

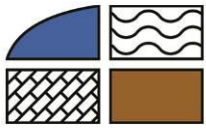


Cush Wind Farm
Phase II

Environmental Impact Assessment Report

Annex 7.1: Site Specific Flood Risk Assessment

Cush Wind Limited



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CUSH WIND FARM PHASE II, CO. OFFALY

SITE SPECIFIC FLOOD RISK ASSESSMENT

FINAL REPORT

Prepared for:
Cush Wind Limited

Prepared by:
Hydro-Environmental Services

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1. INTRODUCTION

1.1 BACKGROUND

Hydro-Environmental Services (HES) were requested by Galettech Energy Services (GES) on behalf of Cush Wind Limited to prepare a Site-Specific Flood Risk Assessment (FRA) for the proposed Cush Wind Farm Phase II, located ~4km north of Birr, Co. Offaly. The project is described at **Chapter 3** of the accompanying EIAR.

This FRA is carried out in accordance with ‘The Planning System and Flood Risk Management Guidelines for Planning Authorities’ (DoEHLG, 2009).

1.2 STATEMENT OF EXPERIENCE

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. We routinely work on surface water monitoring and modelling and prepare flood risk assessment reports.

Michael Gill (P.Geo, BA, BAI, Dip Geol., MSc, MIEI) is an Environmental Engineer and Hydrogeologist with over 24-years’ environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological impact assessments of wind farms and renewable projects in Ireland. He has substantial experience in surface water drainage design and SUDs design, and surface water/groundwater interactions. For example, Michael has worked on the EIS/EIARs for Glenard Wind Farm, Cloncreen Wind Farm, and Seven Hills Wind Farm, and over 100 other wind farm related projects across the country.

David Broderick (P. Geo, BSc, H. Dip Env Eng, MSc) is a Hydrogeologist with over 19-years’ experience in both the public and private sectors. David has a strong background in groundwater resource assessment and hydrogeological/hydrological investigations in relation to developments such as quarries and wind farms. David has completed numerous geology and water sections for input into Environmental Impact Assessment Reports/Environmental Impact Statements (EIAR/EIS) for a range of commercial developments. For example, David has worked on the EIS/EIAR for Oweninny Wind Farm, Cush Wind Farm, White Hill Wind Farm, Drumlins Park Wind Farm and Yellow River Wind Farm, and over 80 other wind farm related projects across the country.

1.3 REPORT LAYOUT & APPROACH

This FRA report is structured as follows:

- Section 2 describes the project site setting and details of the project;
- Section 3 outlines the hydrological and geological characteristics of the project site and existing site drainage;
- Section 4 presents a site-specific flood risk assessment (FRA) undertaken for the project which was carried out in accordance with the DoEHLG (2009) guidelines;
- Section 5 reviews local authority planning policy with regard to flood risk; and,
- Section 6 presents the FRA report conclusions.

As stated above, this FRA is carried out in accordance with ‘The Planning System and Flood Risk Management Guidelines for Planning Authorities’ (DoEHLG, 2009). The assessment methodology involves researching and collating flood related information from the following data sources:

- OPW Flood Studies Update (FSU) Web Portal;
- Geological Survey of Ireland (GSI) maps on superficial deposits;

- EPA hydrology maps;
- OPW National Indicative Fluvial Mapping (NIFM);
- Offaly County Development Plan 2021 – 2027 (including Strategic Flood Risk Assessment);
- Lidar and topographical data for the project site;
- Hydro Environmental Services (2023) Proposed Cush Wind Farm Stage 3 Flood Risk Assessment;
- Bord na Móna (2026) Draft Cutaway Bog Decommissioning and Rehabilitation Plan (**EIAR Annex 6.2**); and,
- Site walkovers, site investigations and drainage surveys carried out as part of the Cush Wind Farm Phase II EIAR (refer to Chapter 6 Land, Soils and Geology; and Chapter 7 Hydrology/Hydrogeology).

2. BACKGROUND INFORMATION

2.1 INTRODUCTION

This section provides details on the topographical setting of the project site along with a description of the project. The project site includes the wind farm site and underground electricity line.

2.2 PROJECT SUMMARY

The project comprises a 3 no. wind turbine extension to the permitted Cush Wind Farm Phase I, together with all associated and ancillary infrastructure and works. This includes turbine foundations, crane hardstanding areas, access tracks, internal wind farm underground cabling, site drainage and rehabilitation works, peat/spoil management, a proposed electrical switch room building, and a c.5km underground electricity line required to facilitate connection of the project site to the national electricity network.

A full description of the project is presented in **Chapter 3** of the EIAR.

2.3 SITE LOCATION AND TOPOGRAPHY

The project site is located c. 4km north of Birr, Co. Offaly.

The wind farm site setting is primarily cutaway raised bog with some grassland. The 3 no. proposed turbine locations (T9, T10 and T11) are located on a Bord na Mona (BnM) owned bog which is named 'Galros Bog'. Much of Galros Bog is now cutaway and most of the original raised bog surface has been removed. The bog surface is extensively drained by a north – south trending, parallel running open drain network.

Galros Bog was in industrial peat production from the 1950s up until 2019. Industrial peat harvesting has now ceased across the whole of Galros Bog as of 2021. Galros Bog is currently not being used for any particular land-use according to BnM.

A draft bog rehabilitation plan for Galros Bog has been prepared by BnM as part of obligations to carry out peatland rehabilitation via an IPC Licence.

Galros Bog is bordered on its western side by the N62 road between Cloghan and Birr. The bog is situated in a small topographical basin surrounded by esker ridges along the northern and western and south-western sides. Conifer plantation has been developed on cutover bog adjacent to the south side of the bog. The West Galros Stream, a tributary of the Rapemills River, flows along the southwestern boundary of the bog.

Galros Bog topography is typically flat or very gently sloping with ground elevations ranging from approximately 56m OD on the northeast of the bog to approximately 47m OD on the southwest.

The underground electricity line will connect into the proposed Mullanafawnia 110kV substation (separate third-party development) which is located 3.8km to the southeast of the wind farm site. The proposed route is approximately 5km in length and extends from the proposed electrical switch room building ('switch room') located within agricultural lands to the southeast of the wind farm site.

The majority of the underground electricity line route will be situated in private lands (off road) which comprise mainly grassland. The proposed route also crosses public roads at the N52 national road and at the L7006 local road, where it will be placed under the carriageway.

The underground electricity line route runs adjacent to the Rapemills River channel for approximately 2.5km as well as intercepting the river channel at 2 no. locations along the route. The topography along the proposed route is relatively flat to undulating with ground elevations ranging from approximately 51 to 65m OD.

The haul route works are predominately located within motorway and national roads and generally comprise the removal of street furniture to accommodate the delivery of turbine components. Permanent works are required at 1 no. location along the haul route, at the Junction of the R339 regional road and

Connolly Avenue in Galway City, accommodation works will be required on private lands in order to remove a small section of wall and fence to facilitate unrestricted passage of turbine components.

From the junction of the M6 and N52, the haul route follows the N52 to its junction with the N62. Along this section temporary hardcore will be laid on roundabout central islands and road signs, street furniture and street lighting temporarily removed at a number of locations.

A temporary reverse manoeuvre location will be required along the eastern side of the N52/N62 junction and will only be utilised by turbine component delivery vehicles travelling towards the project site. The physical (temporary) works proposed in order to accommodate this reverse manoeuvre were permitted as part of the Cush Wind Farm Phase I planning consent (ACP Reference: ABP-318816-24).

A site location map is shown as **Figure A**

Figure A below.

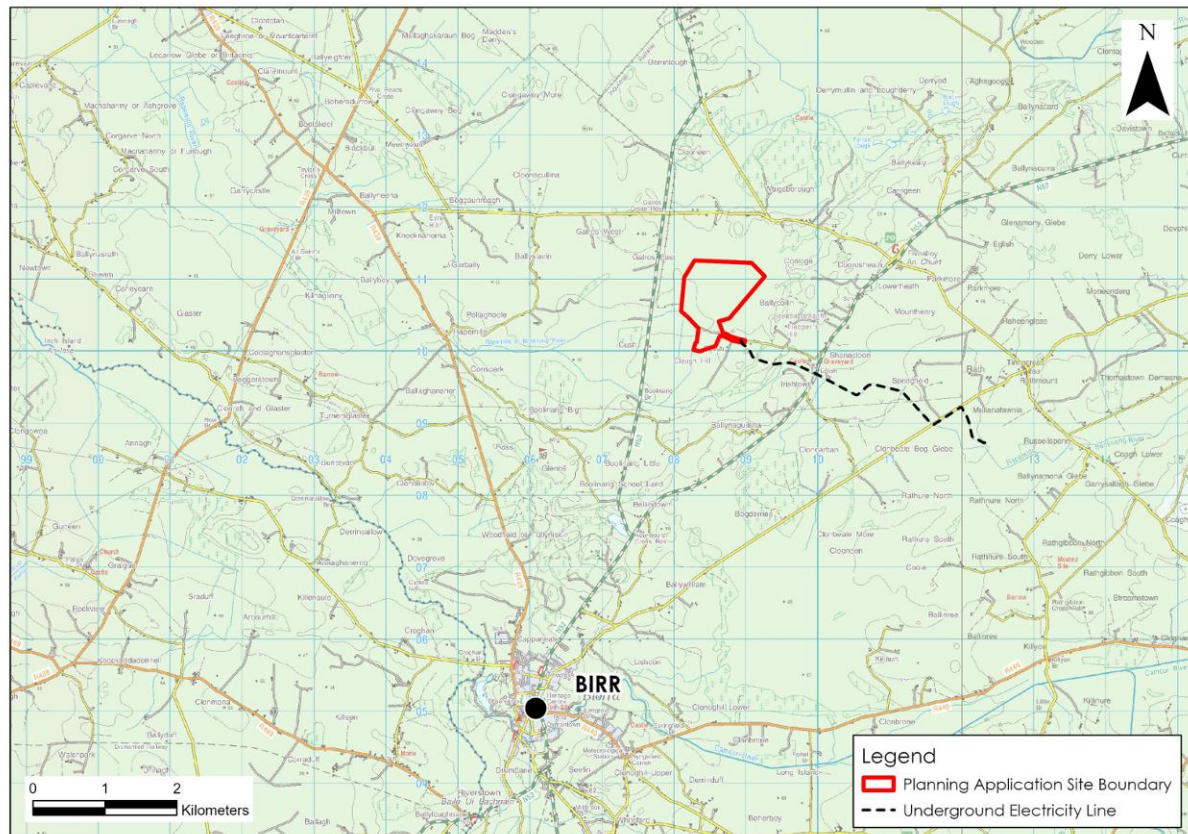


Figure A: Project Site Location

3. EXISTING ENVIRONMENT AND CATCHMENT CHARACTERISTICS

3.1 INTRODUCTION

This section gives an overview of the hydrological and geological characteristics in the area of the project site.

3.2 BASELINE HYDROLOGY

3.2.1 Regional and Local Hydrology

On a regional scale, the project site is located within Hydrometric Area 25 (Lower Shannon Catchment) and locally situated inside the Shannon[lower]_SC_040 sub-catchment which is the Rapemills River catchment.

The Rapemills River (Rapemills_010) rises approximately 8km to the east of the project site and then flows in westerly direction approximately 0.6km to the south of the project site.

East of the project site, the Rapemills River runs adjacent to the underground electricity line route for approximately 2.5km.

The Rapemills River then flows into the River Shannon approximately 12km downstream of the project site.

Refer to **Figure B** below for local and regional hydrology map.

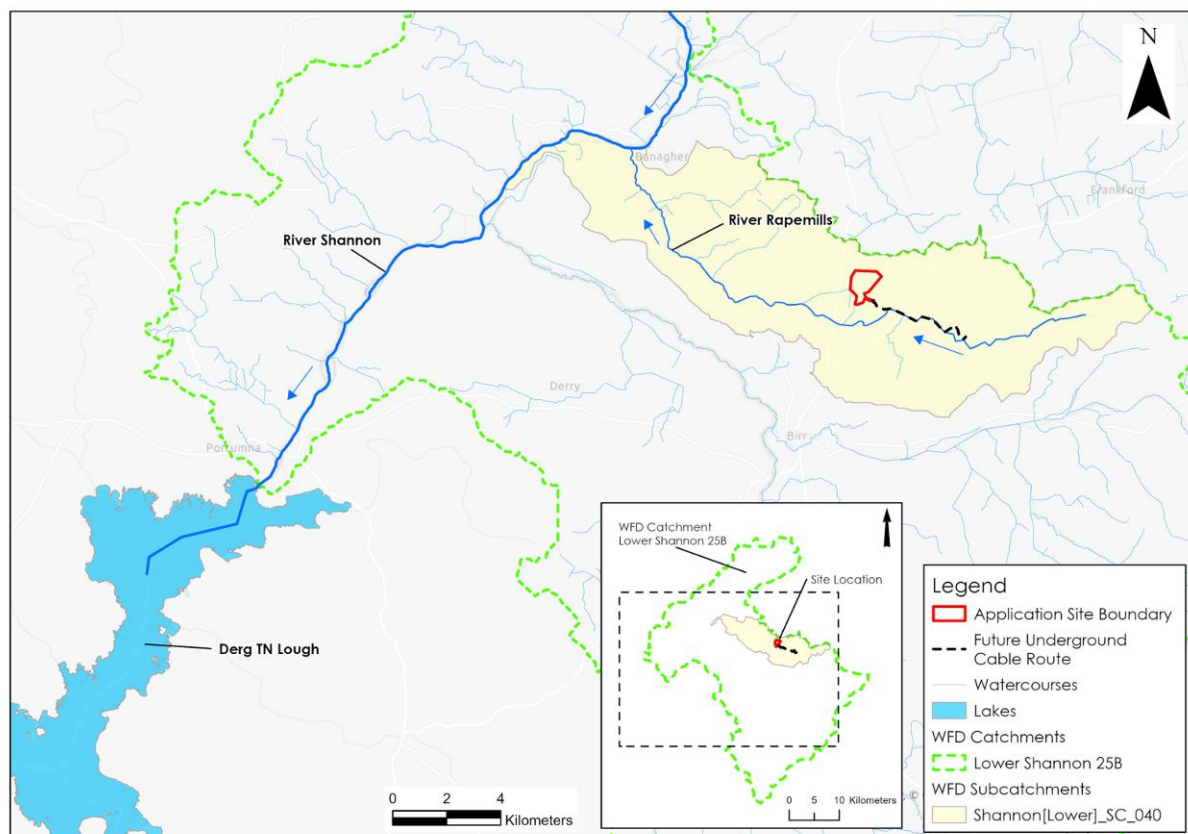


Figure B: Local and Regional Hydrology Map

3.2.2 Rainfall and Evaporation

The SAAR (Standard Average Annual Rainfall) recorded at Birr rainfall station, located ~4km southwest of the project site, is 850mm.

Met Éireann also provide a grid of average annual rainfall for the entire country for the period of 1991 to 2020. Based on these more site-specific modelled rainfall values, the average annual rainfall at the project site is 895mm/year

The average potential evapotranspiration (PE) is also recorded at Birr and is 445mm/year (www.met.ie). The actual evapotranspiration ("AE") is calculated to be 422mm (95% PE). Using the 1991 to 2020 values, the effective rainfall ("ER")¹ for the project site is calculated to be (ER = SAAR – AE) approximately 473mm/year.

Based on recharge coefficient estimates from the GSI (www.gsi.ie), an estimate of 18mm/year average annual recharge is given for basin peat in this area (recharge coefficient of ~4%). This means that the hydrology of the project site is characterised by very high surface water runoff rates and very low groundwater recharge rates.

Therefore, conservative annual recharge and runoff rates for the project site are estimated to be 18mm/year and 455mm/year respectively.

Table A below presents return period rainfall depths for the area of the project site. These data are taken from <https://www.met.ie/climate/services/rainfall-return-periods> and they provide rainfall depths for various storm durations and sample return periods (1-year, 5-year, 30-year, 100-year).

Table A: Rainfall return period depths for Project Site

Duration	Return Period (Years)			
	<u>1</u>	<u>5</u>	<u>30</u>	<u>100</u>
<u>5 mins</u>	3.8	6.6	13.9	17.1
<u>15 mins</u>	6.2	10.9	19.5	28.0
<u>30 mins</u>	7.8	12.3	22.9	32.0
<u>1 hour</u>	10	16.2	26.8	36.5
<u>6 hours</u>	18.6	27.2	40.4	51.5
<u>12 hours</u>	23.6	33.3	47.3	58.9
<u>24 hours</u>	30	40.6	55.5	67.3
<u>2 days</u>	37.1	48.6	63.9	75.8

3.3 EXISTING SITE DRAINAGE

The primary drainage feature within the project site is the Rapemills River which flows adjacent to the underground electricity line route and 0.6km from the proposed wind farm site (proposed 3 no. wind turbines). A project site general drainage map is shown as **Figure C** below.

The Rapemills River channel is typically deep (2m) with steep banks and up to 5m in width.

A tributary stream of the Rapemills River, referred to as the West Galros Stream by the EPA, emerges from forestry located to the southwest of the project site. The West Galros Stream then crosses the N62 and merges with the Rapemills River approximately 1km downstream of the project site.

The West Galros Stream has a modified channel appearance, up to 3m wide, ~1m deep with a high-water level that's close to ground level. The stream is also heavily vegetated. The majority of the project site, including Galros Bog, initially drains to the West Galros Stream.

The cutaway surface of Galros Bog is extensively drained by north – south orientated, parallel running open drain network. Drainage from the open drain network is then collected by an underground pipe network which discharges into 2 no. separate large settlement ponds located on the southwest of the bog

¹ ER – Effective Rainfall is the excess rainfall after evaporation which produces overland flow and recharge to groundwater.

for attenuation/treatment, prior to release into the adjacent West Galros Stream. Refer to **Figure D** below for Galros Bog Drainage Map (Source: BnM).

All surface water drainage from the bog surface at the 3 no. proposed turbine locations, including the proposed spoil deposition areas, enter these settlement ponds via the drain network described above.

The southeastern portion of the project site is drained by the Eglish 25 Stream (EPA Name) which flows southerly along the edge of a separate bog to the south of Galros Bog, prior to discharging into the Rapemills River approximately 0.6km to the south of the project site. The grassland area on the southeast of the project site, where the proposed switch room building is located, also drains to the Eglish 25 Stream.

The haul route works at the N62/N52 junction are intercepted by a small watercourse that drains westerly into a wetland area located immediately to the northwest of the road junction.

As stated above, the underground electricity line route runs adjacent to the Rapemills River for approximately 2.5km. Along the proposed route field drains are crossed at most field boundaries where they drain into the Rapemills River.

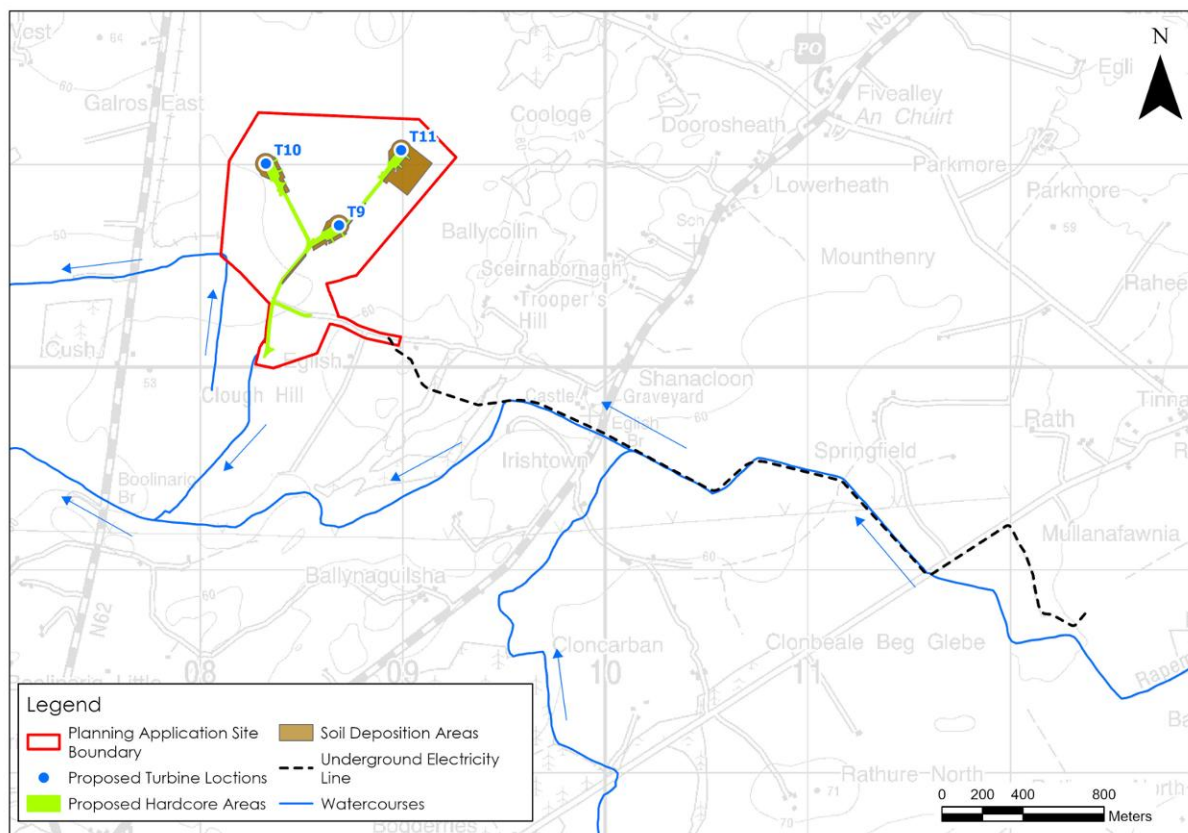


Figure C: Project Site General Drainage



Figure D: Galros Bog Drainage Map (Source: BnM 2026)

3.4 GEOLOGY

GSI subsoils mapping (www.gsi.ie) show that the wind farm site is underlain predominantly by cutover raised peat (Cut) along with Gravels derived from Limestones (GLs) mapped on the southeast of the wind farm site where agricultural lands are present.

Subsoils along the western half of the underground electricity line route are mapped mainly as Gravels derived from Limestones along with two gravel Esker ridges mapped along the proposed route.

Subsoils mapped along the eastern half of the underground electricity line are more variable and comprise cutover raised peat, Gravels and Limestone Tills (glacial tills). Alluvium is also mapped along sections of the Rapemills River. However, due to land improvements, any peat present is limited to shallow peat topsoil.

Much of Galros Bog is now cutaway and the majority of the original raised bog has now been removed. According to the BnM draft bog rehabilitation plan, the western side of Galros Bog has relatively shallow residual peat (<1m). This residual peat is fen peat found in the lower layers of raised bogs. Sections of deeper residual peat remain on the eastern side, with peat thickness of up to 4.5m recorded.

A total of 25 no. peat probes were carried out by FT at the proposed wind farm on 16th March 2026. Peat depths recorded from peat probing across the wind farm ranged from 0 to 5.2m with an average depth of 4m. The areas of deeper peat were recorded within Galros Bog while the shallower peat (<0.3m) was recorded within grassland areas on the south of the proposed wind farm near the switch room building.

Recorded peat depths within Galros Bog are largest on the northeast of the bog near proposed turbine T11 (4.5 -5m) and reduce to <2m at the south periphery of the bog along the proposed wind farm access road alignment. Peat depths recorded at the turbine locations varied from 4.2 to 5.1m with an average depth of 4.8m.

Based on the Cush Wind Farm Phase I site investigations carried out in 2022, the cutover raised bogs typically have the following lithological sequence – peat, shell marl and lacustrine clay. The depth to the base of the lacustrine clay exceeds 5m (depth below ground level) at the previous trial pit locations carried out on cutover bog.

3.5 DESIGNATED SITES & HABITATS

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 project site is not located within any designated conservation-site.

Designated sites in close proximity to the project include Lough Coura pNHA (Site Code: 000909). Lough Coura is located approximately 0.9km to the north of the project site. The project site does not drain into Lough Coura.

As stated previously, the wind farm site and the underground electricity line drains to the Rapemills River, which passes the All Saints Bog and Esker SAC and pNHA (Site Code: 000566) and the All Saints Bog SPA (Site Code:004103) c. 5.5km downstream of the project site.

However, there is no surface water connection between the project site and All Saints Bog and Esker SAC as All Saints Bog discharges into Rapemills River and not vice versa.

Groundwater flow in the area of the project site is likely to be westerly towards All Saints Bog and Esker SAC. However, groundwater flow below Saints Bog will be limited to the deeper glacial deposits which are separated from the overlying bog by very low permeability marl and lacustrine clay deposits which underlies the basin peat in this area.

The Rapemills River ultimately drains into the River Shannon and flows through the River Shannon Callows SAC (Site Code: 00216) and the Middle Shannon Callows SPA (Site Code:004096), which lie approximately 6.8km northwest of the project site.

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4. FLOOD RISK IDENTIFICATION

4.1 INTRODUCTION

The following assessment is carried out in accordance with ‘*The Planning System and Flood Risk Management Guidelines for Planning Authorities*’ (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 project. This report constitutes a Stage 2 site-specific FRA for Cush Wind Farm Phase II. It is informed by the Stage 3 hydraulic modelling prepared for Cush Wind Farm Phase I in 2023 insofar as that modelling covers the overlapping wind farm site and the Rapemills River and West Galros Stream flood mechanisms. The underground electricity line corridor outside the modelled Phase I area has been assessed using NIFM and other mapped flood information. No new Stage 3 modelling is considered necessary because the completed cable will be below ground and will not reduce floodplain storage or impede flood conveyance, while construction-stage risks are addressed in **Section 4.7**.

The primary aim of the assessment is to consider all types of flood risks and the potential impact on the project. As per the relevant guidance (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, 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.*

Due to the project site’s midland location, coastal flooding is not applicable to the project.

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 local 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 Flood Risk Management Guidelines provide direction on flood risk and development. The guidelines recommend a precautionary approach when considering flood risk management and the core principle of the guidelines 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 set out the different types of development appropriate to each identified zone (pg 25, Table 3.1 of the Guidelines). 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 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 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 Soils Maps – Fluvial Maps

A review of the soil types in the vicinity of the project site was undertaken as soils can be a good indicator of past flooding in an area. Due to past flooding of rivers, deposits of transported silts/clays, referred to as alluvium build up within the floodplain and hence the presence of these soils is a good indicator of potentially flood-prone areas.

Based on the EPA/GSI soil map for the area, alluvium soils are not mapped within the wind farm site. However, some alluvium (fluvial deposits) is mapped along the Rapemills River on the east of the project site, which is also the proposed route of the underground electricity line.

4.3.2 Historical Mapping

To identify areas as potentially being at risk of flooding, historical mapping (*i.e.* 6" and 25" base maps) was consulted. There was no identifiable map text on local available historical 6" or 25" mapping for the project site that would identify lands that are "liable to flood".

4.3.3 OPW Past Flood Event Mapping

To identify any areas as being potentially at risk of recurring flooding, OPW's Past Flood Event mapping (www.floodinfo.ie) was consulted.

No past flood incidents within the project site were identified from OPW's Past Flood Event Mapping (refer to **Figure E** below).

The closest mapped past flood event to the project site is located at Fivealley (Flood ID 2904), 2.5km to the east of the wind farm site. According to OPW flood reports, low-lying lands floods on a recurring basis. The project site does not drain towards Fivealley.

The closest mapped downstream flooding event to the project is on the Lower Shannon approximately 12km downstream of the project site.

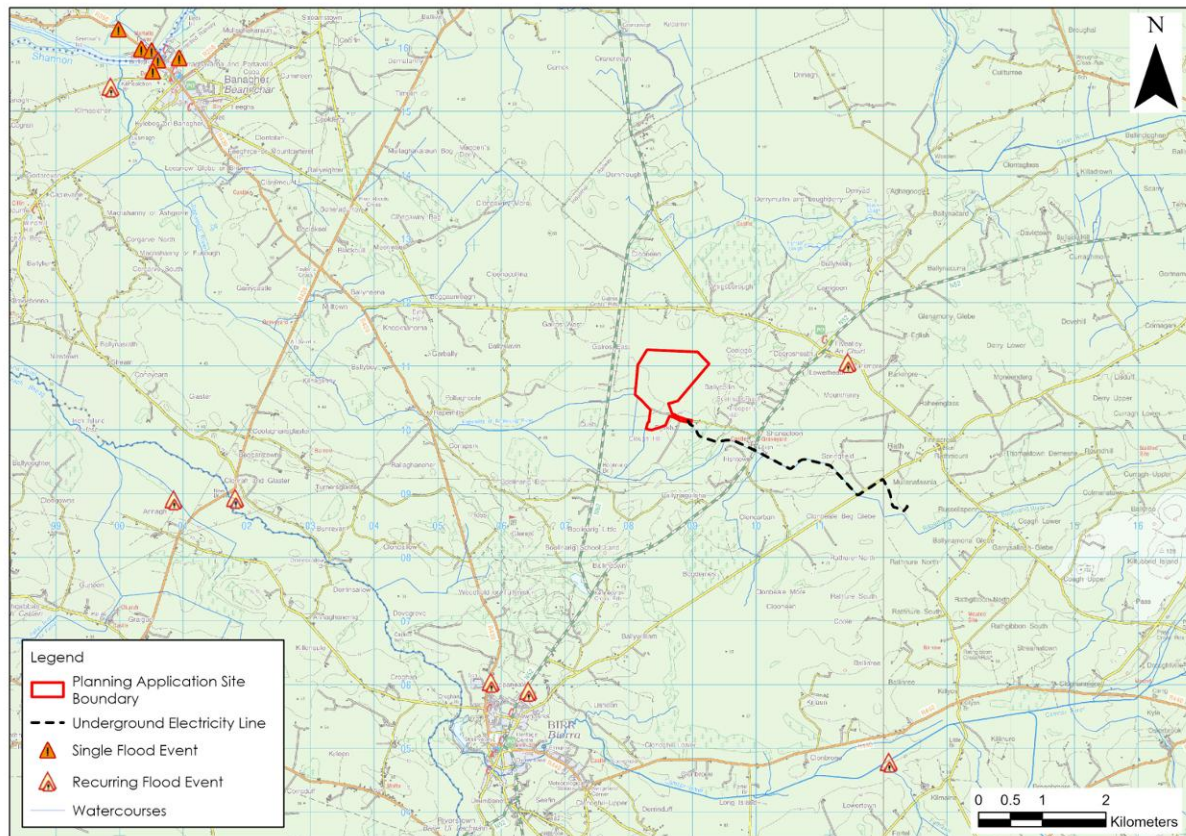


Figure E: OPW Past Flood Event Mapping

4.3.4 Benefiting Lands/Drainage Schemes

The project site is not located within an OPW Arterial Drainage Scheme area or Flood Relief Scheme Benefiting area.

4.3.5 Previous Site-Specific Flood Modelling

Previously, a Stage 3 site specific flood risk assessment including flood modelling was completed by HES in December 2023 for the Cush Wind Farm Phase I². The Stage 3 FRA is applicable to this project as the project site drains to the Rapemills River and Galros Stream.

The Stage 3 site specific flood risk assessment involved detailed site topographic surveys, use of Lidar data and flood flow modelling of the Rapemills River, West Galros Stream and floodplains.

The site specific modelled 100-year and 1000-year flood zones are shown on **Figure F** below. A 20% increase in flows is allowed for climate change.

No part of the wind farm site is located inside the modelled 100-year and 1000-year flood zones which is consistent with the NIFM flood zone mapping (see **Section 4.3.7** below).

Further detailed flood modelling was not carried out for the stretch of the Rapemills River along the underground electricity line route as there is no proposed infrastructure above ground level.

Fluvial flood zones do not present as a constraint to the underground electricity line and therefore an assessment of flood risk posed by the grid connection is not required. (i.e. the underground electricity line is 'water compatible' in terms of flood risk).

² Hydro Environmental Services (December 2023) Proposed Cush Wind Farm Stage 3 Flood Risk Assessment.

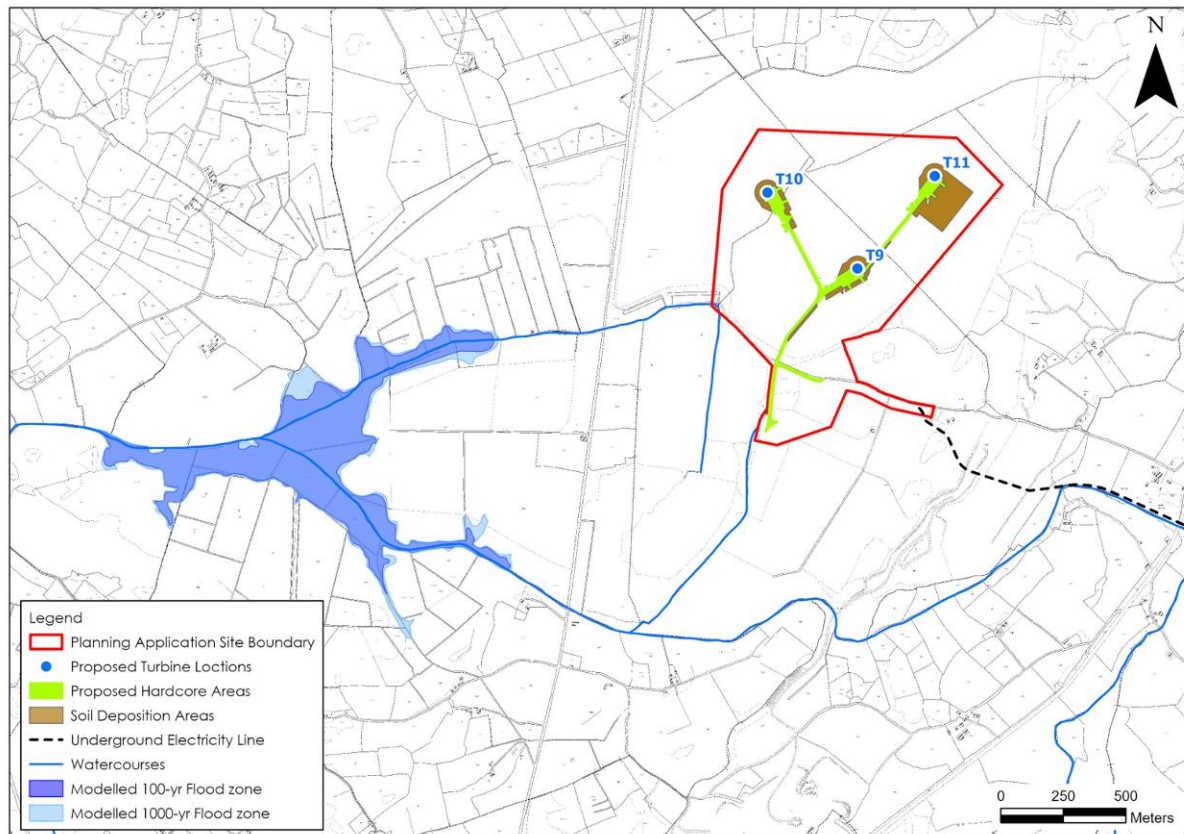


Figure F: Site Specific Flood Modelling (Source: HES 2023)

4.3.6 CFRAM Flood Extent Mapping

Where complete, the Catchment Flood Risk Assessment and Management (CFRAM)³ OPW Flood Extent Maps are now the primary reference for flood risk planning in Ireland. CFRAM mapping is currently not available for the Rapemills River at the location of the project site.

However, there is National Indicative Fluvial Mapping (NIFM) available for the Rapemills River at the project site as discussed in **Section 4.3.7** below.

4.3.7 National Indicative Fluvial Mapping (NIFM)

The National Indicative Fluvial Flood Mapping (www.floodinfo.ie) shows probabilistic fluvial flood zones for catchments greater than 5km² for which flood maps were not produced under the CFRAM Programme.

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 4.3.10** below.)

According to the NIFM, no part of the wind farm site is located within a mapped fluvial flood zone. Therefore, the proposed wind farm site is mapped above the 1000-year flood level and therefore all wind farm infrastructure is located in Flood Zone C (Low Risk).

NIFM flood zones are however mapped along the course of the Rapemills River on the east of the project site which also encroach the proposed underground electricity line route.

However, due to the underground nature of the electricity line, the subsurface infrastructure will have no potential to increase flood risk (i.e. there will be no loss of floodplain storage). The underground electricity line is 'water compatible' in terms of flood risk.

³ 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.

The NIFM fluvial flood zones are shown in **Figure G** below.

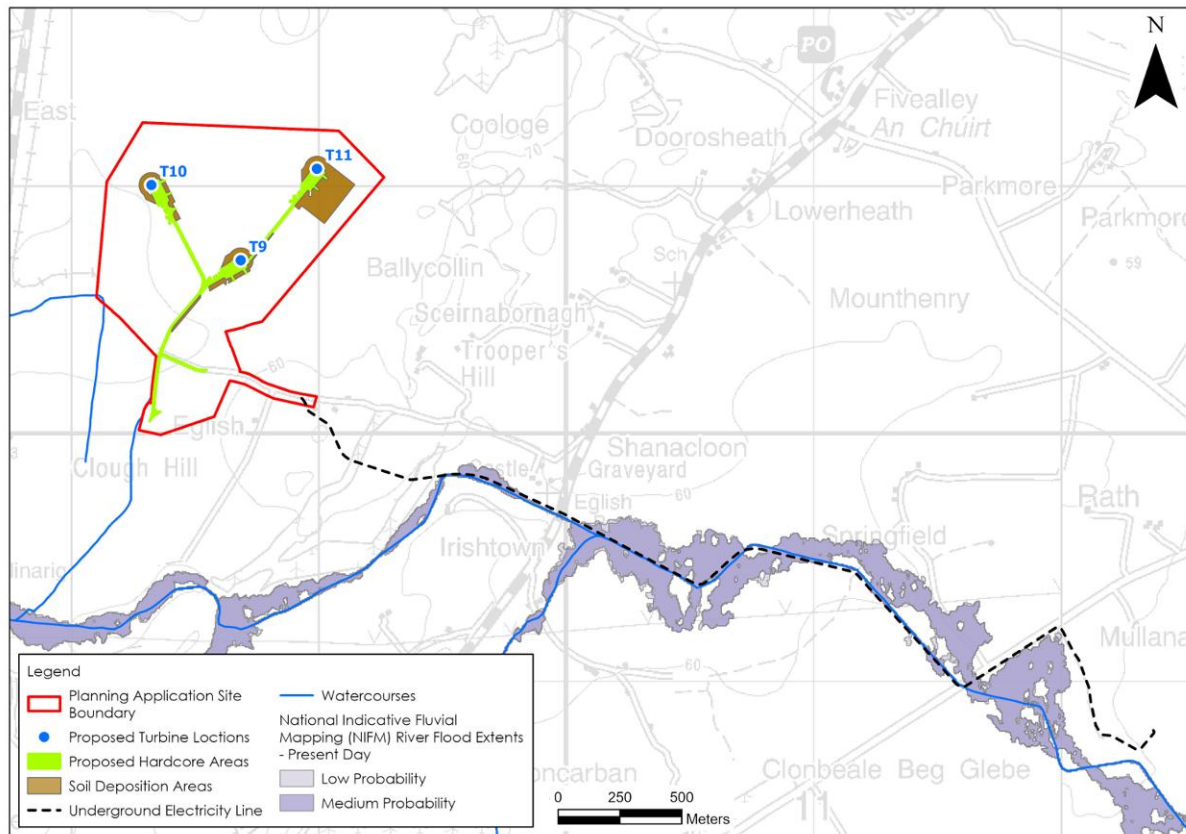


Figure G: NIFM Present Day Mapping

4.3.8 GSI Flood Mapping

The GSI Winter (2015/2016) Surface Water Flooding Map⁴ shows areas of fluvial and pluvial flood extents during the Winter 2015/2016 flood event, which was the largest recorded flood event in many areas.

According to the Geological Survey Ireland (GSI) Winter 2015/2016 Surface Water Flood mapping, localised surface water flooding (ponding) was recorded on the northeast and southwest of Galros Bog within the project site. Refer to **Figure H** below.

Given the flat to undulating topography of the bog surface in areas, localised flooding/ponding would be expected after heavy rainfall events. The mapped surface water flood zones/ponding areas do not significantly interact with the wind farm site infrastructure.

Similarly, the Geological Survey Ireland (GSI) Maximum Historic Groundwater Flood mapping shows some localised groundwater flooding on the south of Galros Bog. Given the low permeability nature of the shell marl and lacustrine clays underlying the peat, the flooding/ponding is likely to be surface water runoff rather than groundwater upwelling/high groundwater table.

⁴ GSI Historical flood mapping principally developed using Sentinel-1 Satellite Imagery from the European Space Agency Copernicus Programme as well as any available historic records (from winter 2015/2016 or otherwise)

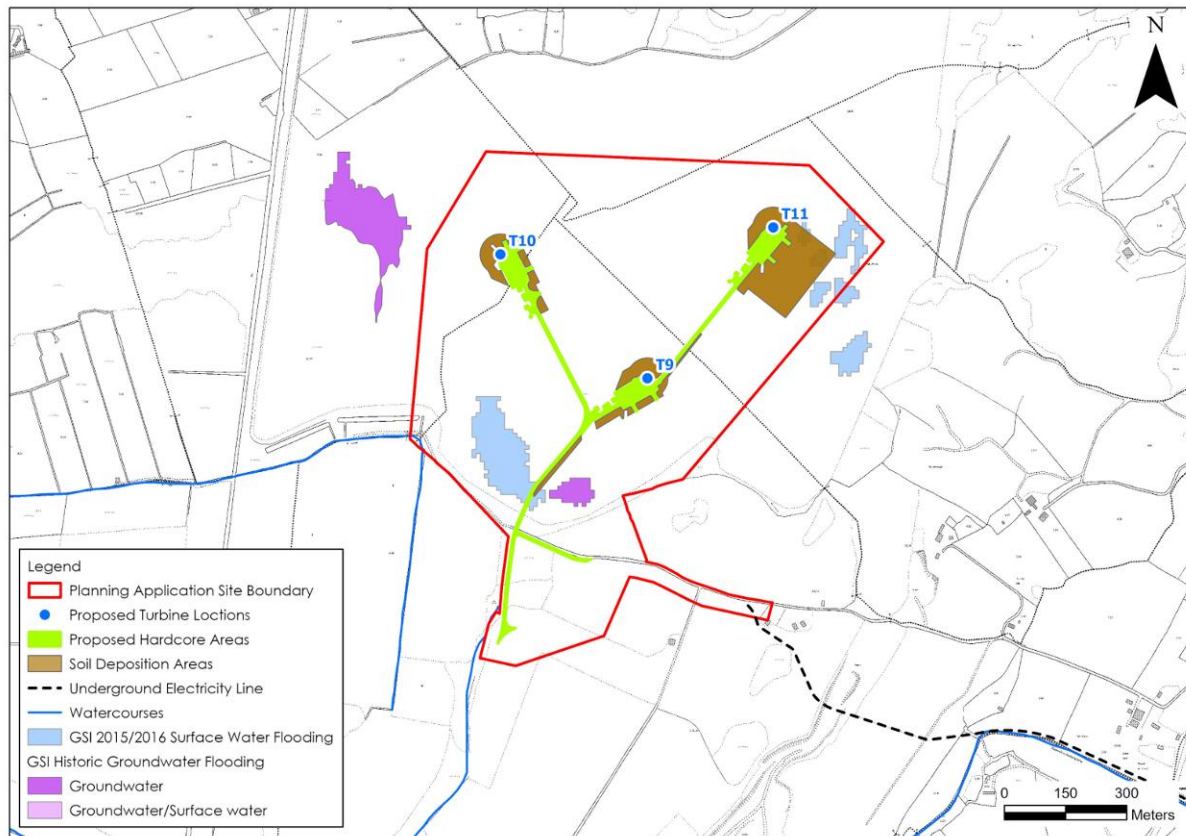


Figure H: GSI Surface Water & Groundwater Flood Mapping

4.3.9 Coastal Flooding

The wind farm site is located 75km inland from the sea and sits at an elevation of between 47 and 56m OD. Therefore, the project site is not at risk of coastal (tidal) flooding.

4.3.10 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 NIFM Mid-Range Future Scenario and High-End Future Scenario apply increases in rainfall of 20% and 30%, respectively. Both scenarios have been reviewed and do not alter the conclusion that the wind farm infrastructure lies in Flood Zone C. Sections of the underground electricity line remain within mapped flood zones, but the completed buried cable will not affect floodplain storage or conveyance.

These future modelled NIFM flood extents show similar flood zones along the Rapemills River to the Present Day Scenario discussed above in Section 4.3.7. Therefore, the fluvial flood zones are unlikely to be significantly impacted by future climate change and will remain distant from the wind farm site.

Therefore, NIFM flood zones downstream of the project site are unlikely to be significantly impacted by future climate change.

4.3.11 Summary – Flood Risk Identification

Based on the information gained through the flood identification process it is apparent that the wind farm site is located in Fluvial Flood Zone C, where the probability of flooding is low.

Sections of the underground electricity line are located in Fluvial Flood Zone A.

The proposed haul route alteration works have been scoped out for assessment as these work areas are along established public transport routes, and with the proposed alterations being relatively minor in nature, they do not have the potential to alter the hydrological regime and increase flood risk.

4.4 INITIAL FLOOD RISK ASSESSMENT

4.4.1 Hydrological Flood Conceptual Model

Potential flooding in the vicinity of the project site can be described using the Source – Pathway – Receptor Model (S-P-R).

There are no identified sources of fluvial flooding at the wind farm site. Localised surface water ponding is likely to persist temporarily after heavy rainfall events.

Groundwater flooding is also not considered a likely risk at the project site due to the hydrogeological setting.

4.4.2 Summary – Initial Flood Risk Assessment

Based on the information gained through the flood identification process and Initial Flood Risk Assessment process it has been determined that flooding is unlikely to pose a high risk at the wind farm site.

The Rapemills River is a potential source of fluvial flooding along the underground electricity line route, albeit the potential flooding will not pose a risk to the project.

All potential sources of flood risk for the project site are outlined and summarised in **Table B**.

Table B. S-P-R Summary of Flood Risk at the Project Site

Source	Pathway	Receptor	Comment
Fluvial	Overbank flooding of the rivers and streams	Land & infrastructure	The wind farm site is located in Fluvial Flood Zone C where there is a low risk of fluvial flooding. NIFM flood zones are mapped along the course of the Rapemills River to the east of the project site which also encroach the proposed underground electricity line route
Pluvial	Ponding of rainwater on site	Land & infrastructure	According to the GSI Winter 2015/2016 Surface Water Flood mapping, localised surface water flooding (ponding) was recorded on the northeast and southwest of Galros Bog within the project site. Ponding is likely to persist temporarily after prolonged heavy rain
Surface water	Surface ponding/ Overflow	Land & infrastructure	Same as above (pluvial).
Groundwater	Rising groundwater levels	Land & infrastructure	GSI Maximum Historic Groundwater Flood mapping show some localised groundwater flooding on the south of Galros Bog. Given the low permeability nature of the shell marl and lacustrine clays underlying the peat, the flooding/ponding is likely to be surface water runoff rather than a high groundwater table.
Coastal/tidal	Overbank flooding	Land, People, property	The project site is located in the midlands so no coastal flooding will be possible.

4.5 REQUIREMENT FOR A JUSTIFICATION TEST

The matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test⁵ is shown in **Table C** below. This table is adapted from Table 3.2 of the PSFRM Guidelines (DoEHLG, 2009).

It may be considered that the wind farm site infrastructure can be categorised as “Highly Vulnerable Development”, while the underground electricity line is a “Water Compatible Development” due to the subsurface nature of the sealed/insulated electrical cable.

The wind farm site is located in Flood Zone C (Low Risk). Therefore, the wind farm site is appropriate from a flood risk perspective. A Justification Test is not required.

The underground electricity line is a “Water Compatible Development” and therefore is appropriate for high to medium risk flood zones. A Justification Test is not required.

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	<u>Appropriate</u>
Less vulnerable development	Justification test	Appropriate	Appropriate
Water Compatible development	<u>Appropriate</u>	<u>Appropriate</u>	Appropriate

Note: Taken from Table 3.2 (DoEHLG, 2009)

Bold: Applies to this project.

4.6 PROPOSED WIND FARM DRAINAGE

The development of the project site means that there will be an increase in hardstand/roofed areas. However, the existing green areas at the project site are formed mainly from peat soils with a naturally high runoff potential. The project site is not steeply sloping, and the slope of the ground will dampen the limited potential for runoff.

The permanent wind farm infrastructure will increase the area of lower-permeability surface. Although the underlying peat already has a high runoff coefficient and the site is generally flat, the development could locally alter runoff pathways and increase ponding if unmanaged. The drainage design will therefore collect, treat and attenuate runoff and limit discharge to greenfield rates. Quantification is provided in **Chapter 7 of the project EIAR**, which identifies a maximum assumed permanent physical footprint of c. 2.33 ha and an average December runoff increase of c. 2.7 m³/day, equivalent to approximately 0.11%, before attenuation.

Nevertheless, the overarching objective of the proposed drainage measures is to ensure that all surface water runoff is comprehensively treated and attenuated such that no silt or sediment laden waters or deleterious material is discharged into the local drainage system. A Planning-Stage SWMP, incorporating the surface water drainage design has been prepared, see **Annex 3.4 of the project EIAR**, and incorporates the principles of Sustainable Drainage Systems (SuDS) through an arrangement of surface water drainage infrastructure. The SWMP has regard to Greenfield runoff rates and is designed to mimic same and is sufficient to accommodate a 1-in-100 year rainfall event.

⁵ 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).

While the SuDS is an amalgamation of a suite of drainage infrastructure; the overall philosophy is straightforward. In summary:

- All surface water runoff will be directed to specially constructed swales surrounding all areas of ground proposed to be disturbed (including the area for the temporary storage of material);
- The swales will direct runoff into settlement ponds/silt traps where silt/sediment will be allowed to settle;
- Following treatment, clean water will be discharged indirectly to the local drainage network via buffered outfalls thus ensuring that no scouring occurs.

The suite of surface water drainage infrastructure will include interception drains, collector drains, swales, sediments, flow attenuation and filtration check dams, settlement ponds/silt traps, and buffered outfalls.

The design criteria implemented as part of the SuDS are as follows:

- To minimise alterations to the ambient site hydrology and hydrogeology;
- To provide settlement and treatment controls as close to the site footprint as possible and to replicate, where possible, the existing hydrological environment of the site;
- To minimise sediment loads resulting from the development run-off during the construction phase;
- To preserve greenfield runoff rates and volumes;
- To strictly control all surface water runoff such that no silt or other pollutants shall enter watercourses and that no artificially elevated levels of downstream siltation or no plumes of silt arise when substratum is disturbed;
- To provide settlement ponds to encourage sedimentation and storm water runoff settlement;
- To reduce stormwater runoff velocities throughout the site to prevent scouring and encourage settlement of sediment locally;
- To manage erosion and allow for the effective revegetation of bare surfaces;
- To manage and control water within the site and allow for the discharge of runoff from the site below the MAC of the relevant surface water regulation value; and,
- The high sensitivity of downstream receptors along with WFD status.

The proposed drainage regime for the wind farm site has been developed having regard to the existing drainage characteristics of Galros Bog and the wider rehabilitation and environmental stabilisation objectives identified in the draft Galros Bog Rehabilitation Plan (2026), included at **EIAR Annex 6.2**. The drainage design seeks, insofar as practicable, to work with the existing hydrological regime rather than fundamentally alter it. Existing drainage pathways have therefore been retained and integrated into the proposed drainage arrangement where appropriate, while clean runoff will be kept separate from water arising within construction areas and potentially sediment-laden runoff will be collected, attenuated and treated prior to controlled discharge.

4.7 FLOOD FORECASTING

NIFM fluvial flood zones are mapped along the course of the Rapemills River to the east of the wind farm site which encroach the proposed underground electricity line route.

Despite the high-risk flood zone mapping along the underground electricity line route, the likelihood of an extreme flood event (i.e. >10-year return period) happening during the construction phase of the underground electricity line is very low. Also, the underground nature of the works, means that there will be no permanent or fixed project infrastructure at ground level that would be at risk of flooding itself or increasing flood risk downstream.

However, there is a flood risk to temporary works such as excavations, temporary stockpiles and also to people and plant.

The first point of mitigation is ongoing monitoring of weather forecasts and weather warnings. The project Environmental Manager (EM) or the site Ecological Clerk of Works (ECow) will be responsible for monitoring weather forecasts during the construction phase.

When the forecast indicates rainfall exceeding any of the works-suspension thresholds set out above, or where a Met Éireann Status Yellow or higher rainfall warning is issued, the planned responses detailed below will be implemented.

A potential high intensity rainfall event would likely be identified 3-5 days in advance, with more accurate forecasts of severity within 24-48 hours of occurrence. Preparations for a flood event would begin from the initial indications that there may be a high rainfall event. This would allow time for the preparation and the implementation of additional emergency mitigation measures.

A managed retreat from the fluvial flood zone will be implemented in the event of a forecasted high intensity rainfall event and/or weather warning related to rainfall. This will include the following:

- Any areas where soil/subsoil is exposed at the surface will be compacted firmly with a digger bucket of a suitably sized excavator.
- Open trenches will be backfilled and compacted.
- Existing sediment control measures will be removed, as these may be washed away and deposited elsewhere by the floodwaters.
- All plant, machinery and equipment will be removed from the flood zones.
- Works will be postponed in the event of flood or high flows in the river.

Exposed soils/peat (exposed temporary stockpiles) will be covered with plastic sheeting during all relatively heavy rainfall events and during periods where works have temporarily ceased before completion at a particular area (e.g., overnight and weekends).

Cessation of all construction works until the storm event, including the storm runoff has passed. All construction works will cease during storm events such as yellow warning rainfall events. Following heavy rainfall events, and before construction works recommence, the project site will be inspected and corrective measures implemented to ensure safe working conditions e.g. dewatering of standing water in open excavations, etc.

5. PLANNING POLICY AND JUSTIFICATION TEST

5.1 PLANNING POLICY AND THE OFFALY COUNTY DEVELOPMENT PLAN

The following policies are defined in the Offaly CDP 2021-2027 (**Table D**) in respect of flooding, and we have outlined in the column to the right how these policies are provided for within the Proposed Development design:

Table D: Offaly County Development Plan Objectives/Policies and Project Responses

No.	Policy	Development Design Response
CAEP-67	It is Council policy to minimise and limit the extent of hard surfacing and paving and require the use of sustainable urban drainage systems (SuDS) where appropriate, for new developments or for extensions to existing developments, in order to reduce the potential impact of existing and predicted flooding risks.	The proposed development will include the use of SuDS and drainage improvement works to mitigate against any potential flooding and pollution at the project site. Refer to Section 4.6 above.
CAEP-55	The assessments shall consider and provide information on the implications of climate change with regard to flood risk in relevant locations. The 2009 OPW Draft Guidance on Assessment of Potential Future Scenarios for Flood Risk Management (or any superseding document) and available information from the CFRAM Studies shall be consulted with to this effect."	This assessment considers the potential effect of Climate change with regard to flood risk. A 20 to 30% increase is applicable for the lifetime of the wind farm.
18.8.3 Flood Risk Assessment	Development proposals within these areas shall be accompanied by a detailed Flood Risk Assessment, carried out in accordance with The Planning System and Flood Risk Assessment Guidelines and Circular PL 2/2014 (or as updated), which shall assess the risks of flooding associated with the proposed development.	<p>This FRA is consistent with the requirements for a flood risk assessment as in line with the recommendations as part of the Offaly County Development Plan 2021-2027.</p> <p>This FRA is consistent with the requirements of the "Planning System and Flood Risk Management – Guidelines for Planning Authorities" and the Strategic Flood Risk Assessment (SFRA).</p>
18.8.3 Flood Risk Assessment	All development proposals within or incorporating areas at moderate to high risk of flooding will require site specific and appropriately detailed Flood Risk Assessments.	<p>This FRA is consistent with the requirements for a flood risk assessment as in line with the recommendations as part of the Offaly County Development Plan 2021-2027.</p> <p>A detailed site specific assessment is fully outlined above in Section 4.0.</p>
18.8.3 Flood Risk Assessment	All development proposals within or incorporating areas at moderate or high risk of flooding will require the application of the Development Management Justification Test in accordance with the Planning System and Flood Risk Management-Guidelines for Planning Authorities (DEHLG and OPW, 2009).	The underground electricity line is a "Water Compatible Development" and therefore is appropriate for high to medium risk flood zones. A Justification Test is not required.

6. CONCLUSIONS

- A flood risk identification study was undertaken to identify any existing potential flood risks at the project location:
 - No instances of historical flooding were identified in historic OS maps within the wind farm site or underground electricity line;
 - No instances of recurring flooding were identified on OPW maps within the wind farm site or underground electricity line;
 - The GSI Winter 2015/2016 Surface Water Flooding and Groundwater Flood mapping suggests there is a potential for temporary localised flooding at the wind farm site
 - No CFRAM or NIFM fluvial flood zones are mapped within the wind farm site.
 - NIFM fluvial flood zones are mapped along the underground electricity line route;
- This report constitutes a Stage 2 site-specific FRA, informed by the 2023 Stage 3 modelling for the overlapping Cush Wind Farm Phase I site. The completed underground electricity line will be below ground and will not materially affect floodplain storage or conveyance. Temporary construction-stage flood risk associated with the underground electricity line and HDD works will be controlled through the measures set out in **Section 4.7** and the CEMP.
- The wind farm site is located in Flood Zone C (Low Risk). Therefore, the wind farm site is appropriate from a flood risk perspective. A Justification Test is not required.
- Due to the underground nature of the electricity line, the subsurface infrastructure will have no potential to increase flood risk (i.e. there will be no loss of floodplain storage)
- The underground electricity line is a “Water Compatible Development “and therefore is appropriate for high to medium risk flood zones. A Justification Test is not required.
- A Planning-Stage SWMP, incorporating the surface water drainage design has been prepared for the project and incorporates the principles of Sustainable Drainage Systems (SuDS);
- Flood/adverse weather forecasting along with managed retreat (if needed) will be employed during the construction phase to reduce the risk of flooding along the underground electricity line; and,
- This FRA fulfils the requirements for a site-specific flood risk assessment and is consistent with the recommendations made in the Offaly CDP and Strategic Flood Risk Assessment (2021-2027).

7. REFERENCES

AGMET	1996	Agroclimatic Atlas of Ireland.
Offaly County Council	2021	Offaly County Development Plan 2021-2027.
DOEHLG	2009	The Planning System and Flood Risk Management.
Met Eireann	1996	Monthly and Annual Averages of Rainfall for Ireland 1961-1990.
OPW	2016	Shannon Catchment-Based Flood Risk Assessment and Management Study – Hydrology Report Unit of Management 25/26
HES	2023	Proposed Cush Wind Farm Stage 3 Flood Risk Assessment
BnM	2026	Draft Cutaway Bog Decommissioning and Rehabilitation Plan