APPENDIX 9-2

SSFRA FOR PROPOSED GRID CONNECTION UNDERGROUND ELECTRICAL CABLE ROUTE AND OFFSITE SUBSTATION

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PROPOSED BALLYDERMOT WIND FARM GRID CONNECTION AND PROPOSED OFFSITE SUBSTATION

SITE-SPECIFIC FLOOD RISK ASSESSMENT

FINAL REPORT

Prepared for:

BORD NA MÓNA POWERGEN LTD.

Prepared by:

HYDRO-ENVIRONMENTAL SERVICES

DOCUMENT INFORMATION

Document Title:	**BALLYDERMOT WIND FARM CO. OFFALY & CO. KILDARE – PROPOSED GRID CONNECTION AND PROPOSED OFFSITE SUBSTATION** **FLOOD RISK ASSESSMENT**
Issue Date:	**07th October 2026**
Project Number:	**P1511-0**
Project Reporting History:	**P1511-0 Stage I - FRA DRAFT D0** **P1511-0_GC and Offsite SS_FRA_D0**
Current Revision No:	**P1511-0_GC and Offsite SS_FRA_F0**
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1. INTRODUCTION

1.1 BACKGROUND

Hydro-Environmental Services (HES) were requested by MKO Ireland (MKO), on behalf of Bord na Móna Powergen Ltd (BnM) (the Applicant), to undertake a Site-Specific Flood Risk Assessment (SSFRA) for the Proposed Ballydermot Wind Farm (i.e. the Proposed Project).

The Proposed Project is described in full in Chapter 4 of this Environmental Impact Assessment Report (EIAR). The Proposed Project encompasses the Proposed Wind Farm and the Proposed Grid Connection. The Proposed Project Site relates to the Planning Application Boundary as shown on Figure A.

This SSFRA has been prepared to assess the flood risk along the Proposed Grid Connection underground electrical cable route and the Proposed Offsite Substation at Killybegs, Prosperous, Co. Kildare. Note that a separate SSFRA (EIAR Appendix 9-1) has been prepared for the Proposed Wind Farm and Onsite Substation. The Proposed Onsite Substation has been assessed within the SSFRA prepared for the Proposed Wind Farm, as it is located within the Proposed Wind Farm site.

This SSFRA is carried out in accordance with 'The Planning System and Flood Risk Management Guidelines for Planning Authorities' (DoEHLG, 2009) (hereafter referred to as the Guidelines (DoEHLG, 2009)). This SSFRA is also completed in accordance with the flood policies and objectives detailed in the local county development plans:

- Flood Risk Management policies (CAEP-53 to CAEP-63) and the policies in relation to Peatlands (CAEP-16 to CAEP20) detailed in the Offaly County Development Plan (2021-2027).
- Flood Risk Management policies and objectives (IN P5 and IN 31 to IN O38) and the policies and objectives in relation to surface water drainage (IN P4; IN O20 to IN O30) as detailed in the Kildare County Development Plan (2023-2029).

1.2 STATEMENT OF QUALIFICATIONS

Hydro-Environmental Services ("HES") are a specialist geological, hydrological, hydrogeological and environmental practice which delivers a range of water and environmental management consultancy services to the private and public sectors across Ireland and Northern Ireland. HES was established in 2005, and our office is located in Dungarvan, County Waterford.

Our core area of expertise and experience is hydrology and hydrogeology, including flooding assessment and surface water modelling. HES routinely work on surface water monitoring and flood modelling and prepare flood risk assessment reports.

This FRA was prepared by Michael Gill, Conor McGettigan and Nitesh Dalal.

Michael Gill (BA, BAI, Dip Geol., MSc, MIEI) is an Environmental Engineer and Hydrogeologist with over 23 years' environmental consultancy experience in Ireland. Michael has completed numerous geological, hydrological and hydrogeological impact assessments of wind farms and renewable projects on peatlands in Ireland. He has substantial experience in surface water drainage design and SUDs design, flood modelling, and surface water/groundwater interactions. For example, Michael has worked on the Environmental Impact Assessment Reports (EIARs) and associated Flood Risk Assessments for over 100 wind-farm related projects. These projects included several wind farms on BnM lands including Lemanaghan WF, Littleton WF, Ballivor WF, Cloncreen WF and Derrinlough Wind Farm.

Conor McGettigan (BSc, MSc) is an Environmental Scientist with over 5 years' experience in environmental consultancy in Ireland. Conor holds an M.Sc. in Applied Environmental Science (2020) and a B.Sc. in Geology (2016) from University College Dublin. Conor has prepared the Land, Soils and Geology and Hydrology and Hydrogeology EIAR Chapters for numerous wind farm EIAR projects. Conor routinely completes Flood Risk Assessments for a wide variety of projects including wind farms, quarries and proposed residential developments. Conor has prepared FRA's for several wind farm developments on BnM peatlands including Ballivor WF, Lemanaghan WF and Littleton WF.

Nitesh Dalal (B.Tech, PG Dip., MSc) is an Environmental Scientist with over 7 years' experience in environmental consultancy and environmental management in India and 2 years' environmental consultancy experience in Ireland. Nitesh holds a M.Sc. in Environmental Science from University College Dublin (2024), a PG Diploma in Health, Safety and Environment from Annamalai University, India (2021) and B.Tech. in Environmental Engineering (2016) from Guru Gobind Singh Indraprastha University, India (2016).

1.3 REPORT LAYOUT

This SSFRA report has the following format:

- Section 2 describes the setting and details of the Proposed Grid Connection underground electrical cable route and the Proposed Offsite Substation;
- Section 3 outlines the hydrological setting and geological characteristics of the Proposed Grid Connection underground electrical cable route and the Proposed Offsite Substation;
- Section 4 deals with a site-specific flood risk assessment (SSFRA) undertaken for the Proposed Grid Connection underground electrical cable route and the Proposed Offsite Substation which was carried out in accordance with the above-mentioned guidelines. This section includes a detailed assessment of the flood risk and also determines whether a Justification Test is required for these elements of the Proposed Grid Connection;
- Section 5 presents a detailed flood risk assessment for the Proposed Offsite Substation and a Justification Test; and,
- Section 6 presents the SSFRA report conclusions.

2. BACKGROUND INFORMATION

2.1 SITE LOCATION AND TOPOGRAPHY

The Proposed Grid Connection 220kV underground electrical cable route is ~13.1km in length and extends from the Proposed Onsite Substation in Lodge Bog, Co. Kildare within the Proposed Wind Farm site to the Proposed Offsite Substation in the townland of Killybegs, Co. Kildare.

The Proposed Grid Connection will traverse through Allenwood, Co. Kildare and Prosperous, Co. Kildare, with infrastructure proposed in the townland of Lullymore and Killybegs, Co Kildare and adjacent townlands.

The Proposed Grid Connection underground electrical cable route is predominantly located within the existing public road network (11.6km). The route will originate at the Proposed Onsite Substation and run north through cutover bog for approximately 500m. The route then travels to the east along the public road network (R414 and R403 regional roads) as far as Prosperous, Co. Kildare. In the centre of Prosperous, the route travels to the south, along the L6002 local road for 800m before it enters agricultural land. The route then travels within private agricultural land for approximately 1km before connecting to the Proposed Offsite Substation.

Ground elevations along the Proposed Grid Connection underground electrical cable route range from ~76mOD (metres above Ordnance Datum) in the vicinity of the Proposed Onsite Substation to ~96mOD along the L6002 local road to the south of Prosperous, Co. Kildare near The Hatters Cross Roads (as referenced on the OSI Discovery Series Maps).

The Proposed Offsite Substation is located in the townland of Killybegs, Co. Kildare, ~1km south of the town of Prosperous in north Co. Kildare. The site can be accessed from the L6002 which runs to the southeast from Prosperous town centre. The entrance to the Proposed Offsite Substation is located just south of the Hatters Cross Roads.

The Grand Canal Main Line runs east to west ~800m south of the Proposed Offsite Substation. A small drain is present to the west of the Proposed Offsite Substation.

Topography in the area of the Proposed Offsite Substation slopes gently to the southwest. Ground elevations range from ~96mOD adjacent the L6002 in the east to ~85mOD in the southwest.

A site location map is included as **Figure A** below.

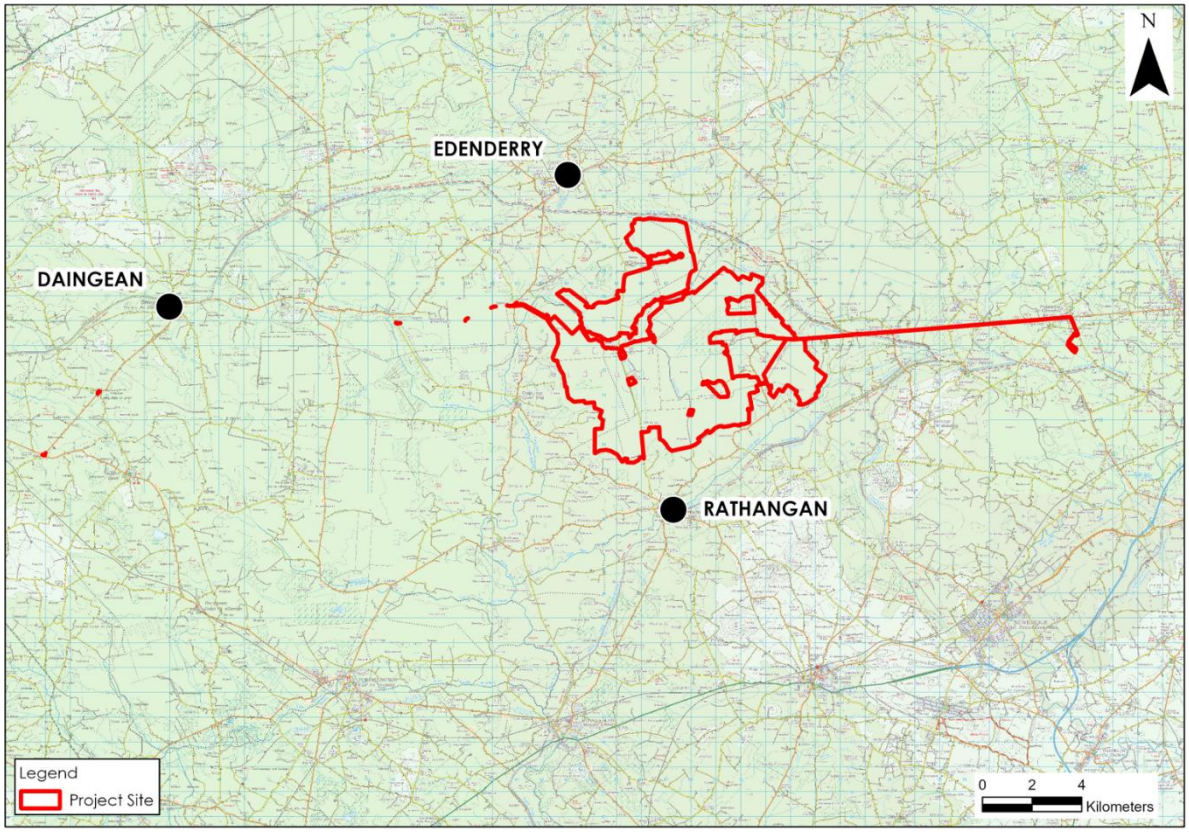


Figure A: Site Location Map

2.2 PROPOSED PROJECT DETAILS

The Proposed Project consists of 46 no. wind turbines and associated infrastructure including hardstands, 2 no. meteorological masts, 10 no. temporary construction compounds, 10 no. temporary security cabins, the provision of new internal site access roads, the upgrade of existing internal site access roads, the provision of dedicated amenity access tracks and amenity carparks (4 no.), a relay mast, watercourse crossings (11 no.), biodiversity enhancement, tree felling and vegetation removal, peat and spoil deposition areas, and all associated development and drainage works.

The Proposed Grid Connection comprises the Proposed Onsite Substation, associated control buildings and site entrance. The Proposed Grid Connection underground electrical cabling connects the Proposed Onsite Substation to the Proposed Offsite Substation via 13.1 km of underground cabling located primarily within the public road corridor. A temporary construction compound will also be located at the Proposed Offsite Substation. The Proposed Offsite Substation is located in the townland of Killybegs, Co. Kildare and the Proposed Project will connect to the existing Maynooth-Dunstown 220kV OHL via a loop-in connection.

As stated above, this SSFRA assesses the elements of the Proposed Project, excluding the Proposed Onsite Substation which is assessed in Appendix 9-1 of the EIAR. The elements of the Proposed Project assessed in this SSFRA are shown on **Figure B**.

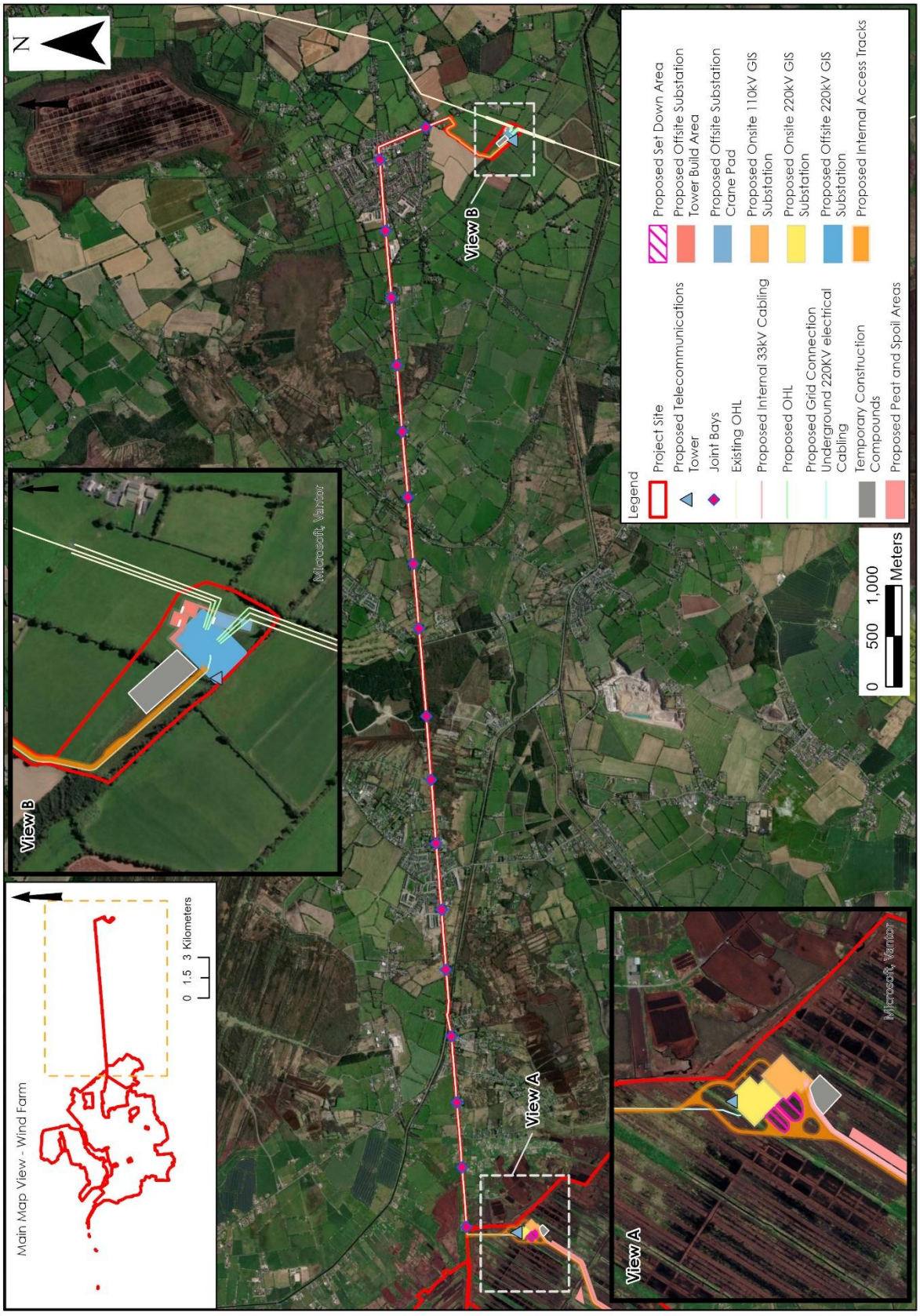


Figure B: Proposed Grid Connection

3. EXISTING ENVIRONMENT AND CATCHMENT CHARACTERISTICS

3.1 INTRODUCTION

This section gives an overview of the hydrological and geological characteristics of the Proposed Grid Connection underground electrical cable route and the Proposed Offsite Substation.

3.2 HYDROLOGY

3.2.1 Regional and Local Hydrology

Regionally, the vast majority of the Proposed Grid Connection underground electrical cable route is located in the River Barrow regional surface water catchment within Hydrometric Area 14 of the South Eastern River Basin District. A small area in the east of the Proposed Grid Connection is located in the Liffey and Dublin Bay surface water catchment within Hydrometric Area 09 of the Eastern River Basin District.

Regionally, within the River Barrow surface water catchment, the majority of the Proposed Grid Connection is located in Slate_SC_010 river sub-catchment with a very small area in the west mapped within the Figile_SC_010 river sub-catchment. Within the River Liffey and Dublin bay surface water catchment, the Proposed Grid Connection is located in Liffey_SC_050 river sub-catchment.

A small drain is located approximately 10 m southwest of the Proposed Offsite Substation. The feature is not included in the EPA blueline database but is shown on OSI Discovery Series mapping and historic 6-inch mapping.

Within the Slate_SC_010 river sub-catchment, the Proposed Grid Connection is mapped in 5 no. WFD river sub-basins: the Slate_010, Slate_020, Slate_030, Slate_040 and Slate_050 WFD river sub-basins. There is a total of 11 no. crossings of watercourses within this sub-catchment (7 no. crossings over EPA mapped watercourses, 1 no. crossing under the Grand Canal and 3 no. crossings over unmapped watercourses). The crossings are listed below.

- Within the Slate_050 WFD river sub-basin, the Proposed Grid Connection underground cabling route crosses the EPA mapped Killinagh Upper Stream (EPA Code: 14K17) along the R414 at an existing stone arch bridge. This stream flows to the south before discharging into the Slate River (EPA Code: 14S01).

- Within the Slate_050 WFD river sub-basin, the Proposed Grid Connection underground cabling route is mapped to cross the Grand Canal Main Line East (Barrow) approximately 200m to the west of Shee Bridge. The proposed crossing will utilise Horizontal Directional Drilling (HDD) and will not interact with Shee Bridge.

- Within the Slate_040 WFD river sub-basin, the Proposed Grid Connection underground cabling route crosses the Upper Ballynakill Stream (EPA Code: 14U09) to the east of Allenwood along the R403 at an existing clear span bridge.

- There is an additional stone arch bridge crossing over a watercourse which is not included in the EPA database within the Slate_040 WFD river sub-basin. This crossing is located approximately 700m east of the Upper Ballynakill Stream along the R403.

- Within the Slate_020 WFD river sub-basin, the Proposed Grid Connection underground cabling route crosses the Slate River (EPA Code: 14S01) along the R403 at Quigley's Bridge (Stone Arch Bridge).

- There are also an additional 2 no. EPA mapped crossings over the Slate River to the east of Quigley's Bridge (Whilst these crossings are mapped by the EPA – no crossings were recorded during surveys of the Proposed Grid Connection underground cabling route. The crossings are assumed to be piped or culvert crossings).

- There is also a crossing over the feeder canal for the Blackwater SAC/SPA to the east of Quigley's Bridge. This crossing is a pipe or culvert crossing along the R403.

- Within the Slate_010 WFD river sub-basin, the Proposed Grid Connection underground cabling route crosses the Brockagh Stream (EPA Code: 14B73) at Dagwelds Cross. This stream flows north where it discharges into the Slate River (EPA Code: 14S01). This is an existing pipe or culvert crossing along the R403 (no crossing was recorded during surveys).

- There is also a crossing over a non-EPA mapped watercourses, located approximately 630m to the east of the EPA mapped Brockagh Stream along the R403 to the west of Prosperous, Co. Kildare. This is an existing culvert crossing.

- Within the Slate_010 WFD river sub-basin, the Proposed Grid Connection underground cabling route crosses the Temp Stream (EPA Code: 14A46) at Black Stick Cross Roads in Prosperous, Co. Kildare. This is a pipe or culvert crossing along the R403.

The Proposed Grid Connection will generally utilise existing watercourse crossing locations and will not require the construction of new in-stream crossing structures. At the Grand Canal, where the cable route crosses at a location without an existing crossing structure, the crossing will be completed by Horizontal Directional Drilling (HDD)

A regional hydrology map is shown as **Figure C** below.

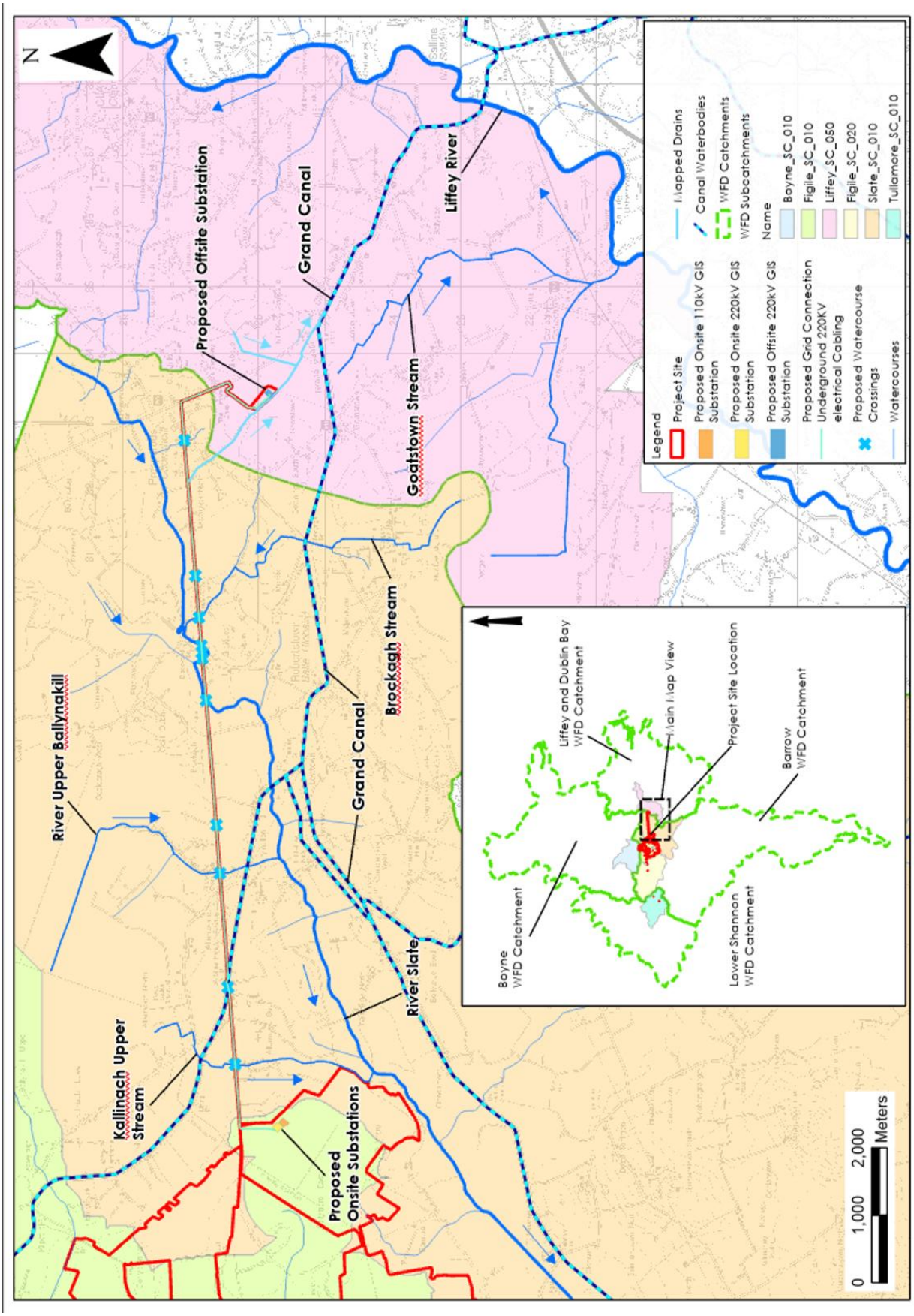


Figure C: Regional Hydrology Map

3.2.2 Rainfall and Evaporation

The SAAR (Standard Average Annual Rainfall) recorded for the period between 1981 and 2010 at Clane Garda Station, located ~4.3km northeast of the Proposed Offsite Substation, is 847mm (www.met.ie).

Met Éireann also provide a grid of Average Annual Rainfall (AAR) for the entire country for the period of 1991 to 2020. Based on this, the 30-year AAR (1991-2020) along the Proposed Grid Connection underground electrical cable route ranges from 878mm/yr in the west, near Lodge Bog to 858mm/yr in the east near Prosperous. The average AAR along Grid Connection is ~868 mm/yr.

The average potential evapotranspiration (PE) at Casement Aerodrome, ~20.3km northeast of the Proposed Offsite Substation, is taken to be 510mm (www.met.ie). The actual evapotranspiration (AE) is calculated to be 485mm (95% PE). Using the Clane SAAR value above, the effective rainfall (ER) for the Proposed Offsite Substation is calculated to be (ER = SAAR – AE) ~377mm/yr.

Groundwater recharge estimates from the GSI along the Proposed Grid Connection underground electrical cable route range from 4 to 80%. The area of low groundwater recharge corresponds with the areas mapped to be covered by peat soils/subsoils which are located predominantly in the west of the Proposed Grid Connection underground electrical cable route. Recharge rates are mapped as 60% near Allenwood due to the presence of moderate permeability subsoils overlain by well drained soils. Recharge rates near Prosperous, including the location of the Proposed Offsite Substation, are mapped as having recharge rates of 22% due to moderate permeability subsoil and poorly drained gley soils. A very small area to the west of Allenwood is mapped as having high recharge rates (85%) due to the presence of a sand and gravel aquifer.

In the west of the Proposed Grid Connection underground electrical cable route, where recharge is low (4%), the split between groundwater recharge and runoff will be 35mm/yr and 833mm/yr respectively. Meanwhile, in the east recharge is estimated to be between 22% and 60%, the split between groundwater recharge and runoff will be 191mm/yr and 677mm/yr respectively (22% recharge) and 521mm/yr and 347mm/yr (60% recharge).

In addition to average rainfall data, extreme value rainfall depths are available from Met Éireann. A summary of rainfall depths for various return periods and durations for the Proposed Offsite Substation are presented in **Table A**.

Table A. Return Period Rainfall Depths (mm) at the Proposed Offsite Substation

	Return Period (Years)			
Duration	**1**	**5**	**30**	**100**
5 mins	3.5	5.8	9.9	13.8
15 mins	5.7	9.5	16.2	22.6
30 mins	7.4	12.2	20.3	27.9
1 hour	9.6	15.6	25.5	34.6
6 hours	19.2	29.4	45.6	59.8
12 hours	25.0	37.6	57	73.9
24 hours	32.6	48	71.4	91.4
2 days	38.2	54.6	78.8	99.0

3.3 GEOLOGY

The published soils map from Teagasc (www.gsi.ie) shows that much of the Proposed Grid Connection underground electrical cable route is mapped to be overlain by cutover/cutaway peat (cut) in the west, with mainly basic deep well drained mineral soils (BminDW) further to the east. Made ground is mapped by Teagasc along the Proposed Grid Connection underground

electrical cable route at Prosperous and Allenwood, Co. Kildare. The soils mapped to overlie the Proposed Offsite Substation are predominantly basic poorly drained mineral soils (BminPD), with alluvial deposits (AlluvMin) mapped in the west. Soils in the lands surrounding the Proposed Offsite Substation are typically mapped as basic poorly drained mineral soils and basic deep well drained mineral soils (BminDW). Alluvial deposits are mapped along the length of the small drain to the west of the Proposed Offsite Substation.

The published subsoils map from the GSI (www.gsi.ie) shows that much of the Proposed Grid Connection underground electrical cable route is mapped to be underlain by cut over raised peat (cut) in the west, with till derived from limestones (TLs) further to the east. The Proposed Offsite Substation is underlain largely by till derived from limestones (TLs) with some alluvium (A) in the west. Subsoils in the lands surrounding the Proposed Offsite Substation comprise limestone derived tills.

In terms of bedrock geology, the GSI map the western section of the Proposed Grid Connection underground electrical cable route as underlain by several bedrock geological formations including the Boston Hill Formation (comprising nodular and muddy limestones and shales), the Waulsortian Limestones (consisting of massive, unbedded lime-mudstones) and the Allenwood Formation (comprising thick-bedded limestone). A small section (~100m) of the Proposed Grid Connection underground electrical cable route is mapped to be underlain by the Feighcullen Formation which consists of skeletal, oolitic and micritic limestone. Meanwhile, the eastern 4.3km of the Proposed Grid Connection underground electrical cable route and the Proposed Offsite Substation are underlain by the Boston Hill Formation (www.gsi.ie).

The GSI map several bedrock geological faults along the Proposed Grid Connection underground electrical cable route.

Further details on the local geology are provided in Chapter 8 of the EIAR.

3.4 DESIGNATED SITES & HABITATS

Within the Republic of Ireland designated sites include Natural Heritage Areas (NHAs), Proposed Natural Heritage Areas (pNHAs), Special Areas of Conservation (SACs), candidate Special Areas of Conservation (cSAC) and Special Protection Areas (SPAs).

The Proposed Grid Connection underground electrical cable route is mapped to cross the Grand Canal pNHA (Site Code: 002104) to the west of Allenwood. The proposed crossing is located ~200m west of the existing crossing at Shee Bridge. No new watercourse crossing is proposed at this location with the crossing to be achieved by HDD.

Further to the east a small section of the Proposed Grid Connection underground electrical cable route is mapped to cross the Ballynafagh Lake SAC (Site Code: 001387). An existing road bridge crossing, along the R403, over the Blackwood Feeder, which connects Ballynafagh Lake to the Grand Canal, already exists at this location.

The Proposed Grid Connection underground electrical cable route is also mapped ~145m to the south of Ballynafagh Bog SAC/pNHA (Site Code: 000391).

Hodgestown Bog NHA (Site Code: 001393) exists ~2km to the north of the Proposed Grid Connection electrical cable route. There are no hydrological connections between the Proposed Grid Connection and this NHA.

The Proposed Offsite Substation is not located within any designated conservation site. The closest designated site is the Grand Canal pNHA (Site Code: 002104) located ~800m to the south.

3.5 PROPOSED OFFSITE SUBSTATION DRAINAGE

Inspection of aerial photographs and historic 6" and 25" maps indicate the presence of a small drain along the southwestern boundary of the Proposed Offsite Substation. The location of this drain corresponds to the mapped alluvium deposits described in Section 3.3 above.

Drainage mapping has been completed for the Proposed Offsite Substation, and a local site drainage map is shown as **Figure D** below. The small drain located along the southwestern boundary of the Proposed Offsite Substation flows to the southeast before it connects with the Grand Canal.

Site surveys completed by HES revealed that this drain is heavily vegetated and exhibits very low to negligible flow conditions. The feature functions more as an agricultural field drain than a natural watercourse of significance. This feature is not considered to pose a significant flood risk.

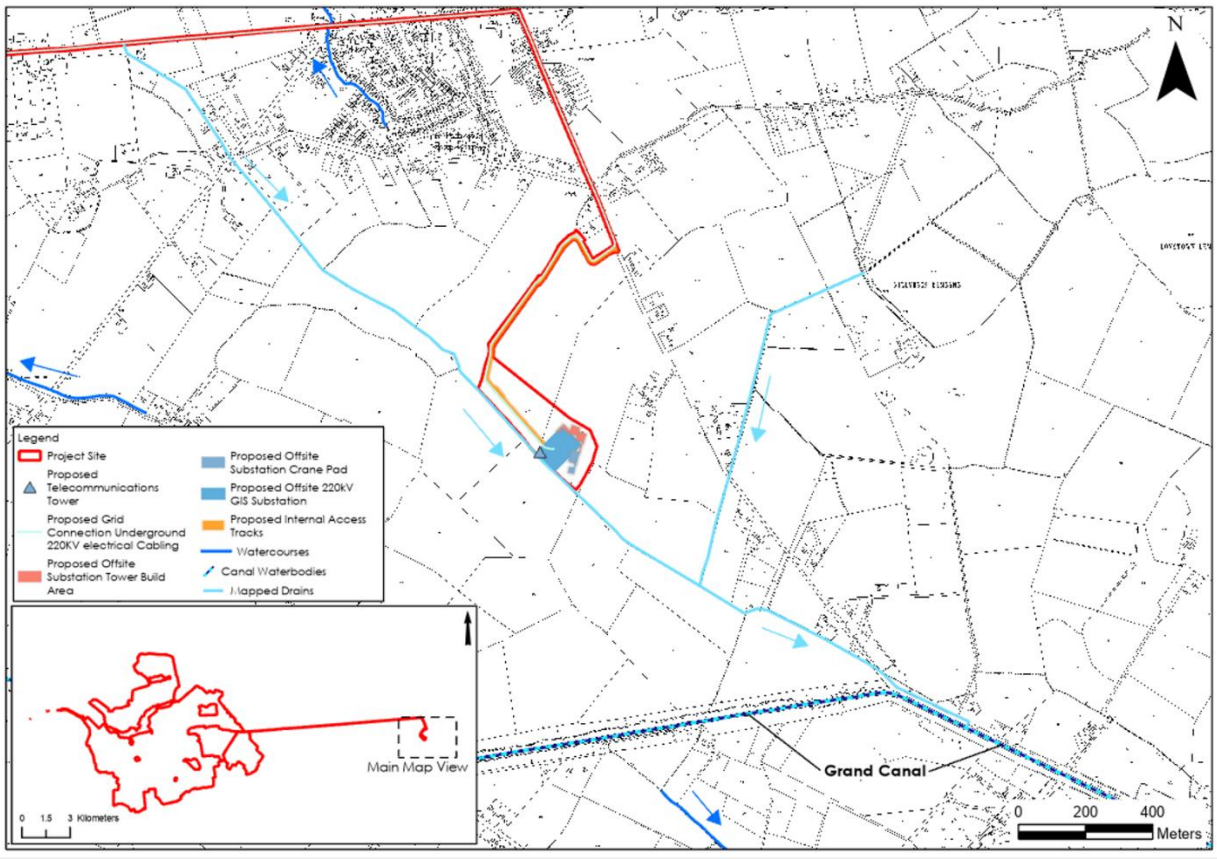


Figure D: Proposed Offsite Substation Drainage Map

4. FLOOD RISK ASSESSMENT

4.1 INTRODUCTION

The following assessment is carried out in accordance with the Guidelines (DoEHLG, 2009). The basic objectives of these guidelines are to:

- Avoid inappropriate development in areas at risk of flooding;
- Avoid new developments increasing flood risk elsewhere, including that which may arise from surface water run-off;
- Ensure effective management of residual risks for development permitted in floodplains;
- Avoid unnecessary restriction of national, regional or local economic and social growth;
- Improve the understanding of flood risk among relevant stakeholders; and,
- Ensure that the requirements of EU and national law in relation to the natural environment and nature conservation are complied with at all stages of flood risk management.

4.2 FLOOD RISK ASSESSMENT PROCEDURE

This section of the report details the Stage 2 site-specific flood risk assessment carried out for the site and surrounding area. The primary aim of the assessment is to consider all types of flood risks and the potential impact on the development. As per the Guidelines (DoEHLG, 2009), the stages of a flood risk assessment are:

- *Flood risk identification* – identify whether there are surface water flooding issues at a site;
- *Initial flood risk assessment* - confirm sources of flooding that may affect a proposed development; and,
- *Detailed flood risk assessment* – quantitative appraisal of potential risk to a proposed development.

As per the Guidelines (DoEHLG, 2009), there are essentially two major causes of flooding:

Coastal flooding which is caused by higher sea levels than normal, largely as a result of storm surges, resulting in the sea overflowing onto the land. Coastal flooding is influenced by the following three factors, which often work in combination:

- High tide level;
- Storm surges caused by low barometric pressure exacerbated by high winds (the highest surges can develop from hurricanes); and,
- Wave action, which is dependent on wind speed and direction, local topography and exposure.

Coastal Flooding is not applicable due to the inland location of the Proposed Grid Connection.

Inland flooding which is caused by prolonged and/or intense rainfall. Inland flooding can include a number of different types:

- Overland flow occurs when the amount of rainfall exceeds the infiltration capacity of the ground to absorb it. This excess water flows overland, ponding in natural hollows and low-lying areas or behind obstructions. This occurs as a rapid response to intense rainfall and eventually enters a piped or natural drainage system.

- River flooding occurs when the capacity of a watercourse is exceeded or the channel is blocked or restricted, and excess water spills out from the channel onto adjacent low-lying areas (the floodplain). This can occur rapidly in short steep rivers or after some time and some distance from where the rain fell in rivers with a gentler gradient.

- Flooding from artificial drainage systems results when flow entering a system, such as an urban storm water drainage system, exceeds its discharge capacity and the system becomes blocked, and / or cannot discharge due to a high-water level in the receiving watercourse. This mostly occurs as a rapid response to intense rainfall. Together with overland flow, it is often known as pluvial flooding. Flooding arising from a lack of capacity in the urban drainage network has become an important source of flood risk, as evidenced during recent summers.

- Groundwater flooding occurs when the level of water stored in the ground rises as a result of prolonged rainfall to meet the ground surface and flows out over it, i.e. when the capacity of this underground reservoir is exceeded. Groundwater flooding tends to be very localised and results from interactions of site-specific factors such as tidal variations. While water level may rise slowly, it may be in place for extended periods of time. Hence, such flooding may often result in significant damage to property rather than be a potential risk to life.

- Estuarial flooding may occur due to a combination of tidal and fluvial flows, i.e. interaction between rivers and the sea, with tidal levels being dominant in most cases. A combination of high flow in rivers and a high tide will prevent water flowing out to sea tending to increase water levels inland, which may flood over river banks.

The Guidelines (DoEHLG, 2009) provide direction on flood risk and development and recommend a precautionary approach when considering flood risk management. The core principle of the Guidelines (DoEHLG, 2009) is to adopt a risk-based sequential approach to managing flood risk and to avoid development in areas that are at risk. The sequential approach is based on the identification of flood zones for inland and coastal flooding.

Flood zones are geographical areas within which the likelihood of flooding is in a particular range and they are a key tool in flood risk management within the planning process as well as in flood warning and emergency planning.

There are three types or levels of flood zones defined within the guidelines:

Flood Zone A – where the probability of flooding from rivers and the sea is highest (greater than 1% or 1 in 100 for river flooding or 0.5% or 1 in 200 for coastal flooding);

Flood Zone B – where the probability of flooding from rivers and the sea is moderate (between 0.1% or 1 in 1000 and 1% or 1 in 100 for river flooding and between 0.1% or 1 in 1000 year and 0.5% or 1 in 200 for coastal flooding); and,

Flood Zone C – where the probability of flooding from rivers and the sea is low (less than 0.1% or 1 in 1000 for both river and coastal flooding). Flood Zone C covers all areas of the plan which are not in zones A or B.

Once a flood zone has been identified for a site, the Guidelines (DoEHLG, 2009) set out the different types of development appropriate to each identified zone (pg 25, Table 3.1 of the Guidelines (DoEHLG, 2009)). Exceptions to the restriction of development due to potential flood risks are provided for through the application of a Justification Test, where the planning need and the sustainable management of flood risk to an acceptable level must be demonstrated by the applicant.

The Justification Test has been designed to rigorously assess the appropriateness, or otherwise, of particular developments that, for the reasons outlined above, are being considered in areas of moderate or high flood risk. The test is comprised of two processes.

- The first is the **Plan-making Justification Test** described in Chapter 4 of the Guidelines (DoEHLG, 2009) and used at the plan preparation and adoption stage where it is intended to zone or otherwise designate land which is at moderate or high risk of flooding. Plan-making Justification Tests are made at Plan/Policy development stage such as County Development Plans, or Local Area Plans.

- The second is the **Development Management Justification Test** described in chapter 5 of the Guidelines (DoEHLG, 2009) and used at the planning application stage where it is intended to develop land at moderate or high risk of flooding for uses or development vulnerable to flooding that would generally be inappropriate for that land. For example, application of Development Management Justification Test would be required at a site-specific level, such as for this FRA assessment, if a Justification Test is required.

4.3 FLOOD RISK IDENTIFICATION

4.3.1 Historical Mapping

To identify areas at risk of flooding, historical mapping (*i.e.* 6" and 25" base maps) was consulted.

There is no text on the local available basemaps which indicate that lands along or in the immediate vicinity of the Proposed Grid Connection underground electrical cable route are "liable to flood". Similarly, no such areas are recorded at the Proposed Offsite Substation, or in the surrounding lands.

As described above, the historic base mapping records the presence of a stream to the west of the Proposed Offsite Substation. However, the available local base mapping does not indicate the presence of a floodplain or any recorded history of flooding at this location. As outlined in Section 3.5, site observations recorded this feature as being heavily vegetated with negligible flow. This feature will not present any material flood risk.

4.3.2 Soils Maps - Fluvial Maps

A review of the soil types in the vicinity of the Proposed Grid Connection underground electrical cable route and the Proposed Offsite Substation was undertaken as soils can be a good indicator of past flooding in an area.

Based on the Teagasc/GSI soil maps (www.gsi.ie), no alluvial soils are mapped along the Proposed Grid Connection underground electrical cable route.

Meanwhile, the western boundary of the Proposed Offsite Substation is overlain by mineral alluvium. These deposits indicate the presence of a drain/watercourse. However, the mapped alluvium deposits are limited to the immediate vicinity of the drain/watercourse. No widespread alluvium deposits, which would be indicative of a floodplain, are present.

4.3.3 OPW Past Flood Events Mapping

To identify those areas as being at risk of flooding, OPW's River Flood Extents Mapping, National Indicative Fluvial Mapping, and Past Flood Event mapping (https://www.floodinfo.ie/map/floodmaps/) were consulted.

The closest OPW mapped recurring flood events to the Proposed Grid Connection underground electrical cable route are located at Allenwood (Flood ID: 1278), mapped ~500m to the north, and at Bluetown, Co. Kildare (Flood ID: 1281) mapped ~150m north. At Allenwood it is noted that a low-lying area floods after heavy rain whilst at Bluetown flooding occurs due to inadequate drainage. A recurring flood event is also mapped to the east of the Proposed Grid Connection underground electrical cable route at Prosperous, Co. Kildare (Flood ID: 1279) mapped ~700m east of the Proposed Grid Connection.

No recurring or historic flood incidents are recorded in the area of the Proposed Offsite Substation or in the surrounding lands. The closest mapped recurring flood event is located ~700m east of Prosperous, Co. Kildare, along the R403 (Flood ID: 1279).

Several recurring flood events are also mapped in the vicinity of Clane, Co. Kildare to the northeast and downstream (via the Liffey) of the Proposed Offsite Substation. The nearest of these recurring flood events is located ~4.5 km to the east on Millicent Road, Clane, and relates to a low-lying area which floods after heavy rainfall.

A map of the OPW historic and recurring flood events is shown below in **Figure E**.

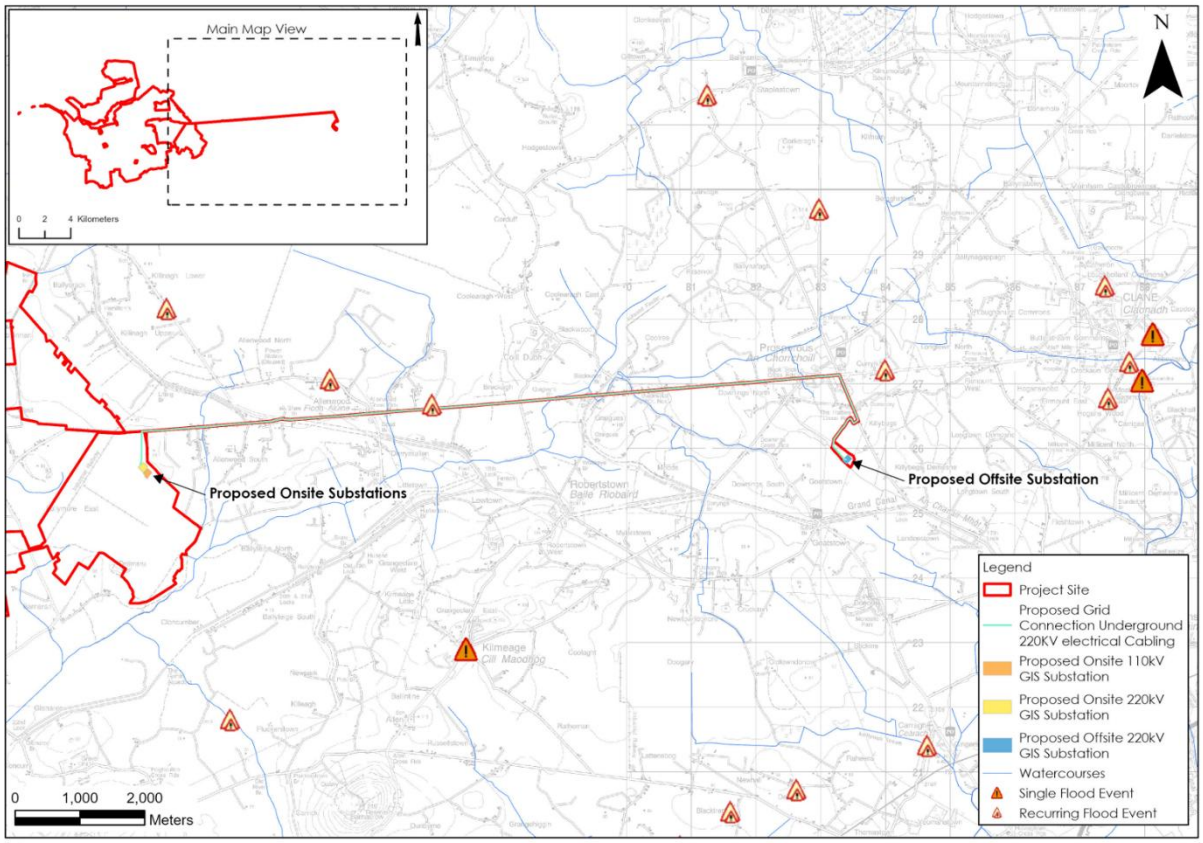


Figure E: OPW Past Flood Event Mapping (www.floodinfo.ie)

4.3.4 GSI Historic Surface Water Flood Map

The GSI Winter 2015/2016 Surface Water Flood Map (www.floodinfo.ie) shows the flood extents recorded during this flood event which was the largest on record in many areas.

This flood map does not record any surface water flood zones in the vicinity of the Proposed Grid Connection underground electrical cable route or at the Proposed Offsite Substation. The closest mapped flood zone is located ~1.6km to the west of the Proposed Offsite Substation in the townland of Downings South, Co. Kildare.

4.3.5 CFRAM Fluvial Flood Mapping

Catchment Flood Risk Assessment and Management (CFRAM)[1] OPW Flood Risk Assessment Maps are now the primary reference for flood risk planning in Ireland and supersede the previous PFRA[2] maps. CFRAM mapping of river flood extents are available at www.floodinfo.ie.

CFRAM fluvial flood zones are located along some sections of the Proposed Grid Connection underground electrical cable route as follows:

- Fluvial flood zones are mapped along the EPA mapped Upper Ballynakill Stream (EPA Code: 14U09) to the east of Allenwood, Co. Kildare. An existing watercourse crossing exists at this location. Medium and low probability fluvial flood zones are mapped immediately to the north and south of the R403. The flood zones are more extensive to the south of the R403.
- Fluvial flood zones are mapped approximately 300m to the south of the Proposed Grid Connection underground electrical cable route along the Slate River at Quigley's Bridge in the townlands of Brockagh and Graigues.

The remainder of the Proposed Grid Connection underground electrical cable route and the Proposed Offsite Substation are not mapped in proximity to any CFRAM mapped fluvial flood zones.

The closest CFRAM mapping to the Proposed Offsite Substation is located ~3km to the west along the Slate River and in a different surface water catchment to the Proposed Offsite Substation. Downstream of the Proposed Offsite Substation, CFRAM fluvial flood zones are mapped along the Liffey River. However, the closest flood zones are mapped ~4.5km to the east.

4.3.6 OPW National Indicative Flood Mapping

The National Indicative Fluvial Flood Mapping (NIFM) (www.floodinfo.ie) shows probabilistic fluvial flood zones for catchments greater than 5km^2 for which flood maps were not produced under the River Flood Extents Mapping.

The Present-Day Scenario has been generated using methodologies based on historic flood data and does not consider the potential changes due to climate change. The potential effects of climate change on flooding have been separately modelled (see **Section 4.3.9** below).

[1] *CFRAM is Catchment Flood Risk Assessment and Management. The national CFRAM programme commenced in Ireland in 2011 and is managed by the OPW. The CFRAM Programme is central to the medium to long-term strategy for the reduction and management of flood risk in Ireland.*
[2] *Preliminary Flood Risk Assessment mapping.*

NIFM fluvial flood zones are located along some sections of the Proposed Grid Connection underground electrical cable route as follows:

- The Proposed Grid Connection underground electrical cable route crosses a modelled fluvial flood zone along the EPA Mapped Killinagh Upper Stream in the townland of Allenwood South, Co. Kildare along the R414. Approximately 350m of the Proposed Grid Connection is mapped within the flood zone and includes an existing watercourse crossing over the EPA mapped stream.
- Fluvial flood zones are mapped immediately to the north (upstream) of the Proposed Grid Connection underground electrical cable route along the Slate River at Quigley's Bridge.
- Flood zones are also mapped along the Slate River to the east of Quigley's Bridge where there are 2 no. additional existing crossings over the Slate River at existing bridges. These flood zones are constrained to the river channel and do not extend any distance away from the mapped watercourse.
- Flood Zones are also mapped along the Slate River ~60m to the north of the R403 in the townland of Downings North, Co. Kildare, adjacent to Ballynafagh Bog SAC.

The remainder of the Proposed Grid Connection underground electrical cable route and the Proposed Offsite Substation are not mapped in close proximity to any NIFM mapped fluvial flood zones.

For the Present-Day Scenario, the closest medium (1 in 100-year) and low probability (1 in 1,000-year) fluvial flood zones to the Proposed Offsite Substation within the Liffey and Dublin Bay catchment are located ~2.3km to the south along the Goatstown Stream.

NIFM fluvial flood zones are shown on **Figure F**.

4.3.7 Groundwater Flooding

The GSI Maximum Historical Groundwater flood map and the modelled groundwater flood extents map (www.floodinfo.ie) do not show the occurrence of any groundwater flooding within the Proposed Offsite Substation or in the surrounding lands. No groundwater flood zones are mapped in the vicinity of the Proposed Grid Connection underground electrical cable route.

4.3.8 Coastal Flooding

The Proposed Grid Connection underground electrical cable route and the Proposed Offsite Substation are located ~38km from the Irish Sea and therefore are not at risk of coastal flooding.

4.3.9 Climate Change

Fluvial flood modelling has also been completed to consider future climate scenarios where the potential effects of climate change can increase rainfall.

The National Indicative Fluvial Flood Mapping Mid-Range Future Scenario models flood extents based on a 20% increase in rainfall. Similarly, the National Indicative Fluvial Flood Mapping High-End Future Scenario models flood extents based on a 30% increase in rainfall.

Both modelled flood extents show similar flood zones to the Present-Day Scenario discussed above in **Section 4.3.6**. Therefore, flood zones at the Proposed Grid Connection underground electrical cable route and the Proposed Offsite Substation are unlikely to be significantly impacted by future climate change.

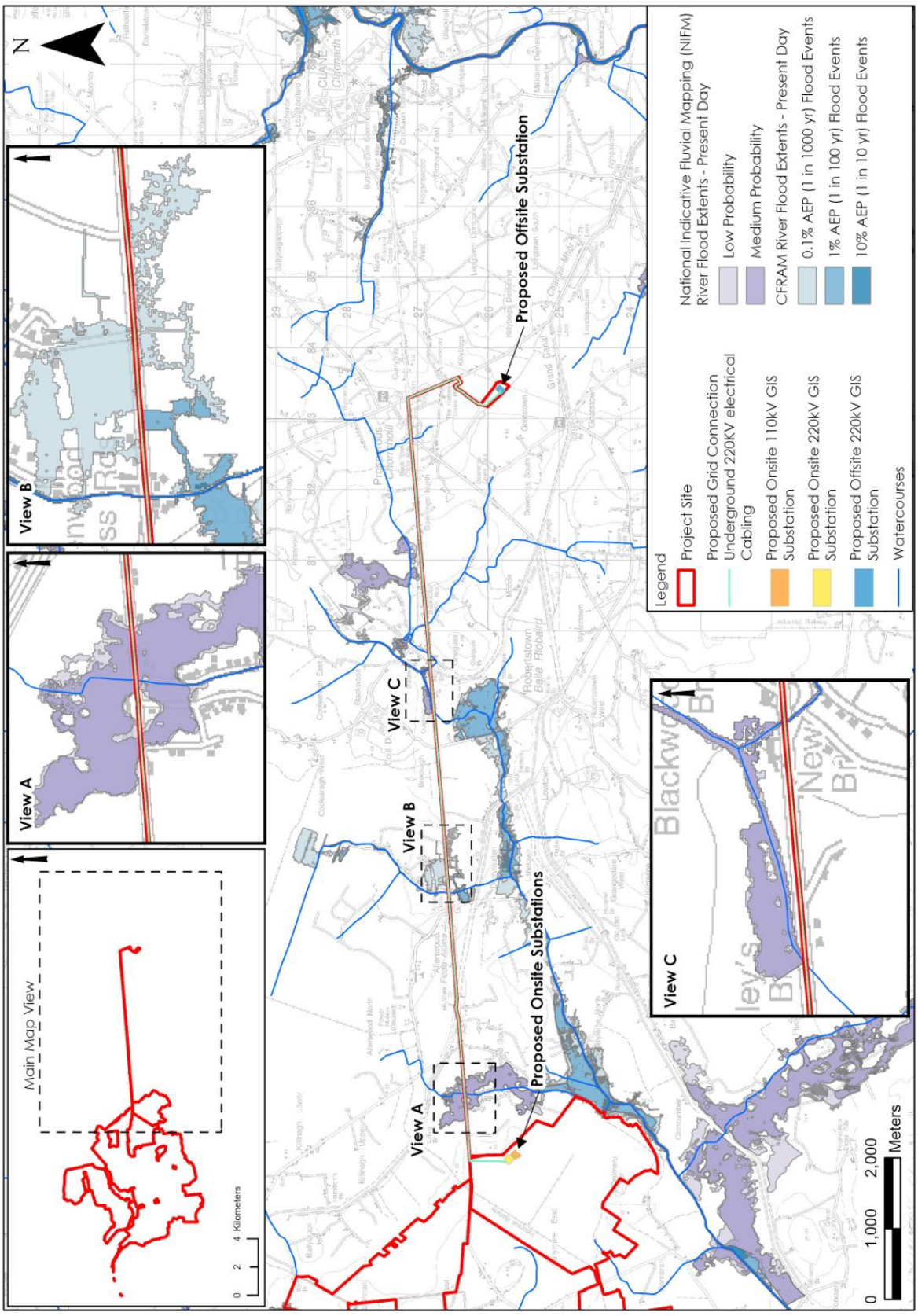


Figure F: OPW National Indicative Flood Mapping (Present Day Scenario)

4.3.10 Summary – Flood Risk Identification

Based on the information gathered through the flood identification process, the Proposed Offsite Substation and the majority of the Proposed Grid Connection underground electrical cable route are located in Fluvial Flood Zone C and are considered to be at low risk of fluvial flooding.

Some areas of the Proposed Grid Connection underground electrical cable route are mapped in Fluvial Flood Zones A and B. These areas have a high and moderate flood risk respectively. Due to the nature of the underground electrical cable route, this will have no effect during the operational phase of the Proposed Grid Connection. During the construction phase, works along the Proposed Grid Connection underground electrical cable route will be postponed following heavy rainfall events which may cause flooding at these locations.

The potential sources of flood risk are outlined and assessed in **Table B.**

Table B. S-P-R Assessment of Flood Sources

Source	Pathway	Receptor	Comment
Fluvial	Overbank flooding of local rivers	Land, People, property, infrastructure, and designated sites	The Proposed Offsite Substation and the majority of the Proposed Grid Connection underground electrical cable route are located in Flood Zone C and are therefore deemed to be at low risk of fluvial flooding. The small hydrological feature recorded to the southwest of the Proposed Offsite Substation is not a flood risk and functions more like an agricultural drain than a natural watercourse. Some areas of the Proposed Grid Connection underground electrical cable route overlap with fluvial flood zones A and B. However, existing watercourse crossings exist at these locations.
Pluvial	Ponding of rainwater on site	Land, People, property.	Due to the gently sloping nature of the Proposed Offsite Substation, the absence of any data to indicate previous inundation, the risk of pluvial flooding is low. No evidence of pluvial flooding was recorded during site surveys. The potential for surface water ponding is considered to be low.
Surface water	Surface ponding/ Overflow	Land, People, property.	Same as pluvial above.
Groundwater	Rising groundwater levels	Land, People, property	Based on local hydrogeological regime and GSI groundwater flood mapping, there is no apparent risk from groundwater flooding at the Proposed Offsite Substation or along the Proposed Grid Connection underground electrical cable route.
Coastal/tidal	Overbank flooding	Land, People, property	Not applicable.

5. DETAILED FLOOD RISK ASSESSMENT

5.1 PROPOSED OFFSITE SUBSTATION

Given the sensitivity of the Proposed Offsite Substation a detailed flood risk identification study was undertaken to identify existing potential flood risks associated with the Proposed Offsite Substation in the townland of Killybegs, Co. Kildare. The detailed assessment included site surveys and drainage mapping completed by HES. From this study, presented throughout **Section 4.3** above:

- No instances of historical fluvial flooding were identified from historic OS maps;
- Areas to the west of the Proposed Offsite Substation are mapped on mineral alluvium;
- No recurring or historic flood events are mapped by the OPW in the local area or immediately downstream of the Proposed Offsite Substation;
- The GSI Historic Surface Water Flood Map does not record any historic flood zones in the area of the Proposed Offsite Substation;
- CFRAM mapping has not been completed in the Killybegs area. Note that CFRAM maps generally prioritise larger watercourses and do not map small local watercourses or drains in detail. Therefore, there is no CFRAM model data available for this area;
- The OPW National Indicative Fluvial Flood Map does not indicate any fluvial flood zone in the area of the Proposed Offsite Substation. Note that the NIFM flood mapping was developed to provide a broad coverage of potential fluvial flood risk across Ireland, including those areas which are not covered by the CFRAM studies; and,
- The Proposed Offsite Substation is not mapped within any historic or modelled groundwater flood zone.

A small drain is located to the southwest of the Proposed Offsite Substation. This watercourse does not form part of the EPA blueline database (national spatial dataset produced by the EPA to represent the mapped river and stream network across Ireland), but is recorded on the historic 6" and 25" base maps and is also shown on the OSI Discovery Series Mapping. This small drain also corresponds to the occurrence of the mapped alluvium deposits referred to in **Section 4.3.2** above.

Drainage mapping has been completed for the Proposed Offsite Substation, and a local site drainage map is shown as **Figure D** above.

Site assessments have confirmed that the feature is heavily vegetated, has negligible flow and does not pose a significant flood risk. There were no signs of recent or historic out of bank flooding. The ground at the Proposed Offsite Substation was noted to be dry and firm with no surface water ponding.

The mapped alluvium deposits are not mapped to extend any significant distance from the watercourse and therefore do not indicate the presence of a floodplain. Furthermore, no fluvial flood zones are mapped along this watercourse, and HES note that the closest mapped flood zones are over 2km from the Proposed Offsite Substation.

Therefore, for the reasons outlined above, the probability of fluvial flooding at the Proposed Offsite Substation is considered to be low *i.e.* it is located within fluvial Flood Zone C (Low Risk).

5.2 REQUIREMENT FOR A JUSTIFICATION TEST

A matrix of vulnerability versus flood zone is shown in **Table C**. This table is used to illustrate appropriate development types or indicate when a Justification Test[3] is required.

It may be considered that the Proposed Offsite Substation can be categorised as a "Highly Vulnerable Development" as it is electricity generating infrastructure. This "Highly Vulnerable Development" infrastructure is located in Flood Zone C (Low risk) and can therefore be considered as appropriate from a flood risk perspective.

However, some sections of the Proposed Grid Connection underground electrical cable route are located in mapped fluvial flood zones. These sections are located along the existing public road network and at existing watercourse crossings (~350m along the R414 near the Killinagh Upper Stream, along the Slate River at Quigley's Bridge near Allenwood and along the Slate River at existing watercourse crossings along the R403). The Proposed Grid Connection underground electrical cable trench at these locations can be considered to be a "Less Vulnerable Development". A conservative justification test has been completed below for the sections of the Proposed Grid Connection underground electrical cable route which are located in the mapped fluvial flood zones.

Table C: Matrix of Vulnerability versus Flood Zone

	Flood Zone A	Flood Zone B	Flood Zone C
Highly vulnerable development (including essential infrastructure)	Justification test	Justification test	**Appropriate**
Less vulnerable development	**Justification test**	**Appropriate**	**Appropriate**
Water Compatible development	Appropriate	Appropriate	Appropriate

Note: *Taken from Table 3.2 (DoEHLG, 2009)*
Bold: *Applies to this project.*

5.3 JUSTIFICATION TEST

Box 5.1 of the Guidelines (DoEHLG, 2009) outlines the criteria required to complete the "Justification Test".

[3] *A 'Justification Test' is an assessment process designed to rigorously assess the appropriateness, or otherwise, of particular developments that are being considered in areas of moderate or high flood risk, (DoEHLG, 2009).*

Table D: Format of Justification Test for Development Management

Box 5.1 Justification Test for Development Management (to be submitted by the applicant)
When considering proposals for development, which may be vulnerable to flooding, and that would generally be inappropriate as set out in Table 3.2, the following criteria must be satisfied: 1. The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines. 2. The proposal has been subject to an appropriate flood risk assessment that demonstrates: i. The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk; ii. The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible; iii. The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and iv. The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to development of good urban design and vibrant and active streetscapes. The acceptability or otherwise of levels of residual risk should be made with consideration of the type and foreseen use of the development and the local development context.

Note: *this table has been adapted from Box 5.1 of "The Planning System and Flood Risk Management Guidelines", (2009).*

Referring to Point 1 and Points 2 (i) to (iv) inclusive:

The Proposed Grid Connection underground electrical cable route is mapped to overlap with fluvial flood zones along the Upper Ballynakill Stream, the Killinagh Upper Stream and the Slate River.

No displacement of floodwaters will result from the emplacement of the Proposed Grid Connection underground electrical cable route at these existing watercourse crossing locations or along the existing public roads.

No instream works are required at these locations. At watercourse crossings the most appropriate construction option will be selected and may include the use of a Standard Trefoil Formation, Flatbed Formation Under, Flatbed Formation Over or by horizontal directional drilling (HDD). There will be no alteration of the existing hydromorphological regime at these locations.

During the construction phase, works at the crossing locations may be postponed in the event of flooding.

1. The Proposed Grid Connection underground electrical cable route has been the subject of a flood risk assessment (this report) and the following has been determined:

    i. Due to the relatively small footprint of the works and given that the only portions of the Proposed Grid Connection underground electrical cable route located within modelled flood zones are at existing watercourse crossings or along existing public roads (~350m along the R414), the Proposed Grid Connection underground electrical cable route is predicted to have no impact on flood water levels downstream. Installation of the Proposed Grid Connection underground electrical cable route will not alter the shape or volume of the existing floodplain, and therefore no increase in downstream flood risk will occur.

ii. All Highly Vulnerable infrastructure, including the Proposed Offsite Substation, is located outside of the flood zones. The location and design of the Proposed Offsite Substation will therefore avoid significant interference with existing flood conveyance or flood storage. No increase in flood risk to people, property, the economy or the environment during extreme flood events as a result of the Proposed Offsite Substation is predicted due to the appropriate design measures which will result in imperceptible upstream and downstream effects.

iii. The Proposed Grid Connection underground electrical cable route overlaps mapped fluvial flood zones associated with the Upper Ballynakill Stream, Killinagh Upper Stream and Slate River. These interactions occur along the existing public road network and at existing watercourse crossing locations. The proposed crossings will not have an effect on flood levels. There will be no instream works, no alteration of the existing hydrological regime and no displacement of flood waters. There will be no increase in flood risk to people, property, the economy or the wider environment as a result of the Proposed Grid Connection underground electrical cable route.

iv. The Proposed Grid Connection underground electrical cable route is compatible with the wider planning objectives of the area, including the provision of wind energy developments at appropriate locations and the proper planning and sustainable development of the area.

6. REPORT CONCLUSIONS

- A flood risk identification study was undertaken to identify existing potential flood risks associated with the Proposed Offsite Substation and the Proposed Grid Connection underground electrical cable route. From this study:
    - No instances of historical fluvial flooding were identified from historic OS maps;
    - Areas of mineral alluvium *(i.e*. soils which are a good indicator of fluvial flooding) are recorded by the EPA/GSI to the west of the Proposed Offsite Substation;
    - No recurring or historic flood events are mapped by the OPW in the local area or immediately downstream of the Proposed Offsite Substation or along the Proposed Grid Connection underground electrical cable route;
    - The GSI Historic Surface Water Flood Map does not record any historic flood zones in the area of the Proposed Offsite Substation or along the Proposed Grid Connection underground electrical cable route;
    - CFRAM mapping has not been completed in the area of the Proposed Offsite Substation;
    - The OPW National Indicative Fluvial Flood Map does not indicate any fluvial flood zone in the area of the Proposed Offsite Substation;
    - Some CFRAM and NIFM fluvial flood zones are mapped along the Proposed Grid Connection underground electrical cable route; and,
    - The Proposed Offsite Substation and the Proposed Grid Connection underground electrical cable route are not mapped within any historic or modelled groundwater flood zone.
- Whilst a small drain is located to the west of the Proposed Offsite Substation, this does not pose a significant flood risk. The drain corresponds with the occurrence of mapped alluvium. However, the alluvium deposits are not mapped to extend any significant distance from the drain and therefore do not indicate the presence of a wider floodplain. Furthermore, no NIFM fluvial flood zones are mapped along this drain, and no historical flooding was recorded by the GSI or on local base mapping. The closest mapped flood zones are in excess of 2km from the Proposed Offsite Substation. Site surveys also revealed that this feature is heavily vegetated and has negligible flow and does not pose a significant flood risk. Therefore, for these reasons the probability of fluvial flooding at the Proposed Offsite Substation is considered to be low *i.e.* the site is located within fluvial Flood Zone C (Low Risk);
- The Proposed Offsite Substation can be categorised as a "Highly Vulnerable Development", however, the Proposed Offsite Substation is located outside of areas mapped as fluvial Flood Zones and is therefore appropriate from a flood risk perspective. The Proposed Offsite Substation floor level will be a minimum of 1000mm above existing ground level at the centre of the Proposed Offsite substation site; and,
- The Proposed Grid Connection underground electrical cable route is largely located in Flood Zone C. However, some small sections of the route are mapped in fluvial flood zones. Existing watercourse crossings are present at these locations along the public road network. The Proposed Grid Connection underground electrical cable route will have no effect on flooding or mapped flood zones as no instream works are proposed. During construction works at these locations, works may have to be postponed following heavy rainfall which could cause high flows/flooding in the rivers/streams. Once the Proposed Grid Connection underground cables are installed, they have no ability to alter existing flood risk as they are buried in the ground.

* *

7. REFERENCES

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