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TIRAWLEY WIND FARM DEVELOPMENT, CO. MAYO

STAGE II - FLOOD RISK ASSESSMENT

FINAL REPORT

Prepared for:
JENNINGS O'DONOVAN AND PARTNERS LIMITED

Prepared by:
Hydro-Environmental Services

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This report has been prepared by HES with all reasonable skill, care and diligence within the terms of the contract with the client, incorporating our terms and conditions and taking account of the resources devoted to it by agreement with the client. We disclaim any responsibility to the client, and others in respect of any matters outside the scope of the above. The flood risk assessment undertaken as part of this study is site-specific, and the report findings cannot be applied to other sites outside of the survey area which is defined by the site boundary. This report is confidential to the client and we accept no responsibility of whatsoever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies upon the report at their own risk.

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1. INTRODUCTION

1.1 BACKGROUND

Hydro-Environmental Services (HES) were requested by Jennings O'Donovan and Partners Limited to undertake a site specific, Stage II Flood Risk Assessment (FRA) for the proposed Tirawley Wind Farm Development (*i.e.* the 'Development'), Co. Mayo.

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 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.

This report was prepared by Michael Gill, Conor McGettigan and Jenny Law.

Michael Gill (BA, BAI, Dip Geol., MSc, MIEI) is an Environmental Engineer and Hydrogeologist with over 22 years' environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological impact assessments of wind farms and renewable projects in Ireland, as well as accompanying Flood Risk Assessments. 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 for Oweninny WF, Cloncreen WF, and Yellow River WF, and over 100 other wind farm-related projects.

Conor McGettigan (BSc, MSc) is an Environmental Scientist with over 5 years' experience in the environmental sector in Ireland. Conor holds an M.Sc. in Applied Environmental Science and a B.Sc. in Geology from UCD. Conor has prepared the Hydrology and Hydrogeology chapter of Envionmental Impact Assessment Reports (EIARs) for numerous wind farm developments, grid connections and quarries. Conor has worked on several wind farm EIAR projects and associated Flood Risk Assessments.

Jenny Law (BSc, MSc) is an environmental geoscientist holding a first honour's degree in applied environmental geosciences from the UCC (2022). Jenny has assisted in the preparation of the land, soils and geology and hydrology chapters for various environmental impact assessment reports, hydrological impact assessments, Water Framework Directive Assessment reports and Flood Risk Assessment reports for a variety of projects including wind farm developments and strategic housing developments.

1.3 REPORT LAYOUT & METHODOLOGY

This Stage II FRA report has the following format:

- Section 2 describes the site setting and details of the Proposed Development;
- Section 3 outlines the hydrological and geological characteristics of the local surface water catchments in the vicinity of the Proposed Development site;
- Section 4 deals with a site-specific flood risk assessment (FRA);
- Section 5 presents the Proposed Development in terms of local flood risk planning policies and presents a Justification Test for the Proposed Development;

- Section 6 presents the drainage design for the Proposed Development in terms of flood prevention; and,
- Section 7 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 and field surveys:

- Base maps – Ordnance Survey of Ireland;
- Geological Survey of Ireland (GSI) maps on superficial deposits (www.gsi.ie);
- EPA hydrology maps (www.catchments.ie);
- OPW Flood Hazard Maps and flooding information for Ireland (www.floodinfo.ie);
- National Indicative Fluvial Mapping (released early 2022) (available to view at www.floodinfo.ie);
- CFRAM mapping;
- Mayo County Development Plan (2022-2028); and,
- Site Walkover, drainage mapping and flow monitoring completed by HES on 3rd – 5th August 2022, 29th November – 1st December 2022, 30th March 2023 and 20th April 2023.

2. BACKGROUND INFORMATION

This section provides details on the topographical setting of the Site along with a description of the Proposed Development.

2.1 SITE LOCATION AND TOPOGRAPHY

The Wind Farm Site is located ~14.5km northwest of Ballina Town, ~5.2km northwest of the village of Killala and ~2.4km east of Ballycastle village in north Co. Mayo. The Wind Farm Site is located ~10.5km east of the county border between Mayo and Sligo. The Wind Farm Site has a total area of ~119.12ha.

The Wind Farm Site is typically comprised of peat bogs, coniferous forestry and agricultural land. Land cover at the Wind Farm Site is mapped by Corine (2018) as inland wetland peat bogs, with some smaller areas of coniferous forestry, semi natural areas and agricultural pastures (www.epa.ie). No significant land use changes have been recorded by historic Corine mapping (1990-2018). Land cover at the Wind Farm Site has been verified by site walkover surveys completed by HES. The south of the Wind Farm Site contains more agricultural land with fields separated by hedgerows and local pockets of coniferous forestry.

The Wind Farm Site is accessed via several local roads which branch off the R314 which joins Killala in the southeast to Ballycastle in the northwest. These local roads serve numerous dwellings and associated farm buildings scattered in lands surrounding the Wind Farm Site.

Topography across the Wind Farm Site is variable, ranging from ~20 to 155mOD (meters above Ordnance Datum). The north and center of the Wind Farm Site are located on elevated ground. The greatest elevations are found in the north of the Wind Farm Site, which is situated on the southeastern slopes of Knockboha Hill, which stands at an elevation of ~186mOD. There are also several other local high points further to the south which range in elevation from ~108 to 137mOD. Meanwhile, the southern section of the Wind Farm Site is located on lower ground with topography sloping gently to the southeast towards Cloonaghmore Estuary and Killala Bay.

The Grid Connection is ~13.55km in length. The Grid Connection generally follows local public roads which connect the proposed on-site substation, in the townland of Barroe, to the existing Tawnaghmore 110kV substation, located ~2km south of Killala village.

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

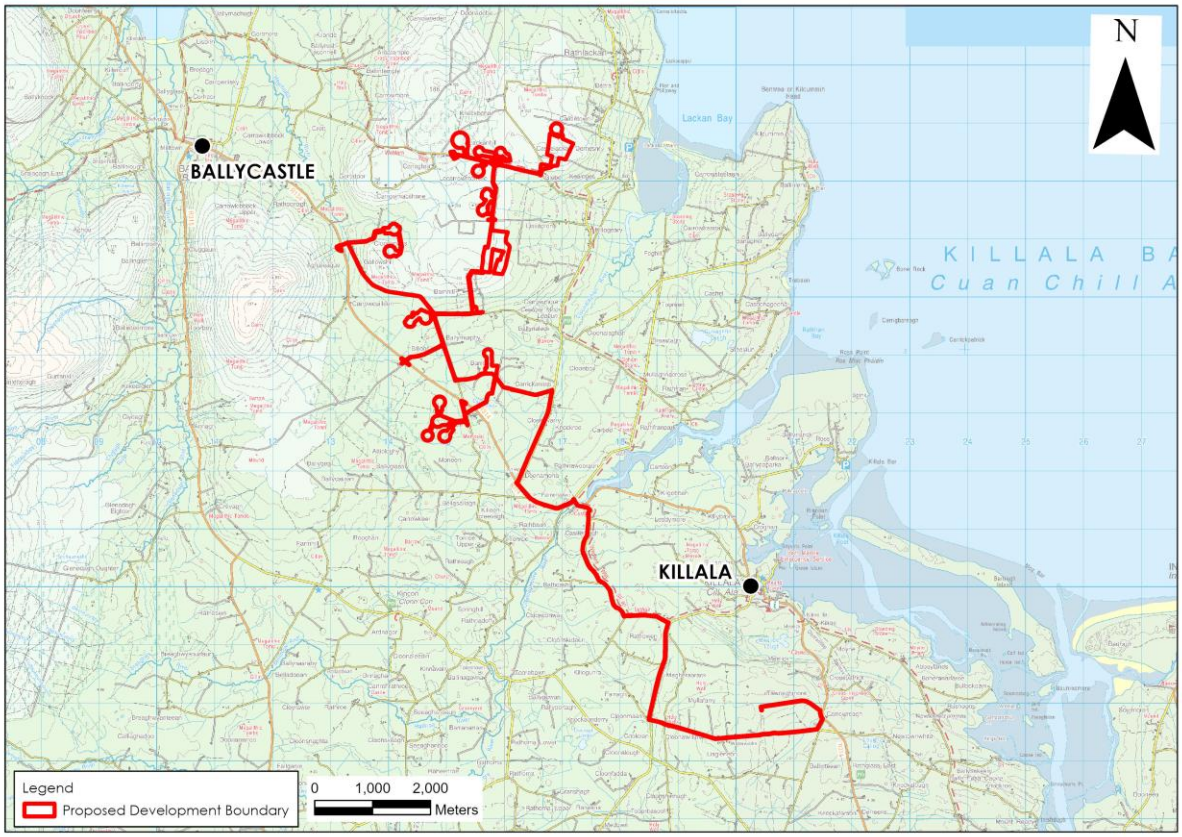

Figure A: Site Location Map

2.2 DEVELOPMENT DETAILS

The Proposed Development comprises the erection of 18 no. turbines and associated hardstands and Turbine Foundations. 18 no. Vestas V117 turbines are proposed and will have a blade tip height of 135m.

The Proposed Development also includes a meteorological mast, an onsite substation and associated compound, a BESS compound, 2 no. Temporary Construction Compounds, a permanent operations building, spoil deposition area (19 no.) and the construction of new internal Site Access Tracks and the upgrade of existing Site Access Tracks and public roads. The Proposed Development will connect to the national grid via an underground connection from the proposed onsite substation to the existing Tawnaghmore 110kV substation in the townland of Tawnaghmore Upper. The Proposed Development also includes all associated site preparation and drainage works. Furthermore, the Proposed Development includes works along the turbine delivery route.

A full description of the Proposed Development is provided in Chapter 2: Development Description of this EIAR.

3. EXISTING ENVIRONMENT AND CATCHMENT CHARACTERISTICS

This section gives an overview of the hydrological and geological characteristics in the area of the Proposed Development.

3.1 BASELINE HYDROLOGY

3.1.1 Regional and Local Hydrology

On a regional scale, the Wind Farm Site is located in the Blacksod-Broadhaven Bay surface water catchment within Hydrometric Area 33 of the Western River Basin District. The Blacksod-Broadhaven catchment includes the area drained by all streams entering tidal water in Blacksod and Broadhaven Bays and between Corraun Point and Benwee Head, Co. Mayo, draining a total area of 1,302km² (EPA, 2021). The Wind Farm Site is also mapped in the Glencullin River sub-catchment (Glencullin[NorthMayo]_SC_010) in accordance with WFD mapping.

More locally the Wind Farm Site is mapped in 3 no. WFD river sub-basins:

- The majority of the Wind Farm Site is located in the Cloonalaghan_010 river sub-basin. This area is drained by the Carn River and several 1st and 2nd order streams all of which discharge into the Cloonalaghan River. The Cloonalaghan River flows to the northeast ~130m east of the wind turbine AT01 before discharging into Lackan Bay.
- The northeast of the Wind Farm Site is located in the Knockboha_010 river sub-basin. This area is drained by several 1st and 2nd order streams which flow downslopes (i.e. to the north and east) before discharging into the Atlantic Ocean. The primary mapped watercourse is the Knockboha stream (EPA name). The watercourses in the vicinity of the Wind Farm Site are locally unnamed and are referred to by the EPA as the Castletown stream. This watercourse is mapped to originate ~180m east of the Wind Farm Site and ~250m northeast of wind turbine AT17.
- The west of the Wind Farm Site is located in the Gortmore Stream_010 river sub-basin. This area is drained by a small stream, referred to by the EPA as the Lecarrowntemple Stream. This stream flows to the east ~150m north of wind turbine AT08 before discharging into the Heathfield River to the Wind Farm Site. The Heathfield River, referred to as the Gortmore Stream by the EPA, flows to the north before discharging into Bunatrahir Bay.

With respect to the Grid Connection, the north of the route, in the vicinity of the Wind Farm Site, is located in the Blacksod-Broadhaven Bay surface water catchment and drains to the Cloonaghlaghan River. Further south, the majority of the Grid Connection is mapped in the Moy and Killala Bay surface water catchment and is drained by the Cloonaghmore River. A small section in the east of the Grid Connection is drained by the Moyne Stream.

A local hydrology map of the area is shown as **Figure B.**

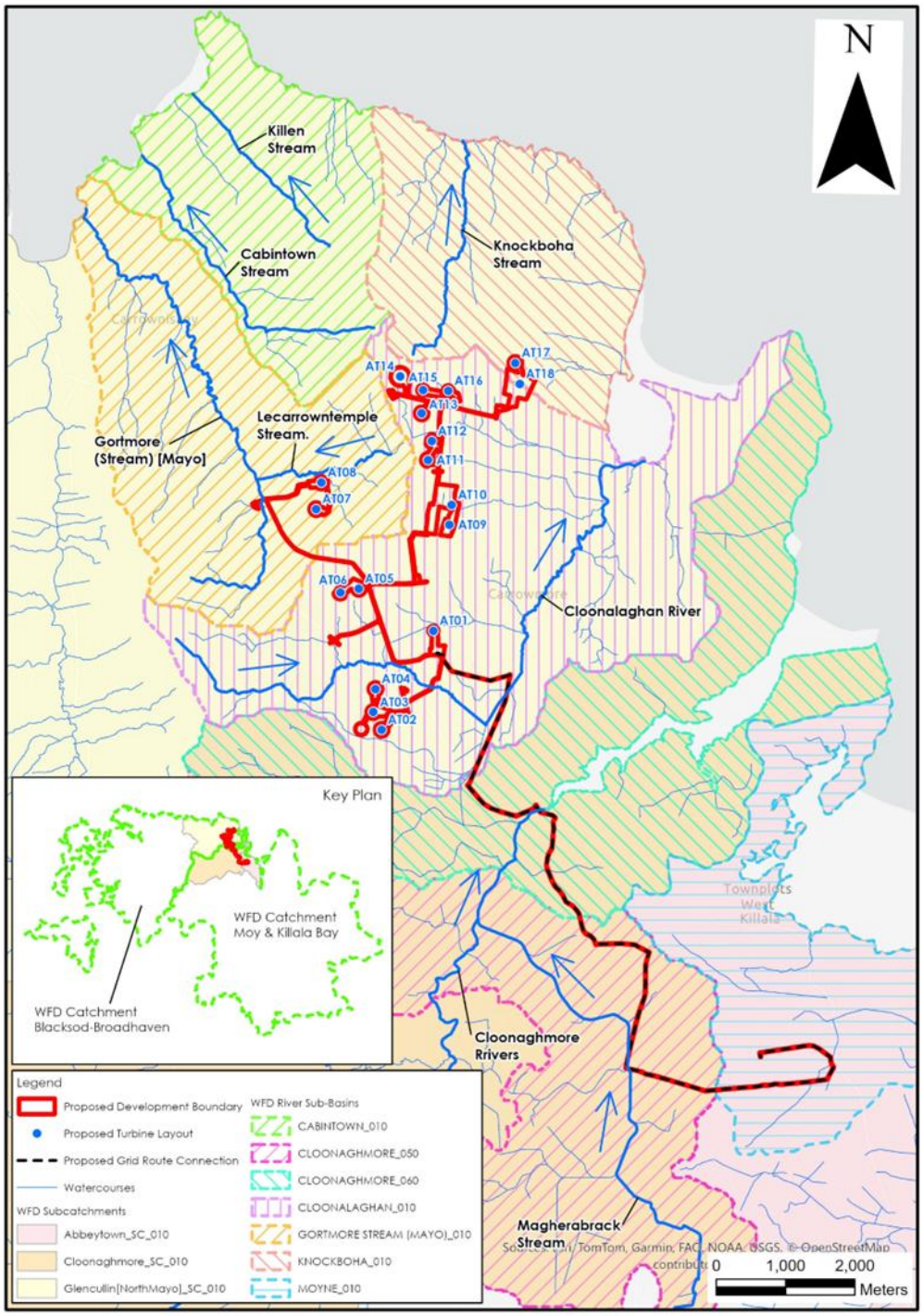

Figure B: Local Hydrology Map

3.1.2 Wind Farm Site Drainage

As discussed above, the Wind Farm Site is drained by several 1st or 2nd order streams. Many of these natural watercourses originate with the Wind Farm Site and flow downslope before discharging into the Cloonalaghan River to the southeast, the Heathfield River to the west or directly into the Atlantic Ocean.

In places the natural drainage is further facilitated by a network of manmade drains. The nature of these drains depend on local landuse.

In agricultural lands, drainage is facilitated by field drains that are typically routed along hedgerows and field boundaries. These drains discharge locally to nearby streams.

In forested areas drainage is facilitated by forestry drainage. The forest plantations are generally drained by a network of mound drains which typically run perpendicular to local topographic contours and feed into collector drains, which discharge to interceptor drains down-gradient of the plantation. Mound drains and ploughed ribbon drains are generally spaced approximately every 15m and 2m respectively. Interceptor drains are generally located up-gradient (cut-off drains) and down-gradient of forestry plantations. Interceptor drains are also located up-gradient of forestry access roads. Culverts are generally located at stream crossings and at low points under access roads which drain runoff onto down-gradient forest plantations. The forestry drains flow towards and discharge into natural streams downstream of the plantations.

2 no. rounds of surface water flow monitoring were completed at the main streams draining the Wind Farm Site and Grid Connection and the results are shown in **Table A** below. The measured flows at most locations are typical of seasonal flows for small streams. The largest flows were at SW4 on the Heathfield River, SW7 on the Cloonalaghan River and SW10 on the Cloonaghmore River with these flows being representative of larger watercourses.

Table A: Surface Water Flow Measurements (L/s)

Location	30/03/2023	20/04/2023
SW1	~15	~8
SW2	~12	~8
SW3	~8	~2
SW4	~80	~50
SW5	~15	~10
SW6	~12	~8
SW7	~30	~30
SW8	~5	~2
SW9	~10	~12
SW10	~1,000	~1,000

3.1.3 Rainfall and Evaporation

The SAAR (Standard Average Annual Rainfall) recorded at Ballycastle G.S., approximately 3km west of the Wind Farm Site, is 1,456mm (www.met.ie). Met Éireann also provide a grid of average annual rainfall for the entire country for the period of 1991 to 2020. Based on this more site-specific modelled rainfall values, the average annual rainfall at the Wind Farm Site ranges from 1,354 to 1,437mm/year. The average annual rainfall is 1,395mm/yr (this is considered to be the most accurate estimate of average annual rainfall from the available sources).

The average potential evapotranspiration (PE) at Belmullet, approximately 45km west of the Wind Farm Site, is 527mm/year (www.met.ie). The actual evapotranspiration ("AE") is

calculated to be 501mm/year (95% PE). Using the above figures the effective rainfall ("ER") for the area of the Wind Farm Site is calculated to be (ER = SAAR – AE) 894mm/year.

Groundwater recharge coefficient estimates are available from the GSI (www.gsi.ie). Within the Wind Farm Site recharge coefficients range from ~4-85%. The majority of the Wind Farm Site is mapped in areas of low groundwater recharge (10-22.5%) due to the presence of peat and moderately permeable subsoils. Some areas in the northeast of the Wind Farm Site, in the vicinity of the disused quarry, have higher percentages of groundwater recharge (85%) due to the presence of rock close to the surface.

Based on recharge coefficient estimates from the GSI (www.gsi.ie), an estimate of 15% recharge is taken for the Wind Farm Site as an overall average. A recharge coefficient at the lower end of the GSI scale was chosen due to the coverage of peat and poorly draining soils across much of the Wind Farm Site, the sloping nature of the area and the low to moderate permeability of the underlying bedrock aquifers. This means that the hydrology of the Wind Farm Site is characterised by relatively high surface water runoff rates and low rates of groundwater recharge. This is supported by on-site observations made during the site walkovers surveys whereby a high density of streams and drainage features were recorded.

Therefore, conservative annual recharge and runoff rates for the Wind Farm Site are estimated to be 135mm/year and 763mm/year respectively.

Table B below presents return period rainfall depths for the area of the Wind Farm 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). These extreme rainfall depths will be the basis of the proposed Wind farm drainage hydraulic design as described further below.

Table B: Rainfall Return Period Depths for Wind Farm Site

	Return Period (Years)			
Duration	**1**	**5**	**30**	**100**
5 mins	3.8	6.7	12.0	17.1
15 mins	6.2	11.0	19.6	28.1
30 mins	8.1	14.0	24.6	34.8
1 hour	10.6	17.9	30.8	43.0
6 hours	21.1	33.8	55.0	74.4
12 hours	27.5	43.3	68.9	91.9
24 hours	35.8	55.3	86.3	113.7
2 days	45.0	66.6	99.7	128.1

3.2 GEOLOGY

The published GSI/Teagasc soils map (www.gsi.ie) for the area show that the Wind Farm Site is overlain by blanket peat and main acidic poorly drained mineral soils (AminPD). No mineral alluvium deposits are mapped on any of the watercourses draining the Wind Farm Site.

The published subsoil map (www.gsi.ie) for the local area shows that much of the Wind Farm Site is underlain by blanket peat with limestone derived tills in the southeast.

Based on GSI bedrock mapping (www.gsi.ie), the Wind Farm Site is mapped to be predominantly underlain by the Downpatrick Formation. In addition, some areas in the northeast and south are underlain by the Mullaghmore Formation.

As stated above, the Grid Connection will predominantly be placed within the carriageway of the existing public roads. The published subsoils map (www.gsi.ie) shows that the Grid

Connection is predominantly underlain till derived from limestones with some local areas underlain by blanket peat. Alluvium is also mapped along the Cloonaghmore River at Palmerstown Bridge. Some areas of bedrock outcrop are mapped in the southern section of the Grid Connection and in the vicinity of Tawnaghmore substation.

3.3 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 Wind Farm Site is not located within any designated conservation site, however there are designated sites in close proximity to the Proposed Development. The Proposed Development has downstream hydrological connections with some of these Natura 2000 sites in the region as described below.

The Lackan Saltmarsh and Kilcummin head SAC/pNHA (Site Code: 000516), and the Killala Bay/ Moy Estuary SPA (Site Code: 004036) are all located to the east (~1.2km) and downstream of the Proposed Development via the Cloonalaghan River.

The Killala Bay/ Moy Estuary SPA as previously mentioned above, along with the Killala Bay/ Moy Estuary pNHA and SAC (Site Code: 00458) are hydrologically connected to the Grid Connection via the Cloonaghmore River which flows to the east and discharges into Killala Bay. The SPA also includes Lackan Bay is this designated site is therefore also hydrologically connected with the Wind Farm Site via the Cloonalaghan River.

The Creevagh head pNHA (Site Code: 000482) is situated ~3km northeast of the Wind Farm Site. No hydrological connections exist between the Proposed Development and this pNHA other than via the Atlantic Ocean.

Meanwhile, Downpatrick Head pNHA (Site Code: 000494) is located ~5km north/northwest of the Wind Farm Site. No hydrological connections exist between the Proposed Development and this pNHA other than via the Atlantic Ocean

Further south, Killala Esker pNHA (Site Code: 001517) is located in close proximity (~1km north of Tawnaghmore substation) to the Grid Connection.

The Glenamoy Bog Complex (Site Code: 000500) is located roughly 3.8km west of Wind Farm Site. The Ballinglen River provides a hydrological barrier between the Wind Farm Site and this SAC. No hydrological or hydrogeological linkages exist.

4. SITE SPECIFIC FLOOD RISK ASSESSMENT

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.

A stage 1 assessment of flood risk requires an understanding of where the water comes from (*i.e.* the source), how and where it flows (*i.e.* the pathways) and the people and assets affected by it (*i.e.* the receptors). It is necessary to identify whether there may be any flooding or surface water management issues related to the proposed site that may warrant further detailed investigation.

As per the guidance (DOEHLG, 2009), the stage 1 of a flood risk assessment comprises:

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

Further to this, a stage 2 assessment involves the confirmation of sources of flooding, appraising the adequacy of existing information and determining what surveys and modelling approach may be required for further assessment.

4.2 FLOOD RISK ASSESSMENT PROCEDURE

This section of the report details the site-specific flood risk assessment carried out for the Proposed Wind Farm 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 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 its inland location, coastal flooding is not applicable to the Proposed Wind Farm Site.

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 Wind Farm 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 it appears that there are no areas of mineral alluvium soils (fluvial deposits) mapped along the rivers and streams within the Wind Farm Site or in the surrounding lands. The closest mapped deposits of alluvium are located on the Heathfield River ~450m north of the Wind Farm Site and along the lower reaches of the Cloonalghan River, ~1.2km southeast of the Wind Farm Site.

No alluvium is mapped along any of the watercourses in the immediate vicinity of the Wind Farm Site. Therefore, there are alluvium deposits in the local area that may be associated with a flood plain or a geographical area that is prone to flooding.

Meanwhile, alluvium is mapped along the Grid Connection at Palmerstown Bridge where the R314 crosses the Cloonaghmore River. No additional alluvial deposits are mapped along the other smaller watercourses along the Grid Connection.

4.3.2 Historical Mapping

There is no text on local available historical OSI 6" or 25" mapping for the Wind Farm Site that identifies areas that are "*prone to flooding*".

4.3.3 OPW Past Flood Events Mappig

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

The OPW Past Flood Events Maps have no records any recurring or historic flood incidences within the Wind Farm Site (www.floodinfo.ie). The closest mapped recurring flood event (Flood ID: 10231) to the Wind Farm Site is recorded in the Lackan Strand area, ~1km east of the proposed spoil depsotion area and wind turbine AT18. Regarding this flood event, the local area engineers report (available at www.floodinfo.ie) states that a local road here floods regularly due to high tides.

In terms of the Grid Connction, the OPWs Past Flood Event Layer records a recurring flood event (Flood ID: 10228) in the Kilgobban area just to the east of the Grid Connection. Here the R314 is noted to flood once or twice a year due to high tides. Further recurring coastal flood events (Flood ID: 10229 and 10227) are mapped to the north of Killala. Meanwhile, recurring fluvial flood events (Flood ID: 587 and 10226) are recorded on the Cloonaghmore River ~3km to the west, and upstream of the Proposed Development, in the townland of Tonrehown.

The OPW Past Flood Events Map is presented as **Figure C**.

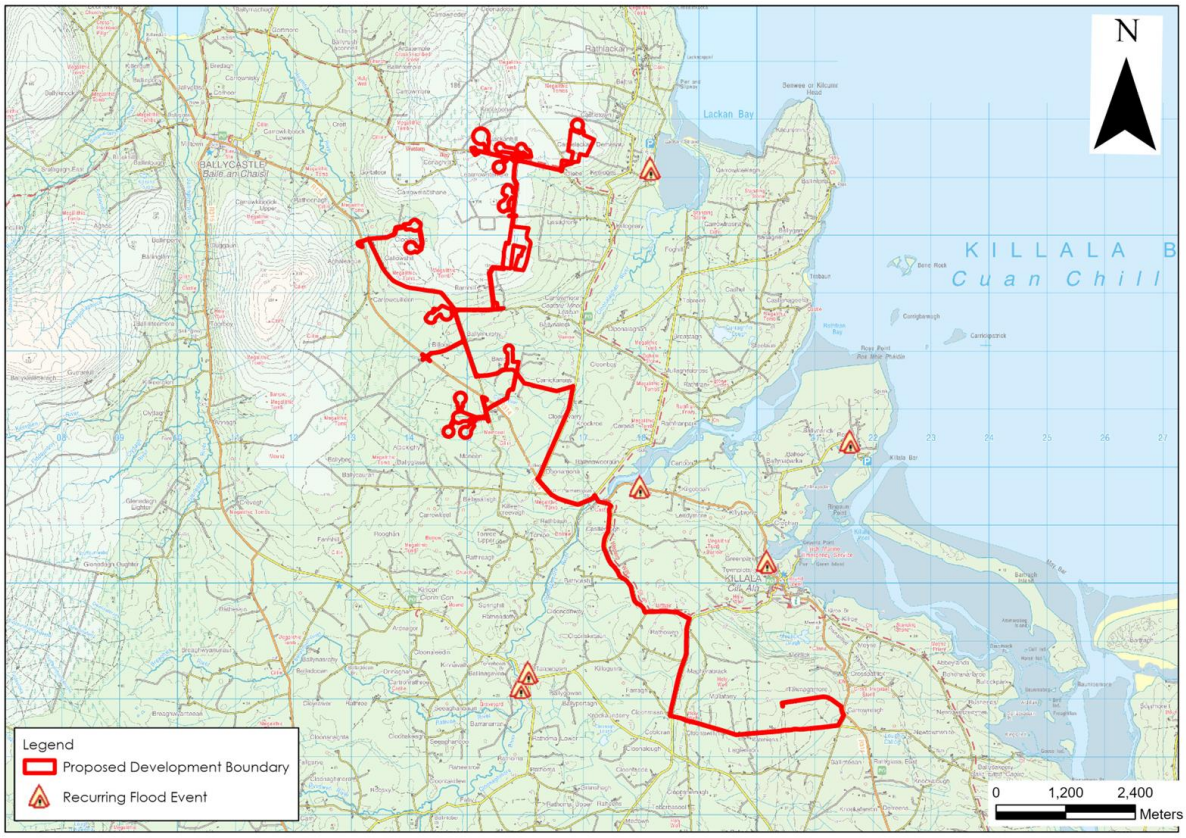

Figure C: OPW Past Flood Events Map (www.floodinfo.ie)

4.3.4 GSI Surface Water Flood Mapping

The GSI Winter (2015/2016) Surface Water Flooding map[1] 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. This surface water flood map is available to view at www.floodinfo.ie.

The GSI Winter 2015/2016 Surface Water Flood Map does not record any flood zones long the streams and watercourses which drain the Wind Farm Site or the Grid Connection.

The closest area of flooding is located at Meelick Lough ~1.2km northeast of Tawnaghmore substation. Some flooding was also recorded in the Kilgobban area, ~2.2km east of Palmerstown Bridge.

4.3.5 CFRAM Fluvial Flood Mapping

Catchment Flood Risk Assessment and Management (CFRAM)[2] OPW Flood Risk Assessment Maps are now the primary reference for flood risk planning in Ireland and supersede the previous PFRA[3] maps. CFRAM mapping of river flood extents are available at www.floodinfo.ie.

However, No CFRAM fluvial or coastal mapping has been completed for the area of the Wind Farm Site or the Grid Connection.

[1] *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).*
[2] *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.*
[3] *Preliminary Flood Risk Assessment mapping.*

The closest mapped CFRAM fluvial flood zones are located at Ballina and Crossmolina. The closest CFRAM coastal flood zones are mapped on the River Moy Estuary.

4.3.6 OPW National Indicative Flood Mapping

The National Indicative 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).

NIFM shows flooding along the Heathfield, Carn and Cloonalaghan Rivers which drain the Wind Farm Site. The flood zones associated with the Heathfield River are located ~300m north of the Wind Farm Site and ~900m west of wind turbine AT08. Meanwhile the flood zones associated with the Cloonalaghan River are located ~1.2km east of the wind turbine AT01. Flood zones are also mapped along the Carn River. These flood sone are located ~20-30m from the Wind Farm Site. The infrastructure proposed in this area comprises of an internal Wind Farm Site grid connection between wind turbine AT04 and the proposed onsite substation. The proposed internal grid cable connection crossing is located upstream of the NIFM modelled fluvial flood zones. The works proposed comprise solely of temporary excavations and horizontal directional drilling under the Carn River and there will be no displacement of waters or increase in downstream flood risk.

No fluvial flood zones encroach upon the Wind Farm Site. The Wind Farm Site is mapped in Fluvial Flood Zone C and is deemed to be at low risk of flooding.

The NIFM was also reviewed along the length of the Grid Connection. The proposed Grid Connection crosses the mapped fluvial flood zones along the Cloonaghmore River at Palmerstown Bridge. Flood zones are also mapped immediately to the west of Grid Connection in the townland of Magherabrack. A small section of the Grid Connection at an existing crossing over the Magherbrack Stream is mapped within the NIFM flood zones.

The flood zones indicated on the NIFM mapping are shown on **Figure D** below.

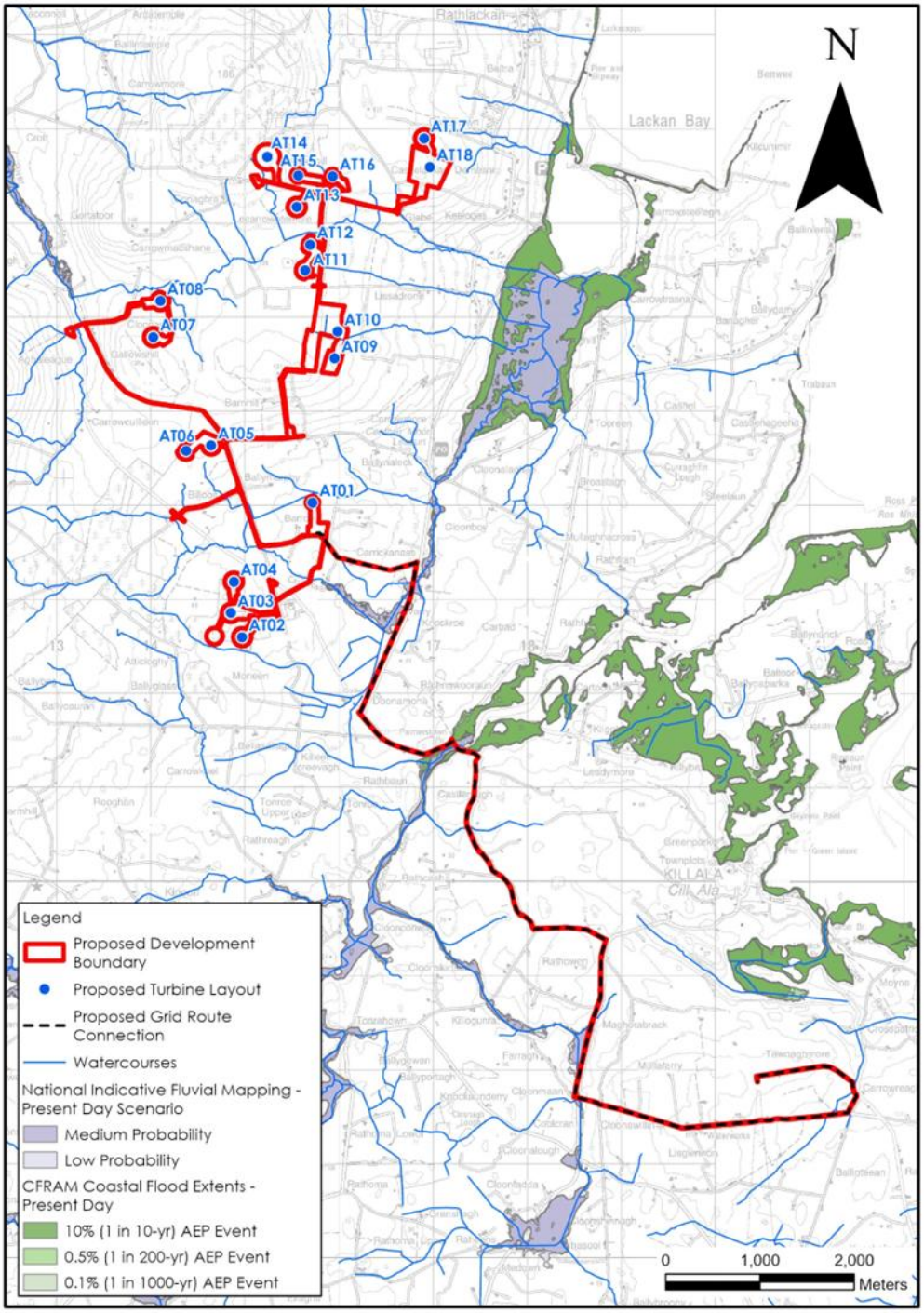

Figure D: National Indicative Flood Mapping (www.floodinfo.ie)

4.3.7 Groundwater Flooding

The GSI Historical Groundwater flood map and the modelled groundwater flood extents maps (www.floodinfo.ie) do not show the occurrence of any groundwater flooding within the Wind Farm Site or along the Grid Connection.

4.3.8 Coastal Flooding

The closest mapped coastal (tidal) flood zones are located at the Moy Estuary, approximately 11km southeast of the Wind Farm Site.

The Wind Farm Site is not at risk of coastal flooding due to its elevation, with topography ranging from 20 to 180mOD.

4.3.9 Climate Change

It is likely that climate change will have significant impacts on flooding and flood risk in Ireland due to rising sea levels, increased winter rainfall and more intense rainfall. The CFRAM Programme has modelled flooding associated with potential future climate change scenarios. However as stated above no CFRAM modelling has been completed in the vicinity of the Proposed Development site.

National Indicative Fluvial Mapping has been completed for catchments greater than 5km^2 for which flood maps were not produced under the CFRAM Programme. These flood zones have also been modelled for 2 no. potential future climate change scenarios, with the Mid-Range and High-End Future Scenario flood extents generated using an increase in rainfall of 20% and 30% respectively.

Both of these 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 Development site are unlikely to be significantly impacted by future climate change.

4.3.8 Summary – Flood Risk Identification

Based on the information gained through the flood identification process, the Wind Farm Site is not largely constrained by coastal, fluvial or groundwater flooding. The vast majority of the Wind Farm Site, including all proposed turbines, are located in Fluvial Flood Zone C and are at low risk of flooding. Meanwhile, a small area of the Wind Farm Site is at risk of fluvial flooding along the Carn River with a proposed grid cable crossing located in Flood Zone A.

Much of the Grid Connection is also located in Flood Zone C, however at Palmerstown Bridge, the Grid Connection is mapped in Flood Zone A due to its proximity to the Cloonaghmore River. Due to the nature of the underground electrical cable, this will have no effect during the operational phase of the Proposed Development. During the construction phase, works along the work may have to be postponsed following heavy rainfall events which may cause flooding at this location.

4.4 DETAILED FLOOD RISK ASSESSMENT

4.4.1 Site Surveys

Detailed walkover surveys of the Wind Farm Site were undertaken by HES on 3rd – 5th August 2022, 29th November – 1st December 2022, 30th March 2023 and 20th April 2023.

The Wind Farm Site was noted to comprise of a mixture of peat bogs, agricultural land and coniferous forestry. As discussed above, several watercourses have their upper reaches (mainly 1st /2nd order streams) within the Wind Farm Site and these flow offsite before discharging into the Heathfield or Cloonalaghan Rivers or directly into the Atlantic Ocean.

Monitoring of stream discharge of the main streams within and downstream of the Wind Farm Site was undertaken on 2 no. occasions and the data is presented in **Table A** above.

During the walkover surveys and flow monitoring there was little evidence of past out of bank flow from within the various river channels. During targeted visits following considerable rainfall in the prior day/s, high flows were observed within the rivers, with many estimated to be several multiples of the typical dry weather flow. No widespread or localized flooding was observed during these site visits, all flow was contained within the channels.

No areas of concern regarding flood risk were noted during the walkover surveys due to:

- The elevation of much of the Wind Farm Site located at elevations in excess of 100mOD;
- The sloping nature of the land with the Wind Farm Site being drained by numerous streams and rivers which flow rapidly downslope; and,
- The existing drainage regime in agricultural areas (manmade field drains) and forestry areas (mound and ribbon drains) which facilitate the movement of water downslope and into the existing natural drainage system and local streams/rivers.

In relation to flooding along the Carn River, it was noted during the site walkovers surveys that no vegetation typical of a floodplain extends any significant distance from the river channel. During the walkover surveys no sign of recent out of bank flows were recorded. The land was noted to rise to the north, towards AT02 and to the south towards AT01. This coincides with the NIFM mapping which does not show flood extents extending from the river channel as far as the proposed turbine locations.

4.4.2 Hydrological Flood Conceptual Model

Potential flooding in the vicinity of the Wind Farm Site can be described using the Source – Pathway – Receptor Model ("S-P-R"). Given the typical sloping topography and elevations, the potential for pluvial flooding is generally low. The primary potential source of flooding in this area, and the one with most consequence for the proposed site, is fluvial. However the proposed Wind Farm Site is mapped in fluvial Flood Zone C.

4.4.3 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 be problematic in the areas of the site proposed for development. The potential sources of flood risk for the proposed site are outlined and assessed in **Table C.**

Table C: S-P-R Assessment of Flood Sources for the Wind Farm Site

Source	Pathway	Receptor	Comment
Tidal	Flooding of nearby (Moy) estuary and bays (Lacken and Killala)	Land and infrastructure.	The Wind Farm Site is ~1.4 km from the coast. There is no risk of coastal flooding due to the topography of the Wind Farm Site (~20-155mOD). The closest mapped coastal/tidal flood zones are located at the Moy Estuary ~11km to the southeast.
Fluvial	Overbank flooding of the rivers and streams that are close to the perimeters of the site and the rivers and streams that flow throughout the site	Land and infrastructure.	No CFRAM or NIFM Fluvial Flood Zones encroach upon the Wind Farm Site. The closest mapped NIFM Flood Zones are associated with the Carn River and are located ~20-30m downstream of an internal Wind Farm Site grid cable crossing. All key development infrastructure (turbines, construction compounds, substation and borrow pit) are located in Fluvial Flood Zone C and are at low risk of fluvial flooding. Small sections of the Grid Connection are mapped in Fluvial Flood Zones, associated with flooding along the Cloonaghmore River and the Magherabrack Stream, However, existing watercourse crossings alreast exist at these locations. Therefore, the Proposed Development will have no effect on flooding in these areas.
Pluvial	Ponding of rainwater on site	Land and infrastructure.	There is very little risk of pluvial flooding within the Wind Farm Site due to the sloping nature of the land. Drainage moves relatively freely downslope due to the sloping topography; the existing forestry drains and the high density of natural watercourses and streams. Therefore, there is little risk of pluvial flooding at the Wind Farm Site.
Surface water	Surface ponding/ Overflow	Land and infrastructure	Same as above (pluvial).
Groundwater	Rising groundwater levels	Land and infrastructure.	Based on local hydrogeological regime and GSI groundwater flood mapping, there is no apparent risk from groundwater flooding at the Wind Farm Site.

5. PLANNING POLICY AND JUSTIFICATION TEST

5.1 PLANNING POLICY AND THE MAYO COUNTY DEVELOPMENT PLAN

The following policies are defined in the Mayo CDP 2022-2028 (**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: Mayo County Development Plan Objectives/Policies and Project Responses

No.	Objectives	Development Design Response
INO 19	To ensure that a flood risk assessment is carried out for any development proposal where a flood risk is identified in accordance with the Planning System and Flood Risk Management (DoEHLG/OPW 2009) and Circular PL2/2014. This assessment shall be appropriate to the scale and nature of risk to the potential development.	This FRA is consistent with the requirements of the "Planning System and Flood Risk Management – Guidelines for Planning Authorities" and is in line with the recommendations of the SFRA prepared as part of the Mayo County Development Plan 2022-2028.
INO 20	To consult with the OPW in relation to proposed developments in the vicinity of drainage channels and rivers for which the OPW are responsible and retain a strip on either side of such channels where required, to facilitate maintenance access thereto.	OPW mapping has been consulted.
INO 21	To assist the OPW in developing catchment-based Flood Risk Management Plans for rivers in County Mayo and have regard to their rovisions/recommendations.	No plan in place currently for the Wind Farm Site
INO 22	To protect the integrity of any formal (OPW or Mayo County Council) flood risk management infrastructure, thereby ensuring that any new development does not negatively impact any existing defence infrastructure or compromise any proposed new infrastructure.	No existing defences at the Wind Farm Site.
INO 23	To ensure that where flood risk management works take place that natural heritage, cultural heritage, rivers, streams and watercourses are appropriately protected.	No flood risk management works *i.e* flood barriers, recommended.
INO 24	Consult, where necessary, with Inland Fisheries Ireland, the National Parks and Wildlife Service and other relevant agencies in the provision of flood alleviation measures in the County.	N/A
INO 25	Ensure each flood risk management activity is examined to determine actions required to embed and provide for effective climate change adaptation as set out in the OPW Climate Change Sectoral Adaptation Plan Flood Risk Management applicable at the time.	No flood risk management activity recommended.

5.2 REQUIREMENT FOR A JUSTIFICATION TEST

The matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test[4] is shown in **Table E** below.

[4] *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).*

The Proposed Development can be categorised as "Highly Vulnerable Development" as electricity generating infrastructure will be present. However, as stated above, with the exception of existing watercourse crossings on the Grid Connection, all Proposed Development infrastructure, including the proposed onsite substation, is located in Flood Zone C (Low Risk). Therefore, the Proposed Development is appropriate from a flood risk perspective.

A justification test has been completed below for the Grid Connection crossings which are located in the mapped fluvial flood zones.

Table E: 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*

Box 5.1 (**Table F**) of "The Planning System and Flood Risk Management Guidelines" (PSFRM Guidelines) outlines the criteria required to complete the "Justification Test".

Table F: 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:

No displacement of floodwaters will result from the emplacement of the Proposed Grid Connection Route underground cable at Palmerstown Bridge over the Cloonaghmore River or at an existing crossing over the EPA named Magherabrack Stream. The crossing at Palmerstown Bridge will be achieved by directional drilling and there will be no in-stream works or alteration of the existing hydromorphological regime. Similarly there will be no instream works at the xisting crossing over the Magherabrack Stream.

Furthermore, no displacement of floodwaters will result from the emplacement of the internal grid cable connection in the mapped flood zones. The works proposed comprise solely of temporary excavations and horizontal directional drilling and there will be no displacement of floodwaters or increase in the downstream flood risk.

1. The Proposed Development 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 Proposed Development and given that the only portions of the Proposed Development located within modelled flood zones are at existing watercourse crossings along the Grid Conenction, the Proposed is predicted to have no impact on flood water levels downstream. No increase in downstream flood risk will occur.
    ii. All proposed turbines and all other site infrastructure (aside from the small section of the Grid Connection) are located outside of the flood zones. These measures will mitigate against any potential disruption to the natural hydrology of the Wind Farm Site. No increase in flood risk to people, property, the economy or the environment during extreme flood events as a result of the Proposed Development is predicted due to the appropriate design measures which will result in unmeasurable/imperceptible upstream and downstream effects;
    iii. The Grid Connection crossing of the Cloonaghmore River at Palmerstown Bridge is located within modelled fluvial flood zones, but this will not have an effect on flood levels. The crossing will be achieved by horizontal directional drilling. There will be no displacement of floodwaters.
    iv. The Grid Connection crossing over the Magherabrack Stream will also not include any instream works. Therefore, there will be no displacement of flood waters;
    v. The Proposed Development 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. FLOOD IMPACT PREVENTION AND DRAINAGE MANAGEMENT

6.1 PROPOSED DRAINAGE

The site drainage system was designed integrally with the Proposed Development design layout as a measure to ensure that the proposal will not change the existing flow regime across the Proposed Development site, will not deteriorate water quality and will safeguard existing water quality status of the catchments from wind farm related sediment runoff.

Overland flow rates are likely to be significant and the drainage system must be designed and managed properly if it is to work effectively. A fundamental principle in the drainage design is that clean water flowing in the upstream catchment, including overland flow and flow in existing streams and drains, is allowed to bypass the works areas without being contaminated by silt from the works. The dirty water from the works areas is collected in a separate drainage system and treated by removing the suspended solids before discharging it to the downstream watercourse. This minimises the volume of dirty water requiring treatment.

Existing streams crossing the works area will be piped to isolate them from the works. New drains will be constructed to collect overland flow that is intercepted by the works areas or by new access roads. These will be constructed on the uphill side of the works and piped to the downhill side, bypassing the works areas. However, this will cause the normally dispersed flow to be concentrated at specific discharge points downstream of the works. In order to disperse this flow each clean water drain will be terminated in a discharge channel running parallel to the ground contours that will function as a weir to disperse the flow over a wider area of vegetation. This will prevent erosion of the ground surface and will attenuate the flow rate to the downstream receiving waters.

The resultant diversion of clean water runoff will ensure that the treatment system will only need to deal with construction related runoff. The treatment system consists of a series of settlement ponds that are located at each works site and at intervals along the access roads. The outflow from the settlement ponds will be allowed to disperse across vegetation and will become diluted through contact with the clean water runoff in the buffer areas before entering the downstream watercourses.

6.2 PROPOSED ON-SITE RUNOFF ATTENUATION

The creation of impermeable areas within a site has the effect of increasing rates of runoff into the downstream drainage system and this may increase flood risk and flood severity downstream. This applies particularly to urban areas that drain to closed pipe systems which do not have the capacity to cater for increased hydraulic loads. The Proposed Development is located within a large rural catchment with an open drainage system. The footprint of the impermeable areas and the associated increase in runoff rate is very small in the context of the catchment size and therefore represents a negligible increase in downstream flood risk. Notwithstanding the low increase in flood risk due to the Proposed Development, the drainage system has been designed to prevent any increase in discharge rates above that which already exist in the undeveloped site.

The volume of water requiring attenuation relates to direct precipitation on the roads and hard-standing footprint only. The aim of the storm water attenuation measures is to limit the flow rate from the developed area to that which prevails on the undeveloped site. This is achieved by limiting the flow rate to the downstream receiving waters and temporarily storing the excess water that accumulates as a result. The developed surfaces have some permeability and this reduces the attenuation requirement. Conventional attenuation systems use proprietary flow control units but these can become blocked with debris and

vegetation and require regular maintenance. They are therefore not appropriate for use within a forestry environment or where routine maintenance would not be practical.
It is proposed to provide the temporary storage within the drainage channels by creating stone dams within them at regular intervals. The spacing of the dams is typically 100m but depends on the channel slope, with steeper channels requiring shorter intervals. The dams, which are constructed with small sized aggregate, also reduce the flow rate through the drainage system and are an effective means of providing flow control. Silt fence also provide storage and flow control.

All runoff from the developed areas will be routed through settlement ponds downstream. The outflow from the settlement ponds will be released in a controlled and diffuse manner. Therefore, the Proposed Development will not increase the magnitude of the hydrograph peak. The control measures are passive as opposed to mechanical and do not require maintenance to ensure their ongoing effectiveness.

7. REPORT CONCLUSIONS

- A flood risk identification study was undertaken to identify existing potential flood risks associated with the Proposed Development. From this study:
    - No instances of historical flooding were identified in historic OS maps within the Wind Farm Site;
    - No instances of recurring flooding were identified on OPW maps within the Wind Farm Site;
    - The GSI Historical 2015/2016 flood map does not record any historic flood zones in the area of the Wind Farm Site;
    - The Wind Farm Site is not mapped within any historic or predictive groundwater flood zone;
    - The Wind Farm Site was not identified as being within CFRAM Flood Zones; and,
    - National Indicative Fluvial Flood Mapping is available for the Wind Farm Site and shows some fluvial flood zones along the Carn River in close proximity to the Wind Farm Site. However, these flood zones do not encroach upon the Wind Farm Site and are located 20-30m downstream.
- During the walkover surveys and flow monitoring at the Wind Farm Site there was no evidence of out-of-bank flow from within the various stream/river channels. No widespread or even localized flooding was observed during these site visits;
- The risk of flooding at the Wind Farm Site is very low due to the elevated and sloping nature of the site and the high density of streams and drains which flow rapidly downslope;
- The Wind Farm Site is mapped within Fluvial Flood Zone C and is at low risk of fluvial flooding;
- The Grid Connection is also largely located in Flood Zone C and is at a low risk of flooding. Local public roads and watercourse crossings already exist along the Grid Connection and the Proposed Development will have no effect on flooding or mapped flood zones. During the construction phase, works along the underground Grid Connection may have to be postponed following heavy rainfall events which could cause flooding in these areas;
- The Proposed Development can be categorised as "Highly Vulnerable Development", however, the key proposed infrastructure is located outside of areas mapped as Flood Zones and therefore the Proposed Development is appropriate from a flood risk perspective;
- The overall risk of flooding is estimated to be very low. A low risk would typically relate to the probability of being impacted by a 1000-year flood (i.e. the entire area of the Proposed Development footprint is located in fluvial Flood Zone C). The flooding risk at the Wind Farm Site has an estimated AEP of <0.1%; and,
- In addition, the risk of the Proposed Development contributing to downstream flooding is also very low, as the long-term plan for the site is to retain and slow down drainage water rates prior to release. Robust drainage measures on the site will include swales, silt traps, check dams, settlement ponds and buffered outfalls. Please refer to the Chapter 9 Water of the EIAR for further details.

* *

8. REFERENCES

AGMET	1996	Agroclimatic Atlas of Ireland.
DOEHLG	2009	The Planning System and Flood Risk Management.
Met Eireann	1996	Monthly and Annual Averages of Rainfall for Ireland 1961-1990.
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