APPENDIX 9-1

FLOOD RISK ASSESSMENT

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PROPOSED LAURCLAVAGH RENEWABLE ENERGY DEVELOPMENT, CO. GALWAY

FLOOD RISK ASSESSMENT

DRAFT REPORT

Prepared for:

LAURCLAVAGH LTD

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) was engaged by MKO Ireland to undertake a Flood Risk Assessment (FRA) for the proposed Laurclavagh Renewable Energy Development (the Proposed Project) at Laurclavagh, Co. Galway.

The Site (all areas inside the EIAR Boundary) which includes a Proposed Wind Farm site and Proposed Grid Connection is located approximately 9 kilometres (km) southwest of Tuam, and approximately 9.8km north of Claregalway, Co. Galway. A site location map is presented below in **Figure A**.

The following assessment is carried out in accordance with '*The Planning System and Flood Risk Management Guidelines for Planning Authorities*' (DoEHLG, 2009).

1.2 STATEMENT OF QUALIFICATIONS

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

Our core area of expertise and experience is hydrology and hydrogeology, including flooding assessment and surface water modelling. 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 18 years' environmental consultancy experience in Ireland. Michael has completed numerous geological, 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 for Oweninny WF, Cloncreen WF, and Yellow River WF, and over 100 other wind farm-related projects.

Adam Keegan P.Geo (BSc, MSc) is a hydrogeologist with two years of experience in the environmental sector in Ireland. Adam has been involved in Environmental Impact Assessment Reports (EIARs) for numerous projects including wind farms, grid connections, quarries and small housing developments. Adam holds an MSc in Hydrogeology and Water Resource Management. Adam has experience in intrusive site investigation works within mapped karst environments and experience in trial and production well drilling within areas mapped as Regionally Karstified. Adam has worked on several wind farm EIAR projects, including Croagh WF, Lyrenacarriga WF (SID), Cleanrath WF, Carrownagowan WF (SID), and Seven Hills WF. Adam has also worked on water supply projects and karst related projects in Galway, Clare, Tipperary and Waterford.

Jenny Law (BSc, MSc) is an environmental geoscientist holding a first honour's degree in applied environmental geosciences from the University College Cork in 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

This FRA report has the following format:

- Section 2 describes the site setting and details of the Proposed Project;
- Section 3 outlines the hydrological and geological characteristics of the Corrib Catchment;
- Section 4 presents a site-specific flood risk assessment (FRA) undertaken for the Proposed Project which was carried out in accordance with the above-mentioned guidelines; and,
- Section 5 presents the FRA report conclusions.

2. BACKGROUND INFORMATION

2.1 INTRODUCTION

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

2.2 SITE LOCATION AND TOPOGRAPHY

The Proposed Wind Farm site is located primarily within the townland of Laurclavagh, between the townlands of Cahermorris and Ballynacreg North. The approximate centre of the site is located at E137055, N243681.

The Proposed Wind Farm site is situated within a slightly elevated area of ground (~45-60mOD) within a broader area which is generally flat to locally undulating and with elevations generally ~30mOD. The land is mainly agricultural improved grassland, primarily used for grazing. The Proposed Project covers an area of approximately 945 hectares, in total, and is divided into two distinct areas; the Proposed Wind Farm site and the Proposed Grid Connection.

It is intended to access the Proposed Wind Farm site via a local road (L61461), just off the N83 Tuam-Galway Road. This proposed entrance is located to the east of the Proposed Wind Farm site, in the townland of Pollcossaun Oughter.

The Proposed Grid Connection includes the proposed onsite 110kV substation, located in the centre-east of the Proposed Wind Farm site. This substation will be connected to the existing 110kV Cloon Substation via a 14.3km long underground cabling route. The existing Cloon 110kV Substation is located approximately 6km northeast of the Proposed Wind Farm site. The proposed onsite 110kV Substation, adjacent temporary construction compound and the first c. 2km of the underground cabling route to Cloon Substation are elements of the Proposed Grid Connection which overlap with the Proposed Wind Farm site.

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

2.3 PROPOSED PROJECT DETAILS

The Proposed Project will comprise the following elements:

- The 'Proposed Wind Farm' refers to the 8 no. turbines and supporting infrastructure which is the subject of this Section 37E application.
- The 'Proposed Grid Connection' refers to the 110kV substation and supporting infrastructure which will be the subject of a separate Section 182A application.
- The 'Proposed Project' comprises the Proposed Wind Farm and the Proposed Grid Connection, all of which are located within the EIAR Site Boundary (the 'Site') and assessed together within the EIAR and this accompany Flood Risk Assessment Report.

A detailed description of the Proposed Project is provided in Chapter 4 of the EIAR.

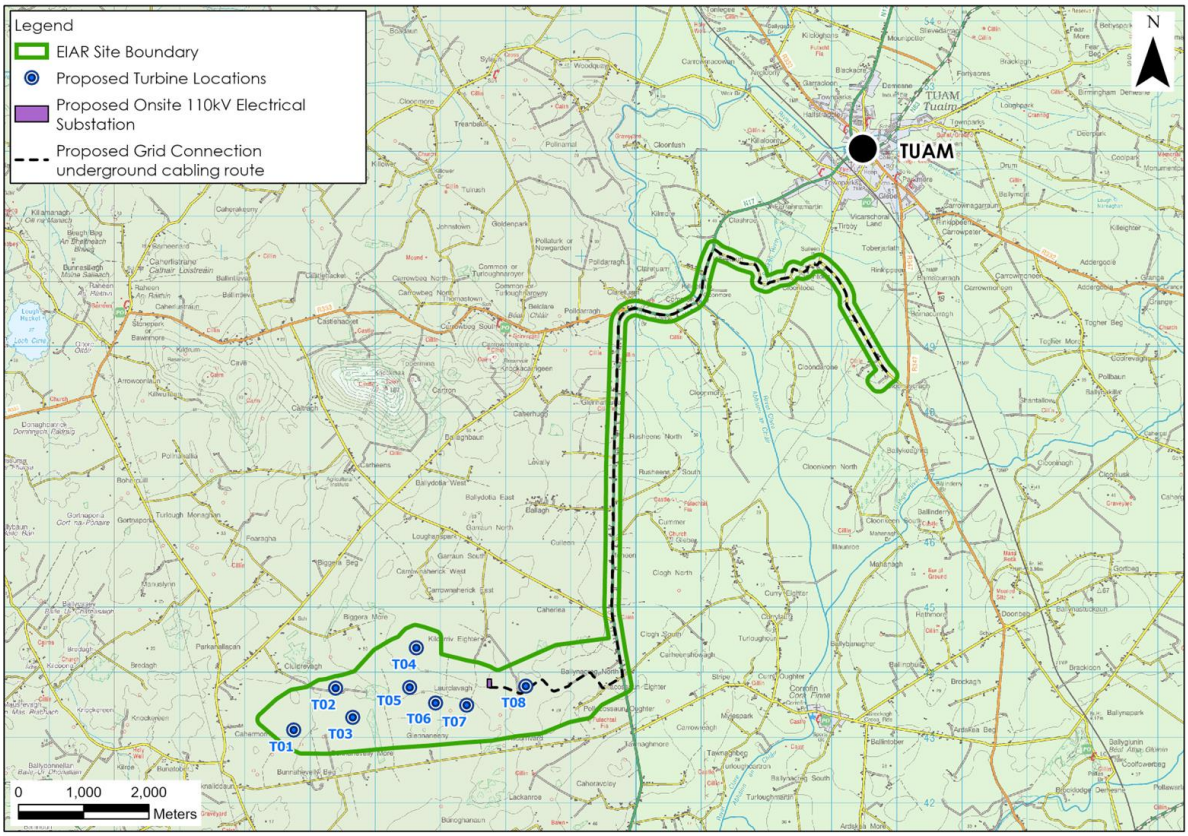

Figure A: Site Location Map

3. EXISTING ENVIRONMENT AND CATCHMENT CHARACTERISTICS

3.1 INTRODUCTION

This section gives an overview of the hydrological and geological characteristics of the region and the Site.

3.2 HYDROLOGY

3.2.1 Regional and Local Hydrology

With respect to regional hydrology, the Proposed Wind Farm site is located within the Corrib catchment, within Hydrometric Area 30 (Corrib) of the Irish River Basin District.

On a more local scale, the Proposed Wind Farm site is contained within the Clare(Galway)_SC_060 subcatchment. The River Clare is situated ~4.0km east of the Proposed Wind Farm site and flows south, while Lough Corrib is located ~4.3km to the west/southwest.

The closest surface watercourse to the Site is the Ballinduff stream (also referred to as "Bunnatubber spring" by the EPA) situated 2.6km west of the Proposed Wind Farm site. The upper reaches of the stream are situated near 2 no. mapped turloughs and a spring mapped in the townland of Kilcoona, as well as a further spring in the townland of Bunatober. The stream is monitored with spot flow measurements by the EPA at a bridge located at E131521, N241001. An average flow of 0.98 m^3/s is recorded, with a range between 0.078 – 4.1 m^3/s.

The Glennafosha stream is mapped ~3.7km northeast of the Proposed Wind Farm site, which flows northeast before discharging to the River Clare. The Cregg stream is mapped ~4.7km south of the Proposed Wind Farm site and flows west to Lough Corrib.

Water levels in the River Clare are measured at station (ID: 30007) with a 50%ile water level of ~32 mOD. Water levels in Lough Corrib are measured at Angligham station (ID: 30089) with the 50%ile water level being measured at 8.72 mOD.

The regional area spanning east-west between Cahermorris and Ballycreg North and north-south between the townlands of Castlehacket and Lackanroe is distinctively void of mapped river/stream channels. The surface hydrological network does increase towards the margins of this regional area, with channels emerging 1-2km west of the River Clare and east of Lough Corrib. There are no surface water courses mapped on or near the Proposed Wind Farm site.

The Proposed Grid Connection underground cabling route is situated within the Clare(Galway)_SC_060, Clare[Galway]_SC_040 and Clare[Galway]_SC_020 sub-catchments. The route runs north along the N83 and crosses a tributary of the River Clare (River Clare (Galway)_050) at Claretuam bridge, and crosses the River Clare approximately 0.9km east of this point at Cloonmore bridge.

A local hydrology map is attached as **Figure B**.

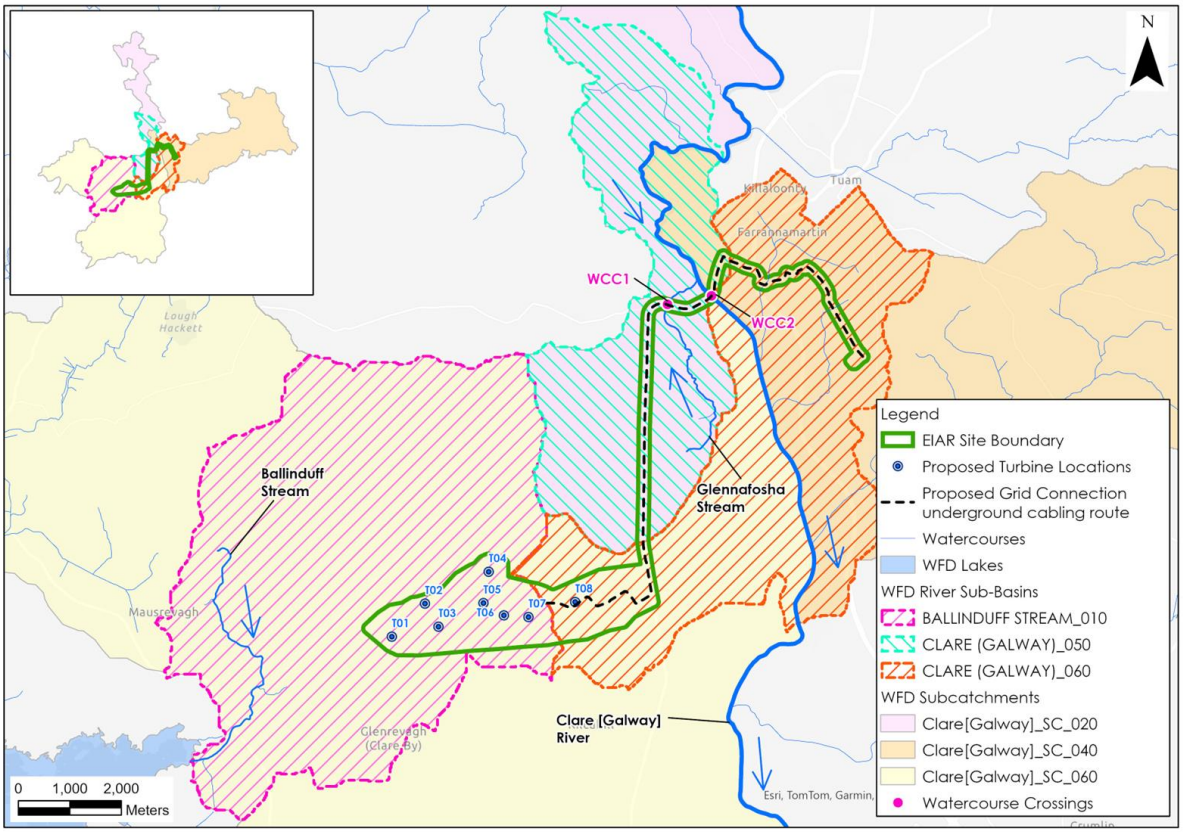

Figure B: Local Hydrology Map

3.2.2 Rainfall and Evaporation

The 30-year annual average rainfall (1991 – 2020) for the Site is 1,226 mm/year.

The closest synoptic weather station where the average potential evapotranspiration (PE) is recorded is at Claremorris, approximately 35 kilometres north of the site. The average potential evapotranspiration (PE) at Claremorris is 407.5mm (www.met.ie). The actual evapotranspiration (AE) is calculated to be 387mm (95% PE). Using the above figures, the effective rainfall (ER)[1] for the area is calculated to be (ER = SAAR – AE) 837mm/yr.

In addition to average rainfall data, extreme value rainfall depths are available from Met Eireann. **Table A** below presents return period rainfall depths for the area of the Proposed 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, 10-year, 50-year & 100-year).

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

Table A. Laurclavagh Wind Farm – Return Period Rainfall Depths (mm)

	Return Period (Years)				
Duration	**1**	**5**	**10**	**50**	**100**
15 mins	6.1	9.7	11.8	17.8	21.1
1 hours	10.4	15.8	18.9	27.4	32.0
6 hours	20.7	29.8	34.7	47.7	54.5
12 hours	27.0	38.0	43.8	59.2	67.0
24 hours	35.2	48.5	55.4	78.3	82.4
2 days	44.5	59.3	66.9	86.1	95.6

3.3 GEOLOGY

The majority of the Proposed Wind Farm site is mapped by the GSI as being overlain by Limestone Tills, with smaller areas mapped as Karstified bedrock outcrop or subcrop. A subsoil geology map for the Site is shown as **Figure C.**

Published soils maps (www.epa.ie) were consulted for data on mapped soils across the Proposed Wind Farm site. Deep well drained basic mineral soils (BminDW) are the dominant soil type at the site and in the local area with smaller pockets of shallow well drained mineral soil (BminSW) mapped on higher elevations. There is no peat mapped locally to the Proposed Wind Farm site.

Subsoils have been logged within the 10 no. rotary core boreholes and during the drilling of the 3 no. groundwater monitoring wells (as well as the trial pit and infiltration test trial pits discussed below). Throughout the drilling, the subsoils are generally described as soft to firm brown clays, with some sand and gravel within the clay matrix, but generally low cobble and boulder content.

The 8 no. trial pits and 14 no. infiltration trial pits also provide detail on the subsoils underlying the site. Topsoil is described as being between 0.2-0.3mbgl, occasionally with rootlets. This is generally underlain by firm, orange-brown, sandy to gravelly clay, however some boulder clays do occur (ITP03, and TP05). The depths of the trial pits range between 1.0-3.5m. 5 of the 8 no. trial pits were terminated on "*possible bedrock, (with) no groundwater encountered*".

Soils along the Proposed Grid Connection underground cabling route are mapped as deep, well drained mineral soils (BminDW), with occasional pockets of shallow, well drained mineral soils (BminSW). Towards the north and northeast of the proposed route, there are peat soils mapped near the M17 road, however these have already been cut through by the existing roadways. Peat probes (35 no.) have been carried out along the Proposed Grid Connection underground cabling route, which demonstrate peat depths between 0-0.7m and an average peat thickness of 0.23m in areas where peat has been mapped.

Bedrock geology across the Proposed Wind Farm site is mapped as the Burren Formation Limestone, which consist of pale grey, clean skeletal Limestone. The formation is typified by pale-grey packstones and wackestones, also containing intervals of dark cherty limestones, often associated with oolitic grainstones. There is some bedrock outcrop mapped across the site and in the surrounding area. The bedrock is mapped as dipping at 3° to the southeast.

The bedrock geology has been further described through intrusive investigation, including the drilling of the 10 no. rotary core boreholes, the 3 no. rotary (DTH) groundwater monitoring wells, as well as information contained within the logs of the 8 no. trial pits and 13 no. infiltration trial pits.

Bedrock was encountered in all 10 no. rotary core boreholes at depths ranging between 1.75 – 5.85mbgl. Bedrock at MW21-01, MW21-02 and MW21-03 was encountered at 1.1m, 13.2m and 2.5m respectively. The bedrock is described as medium-strong light grey to dark grey Limestone, which is moderately weathered in parts.

The bedrock encountered during the intrusive site investigations is consistent with the mapped geology.

The bedrock geology mapped along the Proposed Grid Connection underground cabling route is generally mapped within the Knockmaa Formation Limestones, described by the GSI as Thick-bedded, pale grey, clean limestone similar to that in the Coranellistrum Formation. The northeastern section of the Proposed Grid Connection is mapped within an area of undifferentiated Visean Limestone and the Burren Limestone Formation.

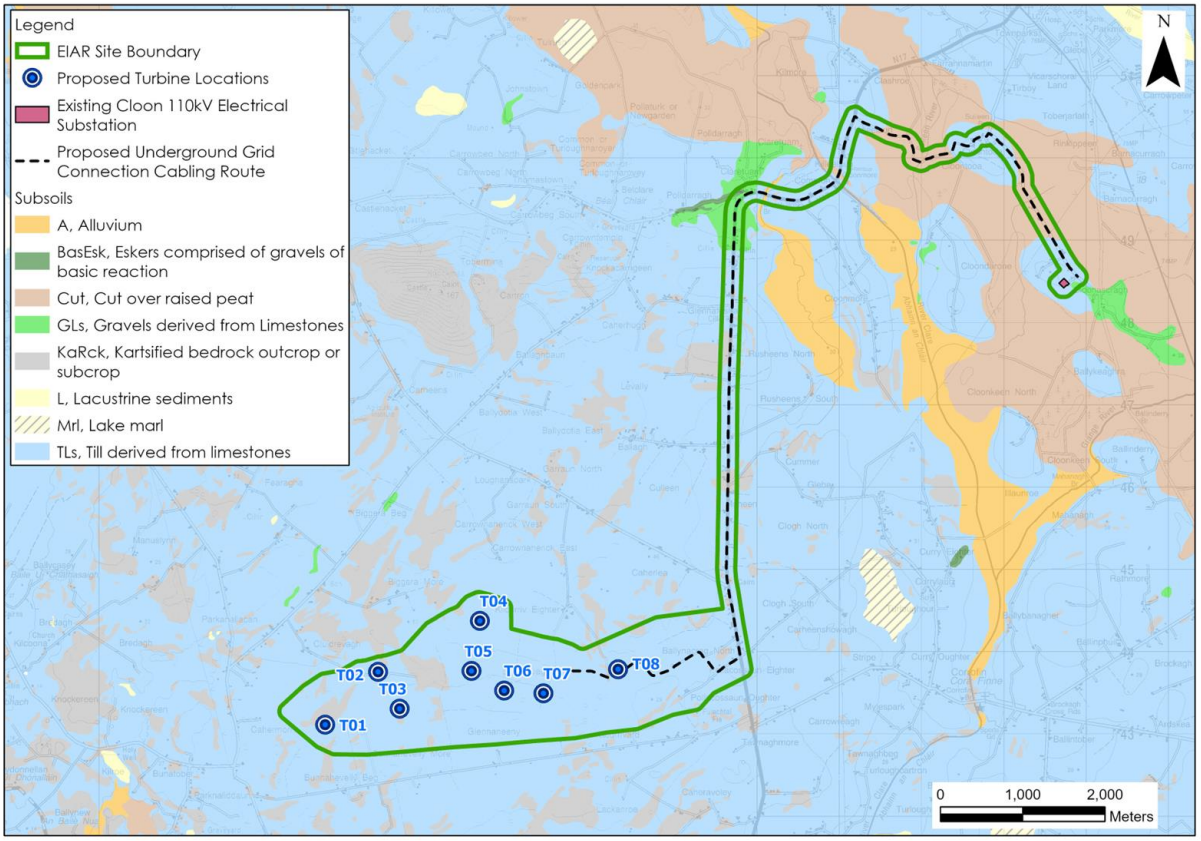

Figure C: Local Subsoil Map (www.gsi.ie)

3.4 DESIGNATED SITES & HABITATS

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

The Proposed Wind Farm site is not located within any designated site.

The nearest SAC to the Proposed Wind Farm site is the Lough Corrib SAC which is located ~4.3km west of the site and ~5.1km east of the site also. East of the site, the boundaries of the Corrib SAC extend up the River Clare. The Proposed Grid Connection underground cabling route crosses the River Clare at an existing bridge crossing.

There are several turloughs, which are listed as pNHA's located to the north and northwest of the Site. Belclare and Killower turlough as well as Turlough O'Gall are situated between 5-7km north of the Proposed Wind Farm site, while Turlough Monaghan, Turlough Cor and Lough Hackett are mapped between 3.5-7km west/northwest of the Proposed Wind Farm site.

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 stages of a flood risk assessment are:

- *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 ZONE MAPPING

Flood zones are geographical areas within which the likelihood of flooding is in a particular range. There are three types or levels of flood zones defined according to OPW 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.

4.3 FLOOD RISK IDENTIFICATION

4.3.1 OPW National Flood Hazard Mapping

To identify those areas as being at risk of flooding, OPW's indicative river and coastal flood map (www.viewer.myplan.ie) were consulted.

No recurring or historic flood incidents are recorded within the Proposed Wind Farm site. The closest recurring flood event is situated ~1.88km southwest of the site at the location of Balrobuck Beg Turlough (ID: 848). Furthermore, several recurring flooding incidents are mapped along the Ballinduff stream, situated 2.6km west of the Proposed Wind Farm site.

A recurring flood event is also recorded in the immediate vicinity of the Proposed Grid Connection underground cabling route as it travels along the N83. This event occurs after heavy rain within low lying lands to the east of the route at the Headford Road Junction (ID:1808).

Historic and recurring flood events in the vicinity of the Site are shown on **Figure D** below.

The Ballinduff stream, 2.6km west of the Proposed Wind Farm site and the Cregg stream ~4.7km to the south are mapped as part of a major arterial drainage scheme i.e. land identified by the OPW as potentially benefitting from the implementation of Arterial (Major) Drainage Schemes and an indicator of land subject to flooding and poor drainage. Additionally, the River Clare and the Glennafosha stream situated ~3.7km northeast of the Proposed Wind Farm site are also mapped as part of an arterial drainage scheme.

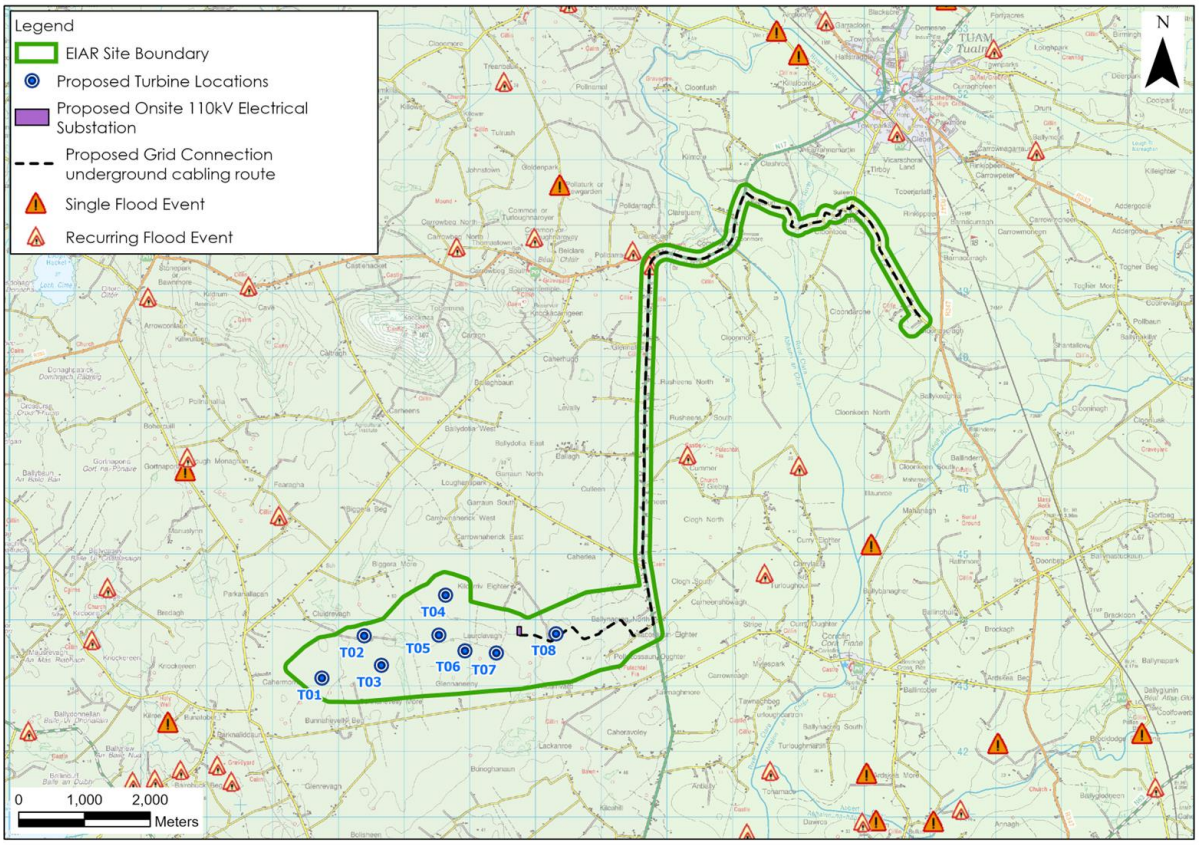

Figure D: OPW Indicative Flood Map

4.3.2 Soils Maps - Fluvial Maps

A review of the soil types in the vicinity of the 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 flood plain 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 local area, no fluvial or lacustrine deposits are mapped within the Proposed Wind Farm site. There are no soils present that indicate areas where flooding may have occurred in the past.

Alluvium soils and subsoils are mapped by the EPA and GSI respectively, along the Glennafosha tributary stream of the River Clare. The Proposed Grid Connection underground cabling route crosses this tributary at the existing Claretuam bridge. The presence of alluvium soils are insignificant at this location, particularly as the underground cabling will be placed within the existing road carriageway.

4.3.3 Historical Mapping

To identify those areas as being at risk of flooding, historical mapping (*i.e.* 6" and 25" base maps) were consulted. There was no identifiable map text on local available historical 6" or 25" mapping for the study area that would identify lands that are "liable to flood" within the Site. "Turloughs" and lands "liable to flood" are denoted in historic maps ~2-3km west of the Proposed Wind Farm site in areas adjacent to the Ballinduff stream as it flows southwards towards Lough Corrib.

4.3.4 CFRAM Mapping – Fluvial and Pluvial Flooding

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 maps.

CFRAM mapping has not been completed at the Proposed Wind Farm site. The closest CFRAM mapping extents are mapped along the Clare River and its tributary the Glennafosha stream, mapped ~3.7km northeast of the Proposed Wind Farm site.

The Proposed Grid Connection underground cabling route is partially mapped within CFRAM fluvial zones as it comes across the Glennfosha, the Clare River and the Killeelaun watercourses. CFRAM fluvial zones with low, medium and high probabilities are mapped along the Proposed Grid Connection underground cabling route near the Glennfosha and the Clare River. Whereas near the Killeelaun stream, CFRAM flood zones with low and medium probabilities are mapped along the route.

A fluvial map showing the CFRAM Flood Mapping for the present-day scenario is included as **Figure E** below.

4.3.5 National Indicative Fluvial Flood Mapping

The National Indicative Fluvial Flood Mapping (www.floodinfo.ie) shows probabilistic fluvial flood zones for catchments greater than 5km^2 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

[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.*

effects of climate change on flooding have been separately modelled (see **Section 4.3.9** below).
For the Present-Day Scenario, no medium (1 in 100) and low probability (1 in 1,000) fluvial flood zones are mapped within the proposed Wind Farm site. The nearest NIFM fluvial flood zone to the Site is mapped along the Ballinduff stream, situated 2.6km west of the Proposed Wind Farm site. NIFM fluvial flood extents are mapped along the Cregg stream ~4.7km south of the Proposed Wind Farm site. These NIFM flood extents continue along the course of the Cregg stream and also into Lough Corrib downstream.

As such, the entire Proposed Wind Farm site, including all proposed infrastructure is located in Fluvial Flood Zone C, where the probability of fluvial flooding is low (less than 0.1%). A fluvial map showing the National Indicative Fluvial Flood Mapping for the present-day scenario is included as **Figure E** below. Partial sections of the Proposed Grid Connection underground cabling route are mapped within Fluvial flood zones A & B as described above in **Section 4.3.4.**

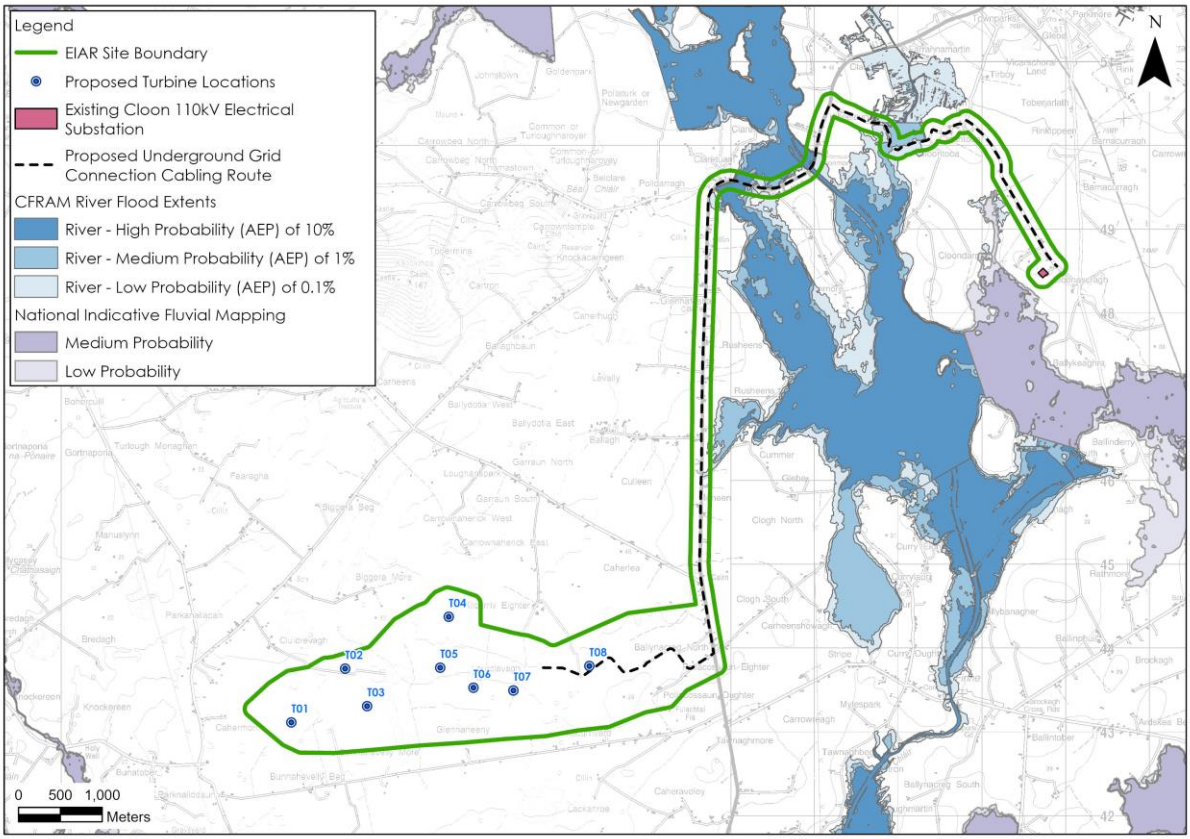

Figure E: OPW CFRAM & National Indicative Flood Mapping

4.3.6 GSI Winter (2015/2016) Surface Water Flood Mapping

The GSI Winter (2015/2016) Surface Water Flooding Map[3] 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. The GSI Winter (2015/2016) Surface Water Flooding Map does not map any surface water flooding areas within the Site.

This map records surface water flooding at Lough Corrib, approximately 4km west / southwest of the Proposed Wind Farm site. Additionally, areas of fluvial and pluvial flood extents during the Winter 2015/2016 flood event are mapped 3km northeast of the Proposed Wind Farm site and within 50m east of the Proposed Grid Connection underground cabling route along the

[3] 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)*

N83. This area coincides with the GSI mapping of karst features in grassland fields adjacent to the road carriageway. A GSI Winter (2015/2016) Surface Water Flooding map is shown below in **Figure F**.

4.3.7 Groundwater Flooding

Groundwater flooding is mapped by the GSI (GSI GWFlood Project)[4] . The groundwater flood modelling highlights areas ~3-7km from the Proposed Wind Farm Site which correspond to mapped turloughs. There are no areas within the Proposed Wind Farm site which are mapped within a groundwater flood zone.

Along the Proposed Grid Connection underground cabling route, an area of modelled groundwater flooding is mapped in the immediate vicinity of the Proposed Grid Connection underground cabling route as it travels along the N83 at the Headford Road Junction. This modelled flood zone correlates with the location of a recurring flood event (ID:1808), as described above in **Section 4.3.1**.

The GSI Groundwater Flooding Data Viewer was also accessed to provide details on the extent of historical groundwater flooding in the area. The data viewer provides maximum historic groundwater flooding extents which are shown in **Figure F.** These extents generally coincide with the known mapped turloughs, particularly the larger Belclare and Killower Turloughs. The proposed turbines and other wind farm site infrastructure are topographically upgradient of these groundwater flood zones, with the closest point of infrastructure being T2, situated ~250m from a historic maximum groundwater flooding area mapped as a ~ 1 Ha area east of T2. During site investigation walkover surveys, water was observed ponding in an area of ~5m^2, situated ~250m from T2. The hydrochemistry of this water indicated it was derived from recent rainfall (low conductivity, low pH) and not from a groundwater source.

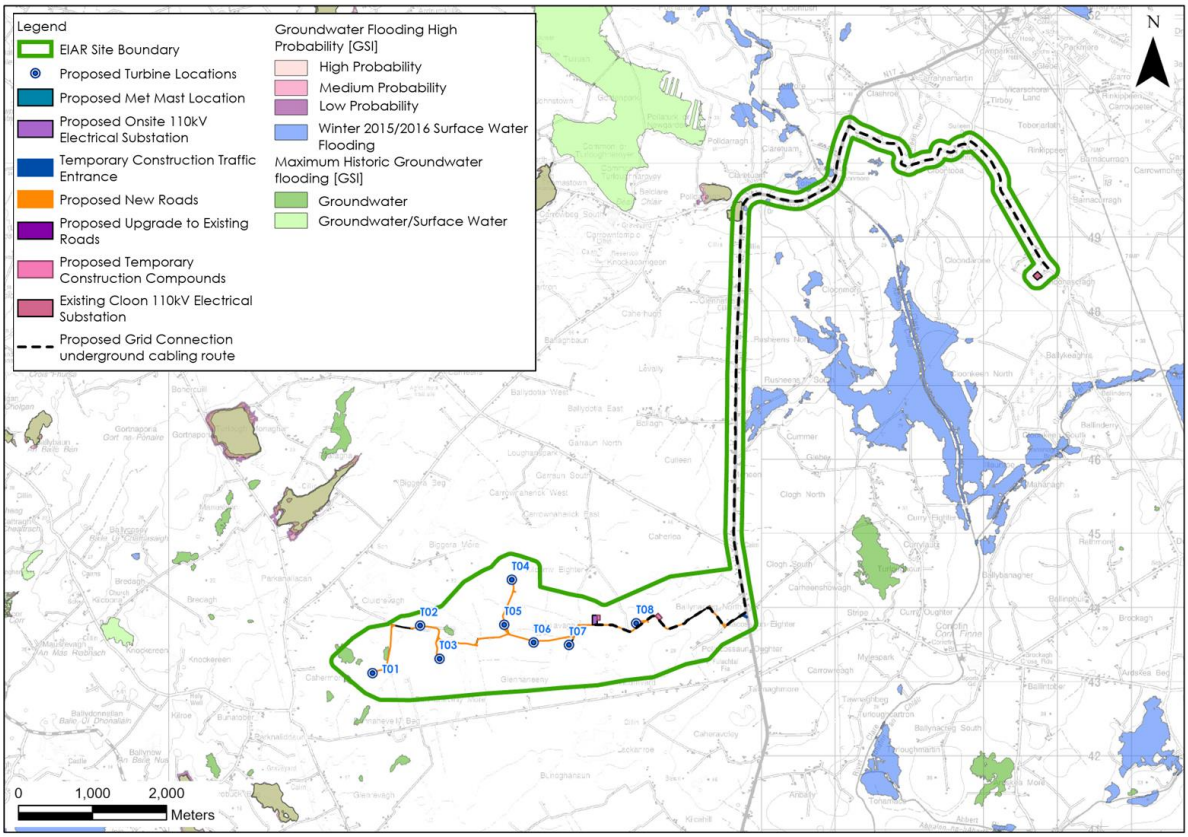

Figure F: Historic Groundwater flood maps and Modelled Groundwater Flood zones

[4] https://www.gsi.ie/en-ie/programmes-and-projects/groundwater-and-geothermal-unit/activities/groundwater-flooding/gwflood-project-2016-2019/Pages/default.aspx

4.3.8 Coastal Flooding

The Site is located 20km inland from the sea and sits at an elevation of ~45-60mOD.

Therefore, the Site is not at risk of coastal (tidal) flooding.

4.3.9 Climate Change

The CFRAM Programme has modelled flooding associated with potential future climate change scenarios. These CFRAM flood zones have 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.

The modelled flood extents show similar flood zones along the Clare River to the Present Day Scenario discussed above in **Section 4.3.4**. Therefore, CFRAM flood zones remain unlikely to encroach the site even in future mid-range and high-range climate change scenarios.

Similarly, there are NIFM flood zones modelled with potential future climate change scenarios. These NIFM 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 in the vicinity of the Site to the Present Day Scenario discussed above in **Section 4.3.5**. Therefore, fluvial flood zones at the site are unlikely to be significantly impacted by future climate change.

4.3.10 Summary – Flood Risk Identification

Based on the information gained through the flood identification process it is apparent that for the most part, the Site is not located in Fluvial Flood Zone A or B. The majority of the Site is located in Fluvial Flood Zone C and is at low risk of flooding. The only areas mapped within Fluvial Flood Zone A or B are where the Proposed Grid Connection underground cabling route crosses the Glennfosha, the Clare River and the Killeelaun watercourses as described above in **Section 4.3.4**.

In terms of historic and modelled groundwater flood extents there are areas in the vicinity and within the site that show the potential for groundwater flooding, however the data from site investigation walkovers (hydrochemistry from water ponding area) indicates that the water is not derived from a groundwater source but is more likely related to recent rainfall and surface water ponding. Nonetheless, all proposed infrastructure within the Proposed Wind Farm site, as described above, are topographically upgradient of these modelled flood zones.

4.4 INITIAL FLOOD RISK ASSESSMENT

4.4.1 Site Survey and Drainage

Detailed walkover surveys of the Proposed Wind Farm site, the Proposed Grid Connection underground cabling route and the surrounding areas was undertaken by HES between December 2021 to December 2023.

There is a distinct lack of local drainage (field drains, ditches, first-order streams etc) within the Proposed Wind Farm site and surrounding area. The topography broadly slopes southwest across the site, although local variations do exist. Any surface water runoff from the site is expected to flow in this direction, however it will infiltrate to ground within a short distance, as evidenced by the lack of drainage channels. No field drains or surface watercourses were observed following numerous site walkover surveys. The agricultural fields are primarily improved grassland, which are well drained.

Drainage along the Proposed Grid Connection underground cabling route is broadly localised to drainage ditches along the road carriageway of the N83, N17 and smaller local roads. The River Clare (Galway)_050 channel (tributary of main River Clare) runs approximately parallel to the N83 road, varying between 0.25 – 1.25km east of the road carriageway. Drainage from the road carriageway will primarily drain in the direction of the tributary of the River Clare, however under baseline rainfall conditions, the surface water will likely infiltrate through the soil/subsoil before reaching the river as shallow baseflow.

4.4.2 Hydrological Flood Conceptual Model

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

There are no apparent sources of flooding at the Proposed Wind Farm site having considered tidal, fluvial and pluvial sources. However, there is potential for groundwater flooding in small, localised areas at the Site.

There is a potential source of surface water flooding along the Proposed Grid Connection underground cabling route, along the N83 road, although the potential implications of this for underground cabling are negligible.

4.4.3 Summary – Initial Flood Risk Assessment

Based on the information gained through the flood identification process and Initial Flood Risk Assessment process flooding is unlikely to be a concern at the Proposed Wind Farm site or downstream of the Proposed Wind Farm site. The potential sources of flood risk for the Proposed Wind Farm site are outlined and assessed in **Table B**.

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 a concern along the Proposed Grid Connection underground cabling route.

Based on the information gained through the flood identification process and Initial Flood Risk Assessment process the sources of flood risk for the Site are outlined and assessed in **Table B.**

Table B. S-P-R Assessment of Flood Sources for the Proposed Wind Farm site.

Source	Pathway	Receptor	Comment
Fluvial	Overbank flooding of the rivers and streams.	Land & infrastructure.	The distinct lack of river/stream channels within the Proposed Wind Farm site means it is located in Fluvial Flood Zone C where there is a low risk of fluvial flooding. Minor sections of the Proposed Grid Connection underground cabling route are mapped within fluvial zones A & B.
Pluvial	Ponding of rainwater on site.	Land & infrastructure.	There is very little risk of pluvial flooding within the Site due to the well drained soil types.
Surface water	Surface ponding/ Overflow.	Land & infrastructure.	Same as above (pluvial).
Groundwater	Rising groundwater levels.	Land & infrastructure.	Based on local hydrogeological regime and GSI mapping, there is localised risk of groundwater flooding at the Site. All proposed infrastructure (turbines, roads, substation) within the Proposed Wind Farm site and along the Grid Connection underground cabling route are topographically upgradient of modelled groundwater flood zones.
Coastal/tidal	Overbank flooding.	Land, People, property.	The Site is ~ 20km inland from the sea and sits at an elevation of ~45-60mOD 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 Test[5] is shown in **Table C** below.

It may be considered that the Proposed Wind Farm can be categorised as "Highly Vulnerable Development". However, as stated above, all proposed wind farm infrastructure is located in Flood Zone C (Low Risk) and therefore the Proposed Wind Farm is appropriate from a flood risk perspective.

The Proposed Grid Connection underground cabling route is considered a "water compatible development" as the cabling will be buried within a 1.3m deep trench, with the exception of watercourse crossings along the Proposed Grid Connection underground cabling route (all of which are already existing). As such, the buried cable is not susceptible to the effects of any minor fluvial flooding/ponding along the road carriageway.

[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).*

Table C: Matrix of Vulnerability versus Flood Zone

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

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

5. REPORT CONCLUSIONS

- A flood risk identification study was undertaken to identify existing potential flood risks associated with the Proposed Laurclavagh Renewable Energy development at Laurclavagh, Co. Galway. From this study:
    - No instances of historical flooding were identified within the Proposed Wind Farm site in historic OS maps. One instance of flooding was identified along the Proposed Grid Connection underground cabling route (along the N83 road);
    - No instances of recurring or historic flooding were identified on OPW maps within the Proposed Wind Farm site;
    - No instances of recurring flood incidents were identified on OPW maps immediately downstream of Wind Farm site;
    - The Proposed Wind Farm site is not identified within the OPW/CFRAM Flood Zones. Partial sections along the Proposed Grid Connection underground cabling route near the Glennfosha, Clare River and the Killeelaun watercourses are identified; and,
    - The Proposed Wind Farm site is not located within any National Indicative Fluvial Flood Zones.
- During the walkover surveys at the Proposed Wind Farm site there was no evidence of widespread flooding. One area of water ponding (~5m^2) was observed in December 2023. Any surface water runoff from the site is expected to flow over very short flowpaths (10's of metres), before infiltrating to ground, as evidenced by the lack of drainage channels;
- The proposed turbines and other wind farm site infrastructure are mapped outside of and are topographically upgradient of all groundwater flood zones mapped within the site;
- The Proposed Wind Farm can be categorised as "Highly Vulnerable Development", however, the proposed infrastructure is located outside of areas mapped as Flood Zones and therefore the Proposed Wind Farm is appropriate from a flood risk perspective;
- The Proposed Grid Connection underground cabling route can be categorised as a water compatible development as any temporary flooding of the N83 road will not affect the operation of the Proposed Grid Connection;
- The overall risk of flooding posed at the Proposed Wind Farm site is 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 Wind Farm footprint is located in fluvial Flood Zone C); and,
- The Proposed Project is considered to be very low risk in terms of flooding potential and will not have an impact on the potential for increased downstream flood risk.

* *

6. REFERENCES

DOEHLG	2009	The Planning System and Flood Risk Management.
Natural Environment Research Council	1975	Flood Studies Report (& maps).
CIRIA	2004	Development and Flood Risk – Guidance for the Construction Industry.
Institute of Hydrology	1994	Flood Estimation in Small Catchments.
Met Eireann	1996	Monthly and Annual Averages of Rainfall for Ireland 1961-1990.