse	Slight
Bedrock quality and significance	Kilmacrea Formation, Dark grey slate, minor pale sandstone	Low	Loss of Solid Geology	Negative	Permanent	Local	Small adverse	Slight
Subsoils quality and significance	Heavily loaded vehicles moving through the site	Medium	Earthworks Haulage	Negative	Temporary	Local	Small adverse	Imperceptible
Subsoils quality and significance	Ground vibrations	Medium	Effect on surrounding ground	Negative	Temporary	Local	Small adverse	Imperceptible
Bedrock -locally Important Aquifer (LI)	Bedrock which is moderately productive only in local zones	Medium	Loss or damage of proportion of aquifer through excavation	Negative	Temporary	Local	Negligible	Imperceptible
Bedrock -locally Important Aquifer (LI)	Bedrock which is moderately productive only in local zones	Medium	Loss or damage of proportion of aquifer through pollution	Negative	Temporary	Local	Moderate adverse	Moderate
Bedrock -locally Important Aquifer (LI)	Bedrock which is moderately productive only in local zones	Medium	Change to groundwater regime	Negative	Temporary	Local	Negligible	Imperceptible

Feature	Description	Importance	Effect	Quality	Duration	Scale	Magnitude	Significance
Gravel – locally Important Aquifer (Lg)	Gravel which is moderately productive only in local zones	Medium	Loss or damage of proportion of aquifer through excavation	Negative	Temporary	Local	Negligible	Imperceptible
Gravel – locally Important Aquifer (Lg)	Gravel which is moderately productive only in local zones	Medium	Loss or damage of proportion of aquifer through pollution	Negative	Temporary	Local	Small adverse	Slight
Gravel – locally Important Aquifer (Lg)	Gravel which is moderately productive only in local zones	Medium	Change to groundwater regime	Negative	Temporary	Local	Negligible	Imperceptible
Arklow Town Marsh	pNHA – Located approximately 750m southeast of the red line boundary	Very high	Loss or damage of groundwater dependent habitat	Negative	Short Term/Temporary	Local	Small adverse	Moderate
Avoca River Valley	pNHA – Located approximately 200m northwest of the red line boundary	Very high	Loss or damage of groundwater dependent habitat	NA – feature is upstream of development	NA	NA	NA	NA

9.6.3 Operational Phase

The operational phase of the proposed development will have an overall **imperceptible** long-term effect on land and soils.

A summary of the operational effects is outlined in **Table 9.36**.

Land will be reinstated to its original use post construction at the proposed landfall site, along the proposed cable route and at the construction areas around the towers and OHL stringing areas (for the connection to the NETN). Potential negative effects on land and soils from these elements of the development during the operational phase will be solely as a result of any ongoing maintenance or inspection of the proposed development, in the event of any accidental leakage of oil, petrol or diesel, allowing contamination of the surrounding environment.

The significance of the effect is **imperceptible** on any of the land and soil important features such as the topsoil and underlying aquifer.

The proposed substation will be operated remotely and will be generally unmanned. It will receive occasional visits for inspection and maintenance. Routine operational checks will be carried out 6 to 8 times per month. There will also be quarterly inspection visits and further visits for maintenance as and when required (typically once a year).

Oil, petrol and diesel will be stored at the substation site during operation. The proposed development will be constructed in accordance with the relevant design standards by means of good practice measures under appropriate engineering supervision.

The substation site will be capped with hard standing and site buildings. A GCL will be installed across the site as part of the remediation strategy associated with contaminated made ground on site. Consequently, the risk of a leak from the proposed development effecting land and soils is considered to be low. As such, the effects on land and soils will be negligible and the significance of the effect is considered to be **imperceptible** during operation.

The implementation of the remediation strategy will result in a reduction in the percolation of rainfall through the contaminated made ground. This in turn will reduce leachate generation from the made ground and reduce groundwater contamination on the site. This will result in a **slight beneficial** effect on the underlying aquifer.

Table 9.36 Summary of Predicted Operational Phase Effects

Feature	Description	Importance	Effect	Quality	Duration	Scale	Magnitude	Significance
Topsoil	AminDW	High	Loss or damage of topsoil and subsoil	Negative	Permanent	Local	Negligible	Imperceptible
AlluvMIN	Mineral alluvium	Medium	Loss or damage of topsoil and subsoil	Negative	Permanent	Local	Negligible	Imperceptible
Bedrock -locally Important Aquifer (LI)	Bedrock which is moderately productive only in local zones	Medium	Loss or damage of proportion of aquifer through pollution	Negative	Permanent	Local	Negligible	Imperceptible
Gravel – locally Important Aquifer (Lg)	Gavel which is moderately productive only in local zones	Medium	Groundwater Quality	Beneficial	Permanent	Local	Slight Beneficial	Slight Beneficial

9.6.4 Decommissioning phase

The decommissioning of the of the proposed development is described in **Chapter 5** *Description of Development*. If decommissioned, all above ground infrastructure including the substation buildings will be removed.

All above ground structures along the cable route will also be removed. It is likely that the ducts and cables will be left in place, as to remove them would be likely to cause a more substantial environmental impact than leaving them in-situ.

The raised flood defence embankment will remain in situ following any decommissioning of the proposed substation.

The potential effects on land and soils will be due to the presence of machinery onsite to undertake decommissioning activities.

The proposed decommissioning effects of the proposed development on the geological attributes identified are listed below:

- Effect on the surrounding ground;
- Effect on groundwater quality and groundwater dependant ecosystems

9.6.4.1 Effects on the surrounding ground

Removal of above ground structures, crushed stone, and reinstatement with topsoil has the potential to induce movement and settlement of surrounding ground. The demolition works could result in minor ground vibrations.

These works may also give rise to noise and vibration effects and may result in the generation of dust. **Chapter 7** *Air Quality* and **Chapter 11** *Noise and Vibration* provides more information on such effects.

The magnitude of this impact is small adverse. The significance of the potential effect is **imperceptible.**

9.6.4.2 Effect on groundwater quality and groundwater dependant ecosystems

The activities which may impact the groundwater quality beneath the proposed scheme during the decommissioning phase are:

- Accidental spillages of polluting materials onsite;
- Release of fines into the groundwater and surface water; and
- The potential for contaminated runoff to enter the groundwater and surface water.

If any of these occur, they may potentially contaminate the groundwater beneath the proposed development and also effect the groundwater quality in the vicinity. The most significant activity will take place at the substation site. The level of activity along the cable route as far as the landfall site will be very minor, as there are very few above ground structures at these locations.

The potential effects are short-term. The magnitude and significance of these potential effects on the receptors are summarised below:

- The magnitude of this potential impact on the sand and gravel aquifer could potentially be small adverse leading to a significance rating of **slight**;
- The magnitude of this potential impact on the water quality of the Locally Important and Poor aquifer could potentially be small adverse leading to a significance rating of **slight**.

Table 9.37 Summary of effects of Proposed Development – Decommissioning phase

Feature	Importance		Magnitude of Effect		Significance of Effect
	Ranking	Justification	Ranking	Justification	
Effects on surrounding ground	Low	The ground works are temporary and are only short term	Small adverse	Due to the nature of the works and short term works the effect is anticipated to low	Imperceptible
Effect on groundwater quality and groundwater dependent ecosystems	Low	Groundwater flow may be affected on a small scale only.	Small adverse	Due to the nature of the works proposed minimal effect is anticipated on groundwater quality	Slight

9.7 Mitigation and Monitoring Measures

The following sections outline the mitigation and monitoring measures designed to avoid or minimise those effects identified in **Section 9.6** for the construction, operational and decommissioning phases of the proposed development.

9.7.1 Construction Phase

The mitigation strategy outlined in this section will be implemented during the construction phase of the proposed development. The strategy will be incorporated into the overall Construction Environment Management Plan (CEMP), which is included in **Appendix 6.1** in **Volume 3** .

Construction techniques that comply with the requirements of statutory bodies (Wicklow County Council and EPA) in terms of noise, vibration, soil and groundwater contamination and disposal of contaminated material for both soil and rock cuttings will be adopted. A summary of the pre-mitigation and post-mitigation effects is contained in **Table 9.38**.

9.7.1.1 General

Regulatory Compliance: The adopted construction techniques will comply with the requirements of statutory bodies (Wicklow County Council and EPA) and construction will be completed in accordance with the CEMP.

Ground Contamination: Good housekeeping (daily site clean-ups, use of disposal bins, etc.) will be carried out on site during construction, and the proper use, storage and disposal of all substances and their containers will help prevent soil contamination. For all activities involving the use of potential pollutants or hazardous materials, there will be a requirement to ensure that the material such as concrete, fuels, lubricants and hydraulic fluids will be carefully handled and stored to avoid spillages. Potential pollutants will also be adequately secured against vandalism and will be provided with proper containment according to codes of best practice. Any spillages will be immediately contained, and contaminated soil removed from site and disposed of in a licensed waste facility.

Ground Contamination: Excavations in made ground will be monitored by an appropriately qualified person to ensure that any localised areas of contamination encountered are identified, segregated and disposed of appropriately. Any identified localised areas of contamination will be segregated and stored in an area where there is no possibility of runoff generation or infiltration to ground or surface water drainage. Care will be taken to ensure that the localised area of contamination does not cross- contaminate clean soils elsewhere throughout the site.

Ground Contamination: Potential soil and water pollution will be minimised by the implementation of good construction practices. Such practices will include adequate bunding for oil containers, wheel wash and dust suppression on site roads, and regular plant maintenance. The Construction Industry Research and Information Association (CIRIA) provides guidance on the control and management of water pollution from construction sites in their publication Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors (Masters-Williams et al, 2001) and this will be reflected in the CEMP. An Environmental Incident & Emergency Response Plan has been prepared and included in the CEMP and will be further developed by the appointed Contractor prior to the commencement of works and regularly updated, identifying the actions to be taken in the event of a pollution incident. The Environmental Incident & Emergency Response Plan will address the following:

- Containment measures;
- Emergency discharge routes;
- List of appropriate equipment and clean-up materials;
- Maintenance schedule for equipment;
- Details of trained staff, location and provision for 24-hour cover;
- Details of staff responsibilities;
- Notification procedures to inform the relevant environmental protection authority;

- Audit and review schedule;
- Telephone numbers of statutory water undertakers and local water company; and
- List of specialist pollution clean-up companies and their telephone numbers.

9.7.1.2 Mitigation of the potential effects identified in Section 9.6

Loss or damage of topsoil

Excavated topsoils will be stockpiled using appropriate methods to minimise the effects of weathering. Care will be taken in reworking this material to minimise dust generation, groundwater infiltration and generation of runoff. Any surplus suitable material excavated that is not required elsewhere for the proposed development, will be reused for other projects where possible, subject to appropriate approvals/notifications or removed off site to a suitable licensed facility.

In order to reduce the compaction and erosion of topsoil outside the areas of direct construction, haul routes will be along predetermined routes within the proposed development and deliveries will be along predetermined routes outside the proposed development. Where compaction occurs due to truck movements and other construction activities on unfinished surfaces, remediation works will be undertaken to reinstate the ground to its original condition. Where practical, compaction of any soil or subsoil which is not part of the works or to remain in-situ within the proposed development will be avoided.

The Contractor will ensure that any topsoil or subsoil is assessed for re-use within the proposed development ensuring the appropriate handling, processing and segregation of the material. Where practical the removal of soil from the proposed development will be avoided. All earthworks will be undertaken in accordance with TII Specification for Road Works (SRW) Series 600 Earthworks and project specific earthworks specifications ensuring that all excavated material and imported material is classified using the same methodology so as to allow maximum opportunity for the reuse of materials on site.

Excavation of Made Ground

Any excavations within made ground should follow the criteria outlined in the CEMP. The CEMP will be updated by the contractor prior to the commencement of construction.

Excavations in made ground will be monitored by an appropriately qualified person to ensure that any localised areas of contamination encountered are identified, segregated and disposed of appropriately and to ensure soils are consistent with the descriptions and classifications according to the waste acceptance criteria testing carried out as part of the site investigations. Any identified localised areas of contamination will be segregated and stored in an area where there is no possibility of runoff generation or infiltration to ground or surface water drainage.

Care will be taken to ensure that the contaminated material does not cross-contaminate clean soils elsewhere throughout the site.

Samples of ground suspected of contamination will be tested for contamination during the detailed investigation and ground excavated from these areas will be disposed of to a suitably licensed or permitted site in accordance with the current Irish waste management legislation.

Any dewatering in areas of contaminated ground will be designed to minimise the mobilisation of contaminants into the surrounding environment. Where dewatering in such areas is unavoidable the water will be adequately treated prior to discharge.

Where piling is undertaken, it will be completed following the placement of the deeper granular gas drainage layer which will also serve as a piling mat. Following this, the barrier layer and upper drainage layer will be placed around the piles and sealed.

Piling may also be completed after the GCL barrier and drainage layer has been laid, which will require excavation of material and sealing the GCL around piles.

The geotechnical design will ensure that any future settlement on site does not lead to a disruption of the integrity of the GCL barrier layer that could lead to water ingress.

Loss of Solid Geology

All excavated material, where possible will be reused within the proposed development. The appointed Contractor will ensure acceptability of the material for reuse for the proposed development with appropriate handling, processing and segregation of the material in accordance with the CEMP.

This material would have to be shown to be suitable for such use and subject to appropriate control and testing according to earthworks specifications.

Care will be taken in reworking this material to minimise dust generation, groundwater infiltration and generation of runoff. Any surplus suitable material excavated that is not required elsewhere for the proposed development, will be used for other projects where possible, subject to appropriate approvals/notifications.

Earthworks haulage

Earthworks haulage will be along predetermined routes within the proposed development and any deliveries to site will be along existing national, regional and local routes for importation and exportation of materials, in accordance with the Construction Traffic Management Plan (CTMP) included in the CEMP. Haulage along the cable route will be along internal haul roads/access tracks, where practicable. Where compaction occurs due to truck movements and other construction activities on unfinished surfaces, remediation works will be undertaken to reinstate the ground to its original condition. Where practicable, compaction of any soil or subsoil which is to remain in situ along the sites will be avoided.

Earthworks operations shall be carried out such that surfaces will be designed with adequate falls, profiling and drainage to promote safe runoff and prevent ponding and flooding. Runoff will be controlled through erosion and sediment control structures appropriate to minimise the water effects. Care will be taken to ensure that surfaces are stable to minimise erosion.

Effects on the surrounding ground

Monitoring of ground settlement, horizontal movement will be implemented during construction activities where required to ensure that the construction does not exceed the design limitations.

Foundation type and method of construction have been selected to control ground settlement. The foundation types are described in **Sections 6.5.4** and **6.5.5** within **Chapter 6** *Construction Strategy*.

Improvement works for flood defences

The short section of flood defence improvement works will be appropriately monitored and supervised and will be enclosed by silt barriers (e.g. straw or silt fence) to prevent any runoff into surface water bodies and will be carried out in accordance with the CEMP.

Horizontal movement monitoring of the sheet piles (if used) will be implemented during construction activities to ensure that movement does not exceed the design limitations. Appropriate remedial actions will be implemented should there be any exceedance of design limitations.

Pollution of soil and groundwater

The CEMP will be updated by the Contractor prior to the commencement of construction.

Good construction management practices will be employed to minimise the risk of transmission of hazardous materials as well as pollution of adjacent watercourses and groundwater.

The construction management of the site will take account of the recommendations of the CIRIA guidance Control of Water Pollution from Construction Sites – Guidance for consultants and contractors (Masters-Williams *et al*., 2001) to minimise as far as possible the risk of soil, groundwater and surface water contamination.

Measures to be implemented to minimise the risk of spills and contamination of soils and waters will include:

- Employing only competent and experienced workforce, and site specific training of site managers, foremen and workforce, including all subcontractors, in pollution risks and preventative measures;

- Ensure that all areas where liquids (including fuel) are stored, or cleaning is carried out, are in designated impermeable areas that are isolated from the surrounding area and within a secondary containment system, e.g. by a roll-over bund, raised kerb, ramps or stepped access;
- The location of any fuel storage facilities will be considered in the design of all construction compounds and will be fully bunded. These are to be designed in accordance with relevant and current guidelines and codes of best practice at the time of construction.
- Good housekeeping will be maintained at the site (daily site clean-ups, use of disposal bins, etc.) during the entire construction phase;
- All concrete mixing and batching activities will be located in designated areas away from watercourses and drains;
- Potential pollutants will be adequately secured against vandalism in containers in a dedicated secured area;
- Provision of proper containment of potential pollutants according to relevant and current codes of practice and legal requirements;
- Thorough control during the entire construction stage to ensure that any spillage is identified at early stage and subsequently effectively contained and managed; and
- Spill kits to be provided and to be kept close to the HDD and temporary construction compounds. Staff to be trained on how to use spill kits correctly.

Landfall and Cable Route

- Any groundwater or rainwater that collects in the HDD drilling pit or in a trench will be pumped away onto adjacent land, not directly into waterways, and through a filter medium in the mud recycling plant;
- Any bentonite (or similar HDD drilling head lubrication material) will be handled and removed by the drilling contractor. Typically, bentonite is used, which comprises 95% water and 5% bentonite clay which is a non-toxic, natural substance. HDD will be a closed system, with drilling fluid recirculated, the drill cuttings recovered, and drilling fluid reused;
- In order to minimise the likely migration of drilling fluids through the subsurface to waterbodies the following measures will be employed:
    - Exit and entry points for the HDD will be enclosed by silt barriers (e.g. straw or silt fence) to prevent any runoff into surface water bodies.
    - If pressure drops during drilling or if there is a lack of returns the drilling will stop immediately to allow an assessment of a potential leakage of drilling fluid into the surrounding formation. A leak stopping compound may be used to prevent the leak from migrating further into the formation. If the leak stopping compound is not successful, the drilling direction may need to change to avoid the area where the leak occurred.
- If damming and over-pumping is adopted for the open cut watercourse crossings the water will be discharged through a filtering medium to limit silt carry over or bed disturbance downstream of the crossing point;

- There will be no tracking of machinery within watercourses other than that related to the temporary works associated with construction of the watercourse crossings for the cable route;
- Where short-term over pumping or flume pipes are required, equipment will be sized to accommodate surface water flow that might reasonably be expected over the period in question;

An Environmental Incident & Emergency Response Plan has been developed and is included in the CEMP (see **Appendix 6.1** in **Volume 3**), which will be further developed by the appointed Contractor prior to the commencement of works and regularly updated. This identifies the actions to be taken in the event of a pollution incident. The CEMP addresses, among other aspects, spoil management, containment measures, emergency discharge routes, a list of appropriate equipment and clean-up materials and notification procedures to inform the relevant environmental protection authority.

9.7.1.3 Monitoring during construction

Excavations in made ground will be monitored by an appropriately qualified person to ensure that any contaminated material is identified, segregated and disposed of appropriately. Any material from identified localised areas of contamination shall be segregated and stored in an area where there is no possibility of runoff generation or infiltration to ground or surface water drainage. Care will be taken to ensure that the localised area of contamination does not cross-contaminate clean soils elsewhere. All excavations will be monitored in accordance with good practice and guidelines at the time of the works.

Any excavation and stockpiled material shall be monitored during earthworks to ensure the stability of slopes and to ensure that the soils excavated for disposal are consistent with the descriptions and classifications according to the waste acceptance criteria testing carried out as part of the site investigations.

Ground settlement, horizontal movement and vibration monitoring will be implemented during construction activities to ensure that the construction does not exceed the design limitations.

Movement monitoring shall be carried out during any activities which may result in ground movements or movements of any nearby structures.

Visual monitoring will be undertaken as part of the regular site audits during the construction of the proposed development to ensure existing surface water drainage runoff and natural infiltration to ground is not affected by the proposed development.

Implementation of the CEMP will be monitored on an ongoing basis.

Table 9.38 Summary of Predicted Construction Effects Following the Implementation of Mitigation and Monitoring Measures

Feature	Description	Importance	Effect	Quality	Duration	Scale	Pre-mitigation Magnitude	Pre-mitigation Significance	Post-mitigation Magnitude	Post-mitigation Significance
Topsoil	AminDW	High	Loss or damage of topsoil and subsoils	Negative	Permanent	Local	Small adverse	Moderate/Slight	Negligible	Imperceptible
Subsoils quality and significance	Alluvium (Substation)	Medium	Loss or damage of topsoil and subsoils	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Subsoils quality and significance	Irish Sea Till derived from Lower Palaeozoic sandstones and shales	Medium	Loss or damage of topsoil and subsoils	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Subsoils quality and significance	Urban (Substation)	Medium	Excavation of contaminate ground	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Bedrock quality and significance	Maulin Formation, Dark blue-grey slate, phyllite and schist	Landfall	Loss of Solid Geology	Low	Permanent	Local	Moderate adverse	Slight	Negligible	Imperceptible
Construction	Piling and soil improvement	Medium	Soil Improvement piling for platform works	Positive	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible

Feature	Description	Importance	Effect	Quality	Duration	Scale	Pre-mitigation Magnitude	Pre-mitigation Significance	Post-mitigation Magnitude	Post-mitigation Significance
Construction	Improvement Works for Flood Defences	Medium	Improvement works for Flood Defences	Positive	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Bedrock - locally Important Aquifer (LI)	Bedrock which is moderately productive only in local zones	Medium	Loss or damage of proportion of aquifer through pollution	Negative	Temporary	Local	Moderate adverse	Moderate	Negligible	Imperceptible
Gravel - locally Important Aquifer (Lg)	Gravel which is moderately productive only in local zones	Medium	Loss or damage of proportion of aquifer through pollution	Negative	Temporary	Local	Moderate adverse	Moderate	Negligible	Imperceptible
Closed Landfills	Adjacent the Substation site	Medium	Degree or extent of soil contamination is moderate on a local scale	Negative	Permanent	Local	Small adverse	Slight	Negligible	Imperceptible
Fertilizer Plant	Substation	High	Degree or extent of soil contamination is high on a local scale	Negative	Permanent	Local	Moderate adverse	Moderate	Negligible	Imperceptible
Arklow Sand Dunes	pNHA – Located approximately 500m east of	Very high	Loss or damage of groundwater	Negative	Temporary	Local	Small adverse	Significant / Moderate	Negligible	Imperceptible

Feature	Description	Importance	Effect	Quality	Duration	Scale	Pre-mitigation Magnitude	Pre-mitigation Significance	Post-mitigation Magnitude	Post-mitigation Significance
	the red line boundary		dependent habitat							
Arklow Town Marsh	pNHA - Located approximately 750m southeast of the red line boundary	Very high	Loss or damage of groundwater dependent habitat	Negative	Short Term/Temporary	Local	Small adverse	Significant/ Moderate	Negligible	Imperceptible

9.7.2 Operational Phase

Emergency procedures detailing the measures to be undertaken should any accidental spill happen during operation will be developed as part of the operations manual for the proposed development.

With the implementation of the proposed design, no additional mitigation measures for land and soils are considered necessary for the operation of the proposed development.

No monitoring measures are proposed during the operation phase.

9.7.3 Decommissioning Phase

The mitigation measures, described above for the construction phase which are relevant to decommissioning, updated to reflect good practice at the time, will be implemented for the decommissioning phase.

9.8 Cumulative Effects

This section considers the potential for cumulative effects arising from the proposed development in association with other developments. Specifically, it considers a worst-case scenario, where both the proposed development and the proposed developments for which timelines are not known are under construction at the same time.

A tiered approach to the cumulative assessment is adopted in which the proposed development is considered cumulatively with other projects as follows:

Tier 1:

- ABWP Phase 2 Offshore Infrastructure
- ABWP Phase 2 Operations and Maintenance Facility (OMF);
- EirGrid Grid Upgrade Works; and
- Irish Water Upgrade Works.

Tier 2:

- Other relevant projects currently under construction;
- Other relevant projects with consent;
- Other relevant projects in the planning process; and
- Other existing projects that were not operational when baseline data were collected.

There are a number of development proposals identified that are currently permitted or proposed in Arklow that were not assessed in this chapter. The nature and scale of these developments are such that development of these projects in combination with the proposed development would not give rise to significant effects to land and soils.

A summary of the cumulative effects is given in detail in **Chapter 21** *Summary of Cumulative Effects.*

9.8.1 Tier 1

9.8.1.1 Arklow Bank Wind Park Phase 2 Offshore Infrastructure and Operations and Maintenance Facility and Proposed Development

As outlined in the EIAR for the Arklow Bank Wind Park Phase 2 Offshore Infrastructure, the development is the subject of an existing foreshore lease, which does not overlap (in terms of area) with either the proposed development or the proposed Operations and Maintenance Facility. The Developer for each of these projects will be Sure Partners Limited ensuring co-ordination between the developments, for which the appropriate land acquisition and foreshore consent will be obtained in advance of the works.

Considering the distance between each of these developments it is not expected there will be a cumulative demand on land and soils with the proposed development. Therefore, it is not expected that there will be cumulative effects on land and soils for the Tier 1 projects.

9.8.1.2 EirGrid Grid Upgrade Works and the Irish Water Upgrade Works and Proposed Development

The proposed EirGrid grid upgrade works and Irish Water watermain upgrade works will result in the loss of a small quantity of soil and geology. However, the cumulative loss is still considered small on a local scale. Thus, there are no likely significant cumulative effects in combination with the proposed development on land, soils and geology.

The development is located within a sand and gravel aquifer, excavations and some dewatering may be required at the substation site, these will not interact with the impacts identified for the proposed development. Thus, there are no likely significant cumulative effects in combination with the proposed development on hydrogeology.

There are no likely significant cumulative effects to land and soils during the operational phase. From a hydrogeological perspective this is due to the location of the EirGrid upgrade works and Irish Water watermain upgrade works relative to the proposed development (i.e. distant or downgradient of the proposed development), the nature and extent of the development and the interaction with impacts identified for the proposed development.

9.8.2 Tier 2

9.8.2.1 Developments within the vicinity of the Avoca River Business Park and the Proposed Development

There are a number of permitted and proposed developments in the vicinity of the Avoca River Business Park that have the potential to overlap during the construction phase. These developments include;

- the permitted Crag Digital Avoca Ltd data centre (Planning Reference 18940),
- the proposed Crag Digital Avoca Ltd data centre amended application (Planning Reference 201285),
- the permitted Rappel Enterprises Ltd office development (Planning Reference 138823),
- the permitted Harmony Timber Solutions Ltd office and factory development (Planning Reference 1954); and
- the proposed (not yet permitted) Crag Digital Avoca Ltd 110kV Substation (Planning Reference PL27.307256).

The substation works that are to be carried out are on a raised platform level with only localised excavation. The developer will ensure co-ordination with Crag Digital Avoca Ltd for the duration of the construction works to minimise any potential effects. This, together with the nature and scale of the other proposed developments, means that the Tier 2 projects within the vicinity of the Avoca River Business Park and the proposed substation will have no likely significant cumulative effect on land and soils during the construction phase.

There are no significant cumulative effects on land and soils predicted during operation.

9.8.2.2 Flood Defence Embankment Works in the Avoca River Business Park

As detailed in **Chapter 5** *Description of Development* and as assessed herein, the proposed development includes improvement works to a short section of the flood defence embankment in the Avoca River Business Park to provide flood protection to the proposed substation site.

There will also be possible maintenance and repair works to the existing flood embankment around the business park as part of a regular inspection, maintenance and repair programme, to manage residual risk of flooding from a potential breach of the embankment. Investigations are to be undertaken which will determine the nature and extent of any works required.

While a range of approaches could be applied and a targeted approach (where only certain areas of the embankment might require works), in a reasonable worst case scenario, the full length of the embankment may require to be reinforced, similar to the works proposed as part of the proposed development (localised reinforcement of the embankment, using either cohesive soils, placed and suitably compacted in layers and/or sheet piling).

Any required maintenance or reinforcement works, will be undertaken in advance of the substation construction, with ongoing maintenance and repair thereafter, subject to regular inspection and monitoring.

These maintenance or reinforcement works, if required, will require the importation of cohesive soils to reinforce the embankment to the extent necessary. The installation of driven sheet piles for flood defences (if this methodology is used) will lead to a localised permanent change in the groundwater flow and levels within the locally important aquifers in the vicinity of the proposed flood defence structure.

However, given that any required maintenance or reinforcement works will be undertaken in advance of the substation construction, and given that, following the implementation of mitigation measures, the proposed development will have an imperceptible effect on land and soils, the proposed development in combination with the possible further flood defence maintenance works, is considered to be not significant.

There will be a requirement for ongoing maintenance and repair of the flood defence works throughout the operational phase. As there are no significant operational effects of the proposed development on land and soils, no significant cumulative effects are predicted.

9.8.2.3 All Tier 2 and the Proposed Development

Only the Tier 2 projects listed were considered to have the potential for a cumulative effect with the proposed development with regard to land and soils.

It is not expected that there will be significant cumulative effects on land and soils caused by the Tier 2 projects and the proposed development.

9.9 Residual Effects

9.9.1 Construction Phase

With the employment of the above mitigation measures and standard good construction practices, it is considered that there will be no significant residual effects on land and soils as a result of the construction of the proposed development.

9.9.2 Operational Phase

With the employment of the above mitigation measures it is considered that there will be no significant residual effects on land and soils as a result of the operation of the proposed development.

9.9.3 Decommissioning Phase

With the employment of the above mitigation measures , it is considered that there will be no significant residual effects on land and soils as a result of the decommissioning phase of the proposed development.

9.10 References

Arklow Bank Wind Park Onshore Grid Infrastructure, *Landfall Site Investigation Factual Report*, Rev01, *LF100034-ENG-GT-ONX-RPT-0001*, 4th January 2021, Irish Drilling Limited (IDL)

Arklow Bank Wind Park Onshore Grid Infrastructure, *Cable Route Site Investigation Factual Report, LF100034-ENG-GT-ONX-RPT-0002, Rev02* - 22th January 2021

Arklow Bank Wind Park Onshore Grid Infrastructure, *Substation Site Investigation Factual Report*, Rev02, *LF100034-ENG-GT-ONX-RPT-0003,* 15th January 2021, Irish Drilling Limited (IDL)

Arklow Bank Wind Park Onshore Cable Route, Co. Wicklow. *Geophysical Survey, LF100034-ENG-GP-ONX-RPT-0001*, Minerex Geophysics Ltd

Arklow Bank Wind Park, *GPR-Utility Survey, Rev02*, 28th January 2021, Scantech Geoscience Limited

Arklow Bank Wind Park, *Topography Survey for Scantech Geoscience Ltd* by J Weir Land Surveying Ltd , November 2021

Arklow Bank Cable Route, Co. Wicklow, *Report on the Pavement Construction Investigation, For Scantech Geoscience Limited*, 18th November 2020, AGP20212_01, Apex Geophysics

Avoca River Park, Arklow, Co. Wicklow. *OCM (2020) Environmental Site Assessment*

Avoca River Park, FT Squared, *Phase 3 Environmental Assessments Factual Report by Ground Investigations Ireland Ltd t – Rev A* dated September 2020

Avoca River Park, FT Squared, Phase 2 Environmental Assessment Factual Report *by Ground Investigations Ireland Ltd* – Rev A dated September 2020

Avoca River Park, FT Squared, *Phase 1 Environmental Assessment Factual Report by Ground Investigations Ireland Ltd* – Rev A dated January 2020

Avoca River Park, FT Squared *Ground Investigation Report by Ground Investigations Ireland Ltd. - Rev A1* dated 19th August 2020

Bing Maps (2019) *Bing Maps* Available at: https://www.bing.com/maps/ [Accessed February 2021]

(Masters-Williams et al. (2001) *CIRIA Guidance Control of Water Pollution from Construction Sites – Guidance for consultants and contractors*

Department of Communications, Energy and Natural Resources (2019) *Exploration and Mining Viewer.* Available at: spatial.dcenr.gov.ie/ExplorationAndMining/SpatialViewer/index.html [Accessed February 2021]

Department of Culture, Heritage and the Gaeltacht, 2018. *National Monuments Service - Archaeological Survey of Ireland.* Available at: https://data.gov.ie/dataset/national-monuments-service-archaeological-survey-of-ireland [Accessed February 2021]

Environmental Protection Agency, 2018. *Corine Landcover 2018.* Available at: https://gis.epa.ie/geonetwork/srv/eng/catalog.search#/metadata/fb5d2fa9-95fe-4d3f-8aed-e548348a40ea [Accessed February 2021]

Environmental Protection Agency, 2019. *EPA Maps*. Available at: https://gis.epa.ie/EPAMaps/ [Accessed February 2021]

Environmental Protection Agency (EPA, 2017). Guidelines on the Information to be contained in Environmental Impact Assessment Reports. Draft;

GSI, 2004. *Groundwater bodies, groundwater body descriptions*. Available at: https://www.gsi.ie/en-ie/programmes-and-projects/groundwater/activities/understanding-ireland-groundwater/Pages/Groundwater-bodies.aspx#S [Accessed February 2021]

Geological Survey Ireland, 2014. *GSI Minerals Active Quarries Database*. Available at: https://secure.dccae.gov.ie/arcgis/rest/services/Minerals/ActiveQuarries2014/FeatureServer [Accessed February 2021]

Geological Survey Ireland, 2016a. *Quaternary geology of Ireland – Sediments Map.* Available at: https://secure.dccae.gov.ie/arcgis/rest/services/Quaternary/QuaternarySediments16/MapServer [Accessed February 2021]

Geological Survey Ireland, 2016b. *Aggregate Potential Mapping - GSI 2016 – Crushed Final Scores.* Available at: https://secure.dccae.gov.ie/arcgis/rest/services/APM/APM16_FinalScoresCrushedRockAggregate/MapServer [Accessed February 2021]

Geological Survey Ireland, 2016c. *Aggregate Potential Mapping - Pits and Quarry Locations.* Available at:

https://secure.dccae.gov.ie/arcgis/rest/services/APM/APM16_PitsAndQuarries/MapServer [Accessed February 2021]

Geological Survey Ireland, 2017. *Landslide Events GSI 2017.* Available at: https://utility.arcgis.com/usrsvcs/servers/6e99fe8736394f389aaf1aac5a407132/rest/services/Landslides/LandslideEvents/FeatureServer [Accessed February 2021]

Geological Survey Ireland, 2017. *Irish Geological Heritage Locations - Public Version.* [Online] Available at: https://secure.dccae.gov.ie/arcgis/rest/services/GeologicalHeritage/EXTIGHSites/MapServer [Accessed February 2021]

Geological Survey Ireland, 2018. *GSI 100k Bedrock Map.* Available at: https://secure.dccae.gov.ie/arcgis/rest/services/Bedrock/Bedrock100k_Seamless_2018/MapServer [Accessed February 2021]

Geological Society of Ireland (GSI) (2019a) *Geotechnical Viewer*. Available from: https://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228 [Accessed February 2021]

Geological Society of Ireland (GSI) (2019b) *Groundwater Viewer.* Available from: https://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=bc0dba38f3f5477c8fd400f66b5eedcd [Accessed February 2021]

Geological Society of Ireland (GSI) (2019c) *Geological Heritage.* Available from: https://www.gsi.ie/en-ie/data-and-maps/Pages/Geoheritage.aspx#Nationwide [Accessed February 2021]

Geological Survey Ireland, 2019d. *GSI Mineral Localities.* Available at: https://secure.dccae.gov.ie/arcgis/rest/services/PublicViewer/MineralLocalities/FeatureServer [Accessed February 2021]

Geological Survey Ireland, 2019e. *GSI Groundwater Level Data Viewer.* Available at: https://gwlevel.ie/ [Accessed February 2021]

Google Maps, 2019, *Google Maps.* Available at: http://www.google.com/maps/ [Accessed February 2021]

(IGI 2013) Institute of Geologists of Ireland (IGI) (2013*) Guidelines for the Preparation of Soil, Geology and Hydrogeology Chapters of Environmental Impact Statements*

National Parks and Wildlife Service, *Proposed / Designated NHA, SPA, SAC Sites,* [online], Available at: http://webgis.npws.ie/npwsviewer/, [Accessed February 2021]

(NRA, 2008a). National Roads Authority (NRA) (2008a) *Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes*

National Roads Authority (NRA, 2008b). Environmental Impact Assessment of National Road Schemes – A Practical Guide

Ordnance Survey Ireland 2019, *Current and historical Ordnance Survey maps and aerial photography available for the study area.* Available at: http://map.geohive.ie/mapviewer.html [Accessed February 2021]

Teagasc, Agency, E. P. and Ireland, G. S., 2017. *Teagasc Soils Data - Surface Soils Classification* and Description. Available at: https://secure.dccae.gov.ie/arcgis/rest/services/THIRD_PARTY/TeagascSoils/MapServer [Accessed February 2021]

Transport Infrastructure Ireland (TII) (2009) *Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes*