TOBIN

Rooaunalaghta Green Energy Project

Appendix 9-2

Flood Risk Assessment

ROOAUNALAGHTA
Green Energy

BUILT ON KNOWLEDGE

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1. INTRODUCTION

Rooaunalaghta Green Energy Limited intends to seek planning permission to develop a 13 no.-turbine wind farm approximately 2.5km to the south west of Shrule, Co. Mayo and approximately 3.5km to the north west of Headford, County Galway (hereafter referred to as 'Rooaunalaghta Green Energy Project') and have commenced the process of Environmental Impact Assessment. The proposed wind farm will contain thirteen (13) wind turbines, as shown in Figure 1-1 below.

The Planning System and Flood Risk Management (PSFRM) Guidelines[1] categorise types of development into three vulnerability classes based on their sensitivity to flooding. As per Table 2-1 below, the classification of vulnerability of different types of development in the PSFRM Guidelines, infrastructure such as wind turbines are classified as "essential infrastructure" and as such are considered appropriate in Flood Zone C (low probability of flooding i.e., less than 0.1% AEP).

For the purposes of this flood risk assessment, the study area comprises the proposed wind farm site, GCR and the proposed 110 kV substation. The study area is surrounded by greenfield sites. There are no mapped hydraulic features in the proposed wind farm site but the *Cloghmoyne* and *Toorad 30* streams originate in their headwaters south and southeast of the study area respectively. Existing minor agricultural drains occur within the proposed wind farm site. The *Shancloon* stream is located adjacent to the proposed 110 kV substation location. For the TDR, minor works are only proposed at one location to a small area of footpath in Galway City where a surface water drainage system is already installed. Otherwise, the TDR only requires vegetation trimming and temporary signage demounting, and so the turbine delivery route is not considered further in this assessment.

An initial screening of available flood-risk information identified potential pluvial and groundwater flood features in the wider study area and limited mapped fluvial information at the proposed 110 kV substation. A Stage 2 FRA was therefore undertaken to provide a more detailed appraisal of flood risk to the proposed project. The purpose of this Stage 2 FRA report is to identify, quantify, and communicate the risks of flooding, if any, to the proposed project.

[1] https://assets.gov.ie/static/documents/the-planning-system-and-flood-risk-management-guidelines-for-planning-authorities-nov-.pdf

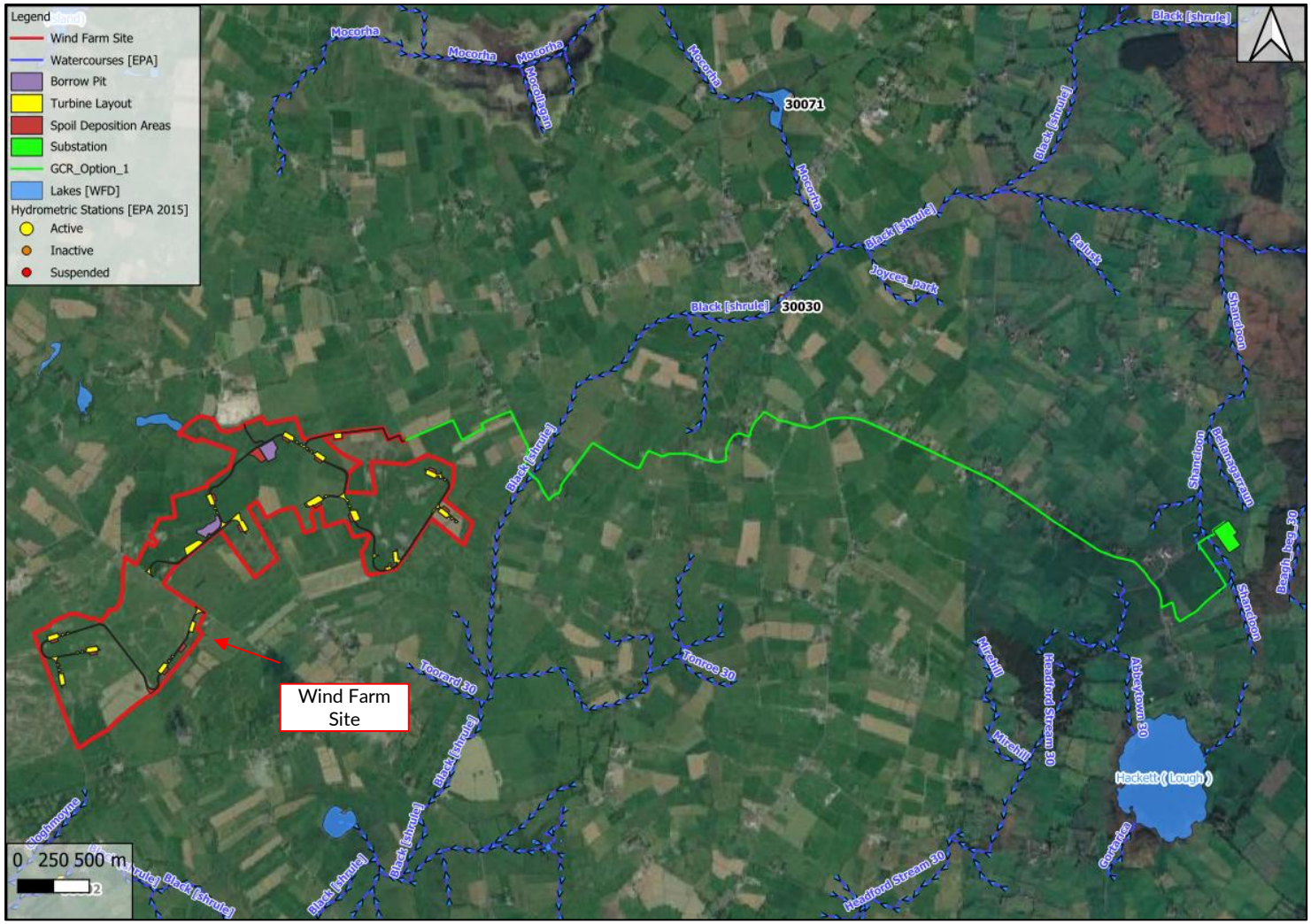


Figure 1-1: Site Location (Study area includes the proposed wind farm site, the GCR and the proposed 110 kV substation)

1.1 PROPOSED PROJECT DESCRIPTION

A detailed description of the Proposed Project is included in Chapter 2. A summary of the proposed project is as follows:

- 13 no. wind turbines with a blade tip height of 150 m, a rotor diameter of 136 m, a hub height of 82 m, and all associated foundations and hard-standing areas in respect of each turbine;
- Creation of two new permanent site entrances onto the R334 Regional Road;
- Two temporary construction compounds with associated temporary site offices, parking areas and security fencing;
- One borrow pit. All works associated with the opening, aggregate and spoil extraction, and decommissioning of the borrow pit;
- New internal site access tracks, to include passing bays and all associated drainage;
- A temporary new access track to connect to the boundary of an adjacent operating quarry;
- Construction of drainage and sediment control systems;
- New on-site control building
- Construction of one permanent loop-in 110 kV electrical substation compound including
    - Two control buildings containing worker welfare facilities;
    - Electrical infrastructure and grid ancillary services equipment
    - Parking
    - Lighting
    - Fencing
    - Wastewater holding tank
    - Rainwater harvesting equipment
    - Communications equipment and storage
    - Associated electrical plant
    - All associated infrastructure, services, and site works including landscaping
- All works associated with the connection of the proposed wind farm to the proposed 110 kV substation, which will be via a 33 kV underground cable connection (circa 8.7 km in length), including 4 no. watercourse crossings, and the onward connection from the proposed 110 kV substation to the existing overhead line via 110 kV cables and steel lattice interface masts;
- All associated infrastructure and services including site works, signage and underground electrical and communications cabling connecting the wind turbines to the proposed wind farm on-site control building;
- A lidar unit, and associated foundation and hard-standing area;

- All related site works and ancillary development including site drainage, security gates, fencing, permanent and temporary signage, berms, landscaping, soil excavation and biodiversity mitigation and enhancements, including habitat, hedgerow and treeline removal, creation and management.
- Temporary additional works required within the public road corridor to accommodate delivery of oversize turbine components.

Figure 1-2: Site Layout

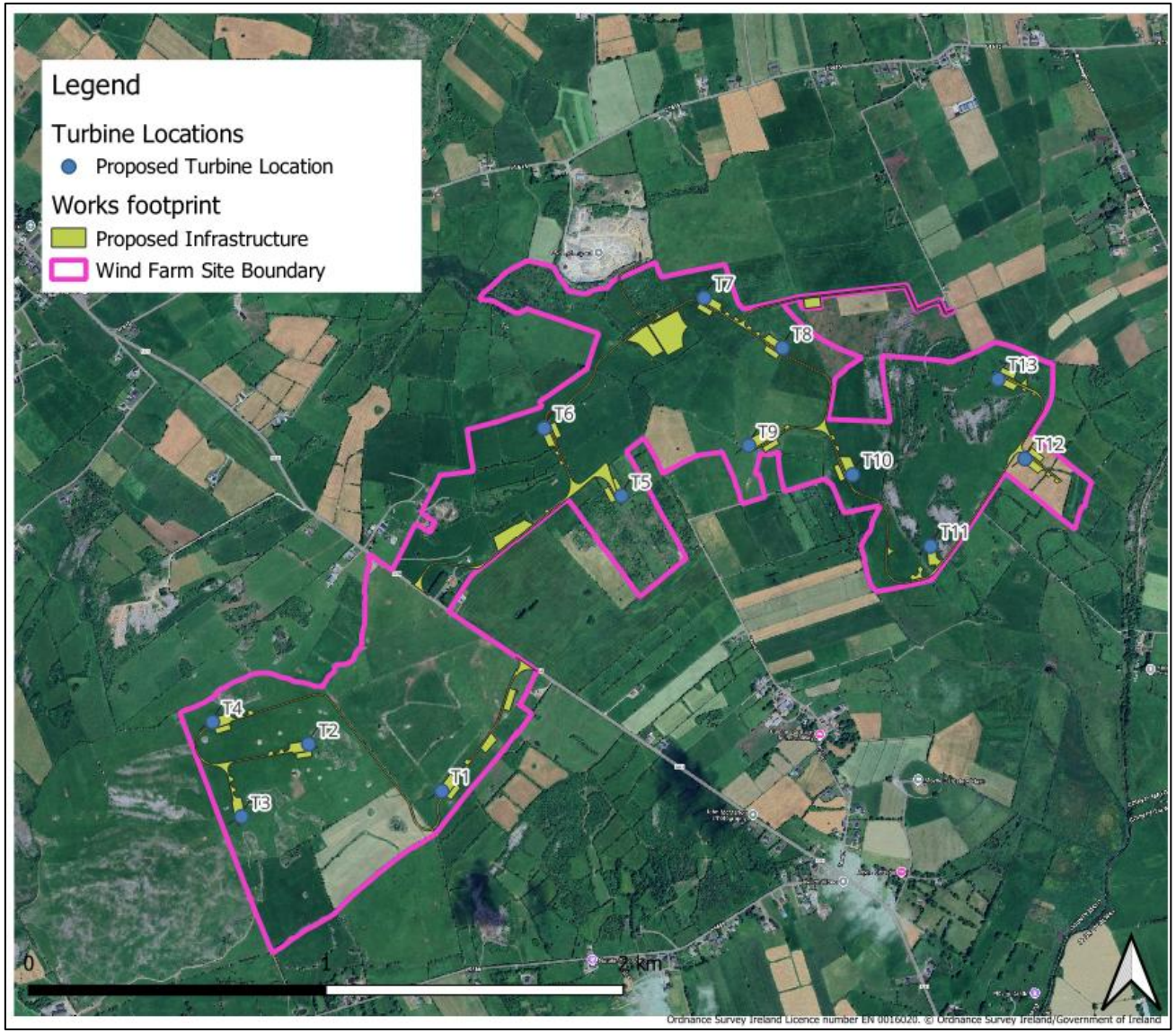


Figure 1-3: Proposed Grid Connection Route



2. FLOOD RISK MANAGEMENT GUIDANCE

This Stage 2 Flood Risk Assessment was carried out in accordance with the following flood risk management guidance documents:

- The Planning System and Flood Risk Management Guidelines for Planning Authorities
- Flood Risk Management Climate Change Sectoral Adaptation Plan
- Mayo County Development Plan (2022 – 2028)
- Galway County Development Plan (2022 – 2028)

2.1 THE PLANNING SYSTEM AND FLOOD RISK MANAGEMENT GUIDELINES

The Planning System and Flood Risk Management Guidelines for Planning Authorities (PSFRM Guidelines) were published in 2009 by the Office of Public Works (OPW) and Department of the Environment, Heritage, and Local Government (DoEHLG). Their aim is to ensure that flood risk is considered in development proposals and the assessment of planning applications.

2.1.1 Flood Zones and Vulnerability Classes

The PSFRM Guidelines discuss flood risk in terms of three flood zones (A, B, and C), which correspond to areas of high, medium, or low probability of flooding, respectively. The extents of each flood zone are based on the Annual Exceedance Probability (AEP) of various flood events.

The PSFRM Guidelines also categorise different types of development into three vulnerability classes based on their sensitivity to flooding. The guidelines classify essential infrastructure as "highly vulnerable" and are therefore considered appropriate in Flood Zone C (less than 0.1% AEP).

Table 2-1 shows a decision matrix that indicates which types of development are appropriate in each flood zone and when the Justification Test (see Section 2.1.2) must be satisfied. The annual exceedance probabilities used to define each flood zone are also provided.

Table 2-1: Decision Matrix for Determining the Appropriateness of a Development

Flood Zone: (Probability)	Annual Exceedance Probability (AEP)	Highly Vulnerable	Less Vulnerable	Water Compatible
A (High)	Coastal Flooding: More frequent than 0.5% AEP Fluvial & Pluvial Flooding: More frequent than 1% AEP	Justification Test Required	Justification Test Required	Appropriate
B (Medium)	Coastal Flooding: 0.1% to 0.5% AEP Fluvial & Pluvial Flooding: 0.1% to 1% AEP	Justification Test Required	Appropriate	Appropriate
C (Low)	Fluvial, Pluvial & Coastal Flooding: Less frequent than 0.1% AEP	Appropriate	Appropriate	Appropriate

2.1.2 Justification Test

Any proposed development being considered in an inappropriate flood zone (as determined by Table 2-1) must satisfy the criteria of the Justification Test outlined in Figure 2-1 (taken from the PSFRM Guidelines).

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: See section 5.27 in relation to major development on zoned lands where sequential approach has not been applied in the operative development plan.

Refer to section 5.28 in relation to minor and infill developments.

Figure 2-1: Criteria of the Justification Test

2.2 The Flood Risk Management Climate Adaptation Plan

The Flood Risk Management Climate Change Sectoral Adaptation Plan was published in 2019 under the National Adaptation Framework and Climate Action Plan. An updated draft for this

plan was issued in 2025[2], outlining the OPW's approach to climate change adaptation in terms of flood risk management.

This approach is based on a current understanding of the potential impacts of climate change on flooding and flood risk. Research has shown that climate change is likely to worsen flooding through more extreme rainfall patterns, more severe river flows, and rising mean sea levels.

To account for these changes, the Adaptation Plan presents two future flood risk scenarios to consider when assessing flood risk:

- Mid-Range Future Scenario (MRFS)
- High-End Future Scenario (HEFS)

Table 2-2 indicates the allowances that should be added to estimates of extreme rainfall depths, peak flood flows, and mean sea levels for the future scenarios.

Table 2-2: Climate Change Adaptation Allowances for Future Flood Risk Scenarios

Parameter	Mid-Range Future Scenario (MRFS)	High-End Future Scenario (HEFS)
Extreme Rainfall Depths	+ 20%	+ 30%
Peak River Flood Flows	+ 20%	+ 30%
Mean Sea Level Rise	+ 0.5 m	+ 1 m

For the purpose of this flood risk assessment, the proposed project has been assessed against the Mid-Range Future Scenario as it represents a likely future scenario.

2.3 Mayo County Development Plan (2022 – 2028)

The Mayo County Development Plan 2022-2028 was adopted by Local Members at a meeting on the 29 June 2022 and came into effect on the 10 August 2022.

Chapter 7 of the plan outlines Mayo County Council's strategy for the management of Infrastructure, with Section 7.4.3.2 detailing the proposed approach to Flood Risk Management, and setting out the following key policies and objectives:

[2] FRM_SAP_DRAFT.pdf

Flood Risk Management Policies	
INP 14	To have regard to the Guidelines for Planning Authorities on the Planning System and Flood Risk Management (DoEHLG/OPW 2009) and Circular PL2/2014 (or as updated), in the preparation of plans and strategies related to development and in the assessment of projects.
INP 15	To support the implementation of the recommendations in the Flood Risk Management Plans (FRMP's), including planned investment measures for managing and reducing flood risk.
INP 16	To support the implementation of recommendations in the CFRAM Programme to ensure that flood risk management policies and infrastructure are progressively implemented.

Flood Risk Management Objectives	
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.
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.
INO 21	To assist the OPW in developing catchment-based Flood Risk Management Plans for rivers in County Mayo and have regard to their provisions/recommendations.
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.
INO 23	To ensure that where flood risk management works take place that natural heritage, cultural heritage, rivers, streams and watercourses are appropriately protected.
INO 24	To 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.
INO 25	To 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.
INO 26	To cooperate with the Office of Public works in the delivery of the Crossmolina Flood Relief scheme and other schemes that may be brought forward in the lifetime of this Plan.
INO 27	To identify and preserve vulnerable floodplains, wetlands and coastal areas to the maximum possible extent in both urban and rural areas.
INO 28	Developments on all Opportunity Sites in all towns and villages in the Settlement Hierarchy will be subject to Flood Risk Assessments if required, 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, and this will determine the scale and nature of the development.

A Strategic Flood Risk Assessment (SFRA) has been prepared for Co. Mayo, to guide the management of flood risk in preparing the County Development Plan. The SFRA recommends the following relevant policies for development in Co. Mayo[3]:

> *In areas where there are no formal land use zoning objectives, the Justification Test cannot pass for any sites within Flood Zone A/B. It would be down to a site-specific FRA to confirm (in appropriate detail) the extent of Flood Zone A/B.*
>
> *Development Proposals in Flood Zone C—Where a site is within Flood Zone C but adjoining or in close proximity to Flood Zone A or B there could be a risk of flooding associated with factors such as future scenarios (climate change) or in the event of failure of a defence, blocking of a bridge or culvert. Risk from sources other than fluvial must also be addressed for all development in Flood Zone C. As a minimum in such a scenario, a flood risk assessment should be undertaken which will screen out possible indirect sources of flood risk and where they cannot be screened out, it should present mitigation measures. The most likely mitigation measure will involve setting finished floor levels to a height that is above the 1 in 100-year fluvial flood level, with an allowance for climate change and freeboard, or to ensure a step up from road level to prevent surface water ingress. Design elements such as channel maintenance or trash screens may also be required. Evacuation routes in the event of inundation of surrounding land should also be detailed.*
>
> *Highly Vulnerable development in Flood Zone A or B - Highly Vulnerable development includes; dwelling houses, hospitals, emergency services and caravan parks. A comprehensive categorisation of land use and vulnerability is provided in Chapter 3 of the Planning System and Flood Risk Management Guidelines.*
>
> *With regards to new development the SFRA states that: It is not appropriate for new, highly vulnerable, development to be located in Flood Zones A or B outside the core of a settlement. Such proposals do not pass the Justification Test for Development Plans. Instead, a less vulnerable or water compatible use should be considered. In some cases, land use objectives which include for highly vulnerable uses have been justified in the Development Plan. This includes zonings focused around an urban core which allow for a mix of residential, commercial and other uses. In such cases, a sequential approach to land use within the site must be taken and will consider the presence or absence of defences, land raising and provision of compensatory storage, safe access and egress in a flood and the impact on the wider development area.*

Key points for FRA for all types of developments as stated in the SFRA are:

- Finished floor levels to be set above the 1% AEP fluvial (0.5% AEP tide) level, with an allowance for climate change plus a freeboard of at least 300mm. The freeboard allowance should be assessed, and the choice justified.
- Flow paths through the site and areas of surface water storage should be managed to maintain their function and without causing increased flood risk elsewhere.

[3] https://www.mayo.ie/getmedia/93834538-bf0f-4e74-aa64-8dd4e5f91a74/Vol-5-Draft-Strategic-Flood-Risk-Assessment.pdf

- Compensatory storage is to be provided to balance floodplain loss as a result of raising ground levels within Flood Zone A. The storage should be provided within the flood cell and on a level for level basis up to the 1% level.
- In a defended site, compensatory storage is not required, but the impact of removing the net reduction in floodplain storage should be assessed, and any impacts to existing development mitigated for the 0.1% event or a breach of these defences.
- A site is considered to be defended if the standard of protection is 1% AEP, within which a freeboard of at least 300mm is included. The FFL of the proposed project needs to take into account the impacts of climate change and other residual risks, including the 0.1% event, unless this has also been incorporated into the defence design. This may be assessed through breach analysis, overtopping analysis or projection of levels from the channel inland.

2.4 Galway County Development Plan 2022-2028

Although the proposed wind farm site (i.e. the majority of proposed infrastructure) is located in County Mayo, the proposed 110 kV substation and parts of the GCR are located in County Galway. The Galway County Development Plan for 2022 to 2028 was adopted by the Elected Members of Galway County Council at the conclusion of the Special Meeting on the 9th of May 2022 and came into effect on the 20th of June 2022.

Chapter 14 of the Galway County Development Plan 2022-2028 outlines the County plan for Climate Change, Energy and Renewable Resource. Section 14.6 of the Galway County Development Plan discusses Flooding and Flood Risk Management for the County.

The Strategic Flood Risk Assessment for County Galway generally confirms the flood extents identified in the OPW Preliminary Flood Risk Assessment (PFRA) mapping and Catchment Flood Risk Assessment and Management Study (CFRAM) mapping.

The relevant objectives of the plan relating to flood risk are outlined below:

ObjectiveFL1 Flood Risk Management Guidelines

It is the policy objective of Galway County Council to support, in co-operation with the OPW, the implementation of the EU Flood Risk Directive (2007/60/EC), the Flood Risk Regulations (SI No. 122 of 2010) and the DEHLG/OPW publication The Planning System and Flood Risk Management Guidelines (2009) (and any updated/superseding legislation or policy guidance) and Department Circular PL2/2014 or any updated / superseding version.

Objective FL 2 Flood Risk Management and Assessment

Comply with the requirements of the DoEHLG/OPW The Planning System and Flood Risk Management Guidelines for Planning Authorities and its accompanying Technical Appendices Document 2009 (including any updated/superseding documents).

This will include the following:

a) *Avoid, reduce and/or mitigate, as appropriate in accordance with the Guidelines;*

b) *Development proposals in areas where there is an identified or potential risk of flooding or that could give rise to a risk of flooding elsewhere will be required to carry out a Site-Specific Flood Risk Assessment, and justification test where appropriate, in accordance with the provisions of The Planning System and Flood Risk Management Guidelines 2009 (or any superseding document); Any flood risk assessment should include an assessment of the potential impacts of climate change, such as an increase in the extent or probability of flooding, and any associated measures necessary to address these impacts;*

c) *Development that would be subject to an inappropriate risk of flooding or that would cause or exacerbate such a risk at other locations shall not normally be permitted;*

d) *Galway County Council shall work with other bodies and organisations, as appropriate, to help protect critical infrastructure, including water and wastewater, within the County, from risk of flooding.*

Objective FL 3 Principles of the Flood Risk Management Guidelines

The Planning Authority shall implement the key principles of flood risk management set out in the Flood Risk Management Guidelines as follows:

a) *Avoid development that will be at risk of flooding or that will increase the flooding risk elsewhere, where possible;*

b) *Substitute less vulnerable uses, where avoidance is not possible; and*

c) *Mitigate and manage the risk, where avoidance and substitution are not possible.*

Development should only be permitted in areas at risk of flooding when there are no alternative, reasonable sites available in areas at lower risk that also meet the objectives of proper planning and sustainable development. Vulnerable development in areas which have the highest flood risk should be avoided and/or only considered in exceptional circumstances (through a prescribed Justification Test) if adequate land or sites are not available in areas which have lower flood risk.

Objective FL 4 Flood Relief Schemes

The Planning Authority shall support and co-operate with the Office of Public Works (OPW) in the delivery of Flood Relief Schemes.

Objective FL 5 Catchment Planning

The Planning Authority will support the OPW'S CFRAM Programme and catchment-based Flood Planning Groups, especially where catchments go beyond the Council's administrative boundary, in the development and implementation of catchment-based strategies for the management of flood risk - including those relating to storage and conveyance.

Objective FL 6 Surface Water Drainage and Sustainable Drainage Systems (SuDs)

Maintain and enhance, as appropriate, the existing surface water drainage system in the County. Ensure that new developments are adequately serviced with surface water drainage infrastructure and promote the use of Sustainable Drainage Systems in all new developments. Surface water run-

off from development sites will be limited to pre-development levels and planning applications for new developments will be required to provide details of surface water drainage and sustainable drainage systems proposals.

Objective FL 7 Protection of Waterbodies and Watercourses

Protect waterbodies and watercourses within the County from inappropriate development, including rivers, streams, associated undeveloped riparian strips, wetlands and natural floodplains. This will include protection buffers in riverine, wetland and coastal areas as appropriate.

Objective FL 10 SFRA/FRA and Climate Change

SFRAs and site-specific FRAs shall provide information on the implications of climate change with regard to flood risk in relevant locations. The 2009 OPW Draft Guidance on Assessment of Potential Future Scenarios for Flood Risk Management (or any superseding document) shall be consulted with to this effect.

Objective FL 11 SFRA/FRA and Climate Change

Flood risk may constitute a significant environmental effect of a development proposal that in certain circumstances may trigger a sub-threshold EIA. FRA should therefore be an integral part of any EIA undertaken for projects within the County.

Objective FL 14 CFRAM

It is Council policy objective to ensure that applications pertaining to existing developments in flood vulnerable zones provide details of structural and non-structural risk management measures to include, but not be limited to specifications of the following - floor levels, internal layout, flood resilient construction, flood resistant construction, emergency response planning, access and egress during flood events.

3. INITIAL FLOOD RISK ASSESSMENT

3.1 PAST FLOOD EVENTS

The OPW's National Flood Information Portal[4] provides past flood event mapping with records of flooding reports, meeting minutes, photos, and/or hydrometric data. Based on the flood map shown in Figure 3-1, there are no past flood events in the vicinity of the study area, the closest past flood event (Flood ID 1071) is located 1.35 km west of the proposed wind farm site. This is a recurring turlough flood event caused by prolonged rainfall and groundwater flooding has been recorded between the Turlough and the site.

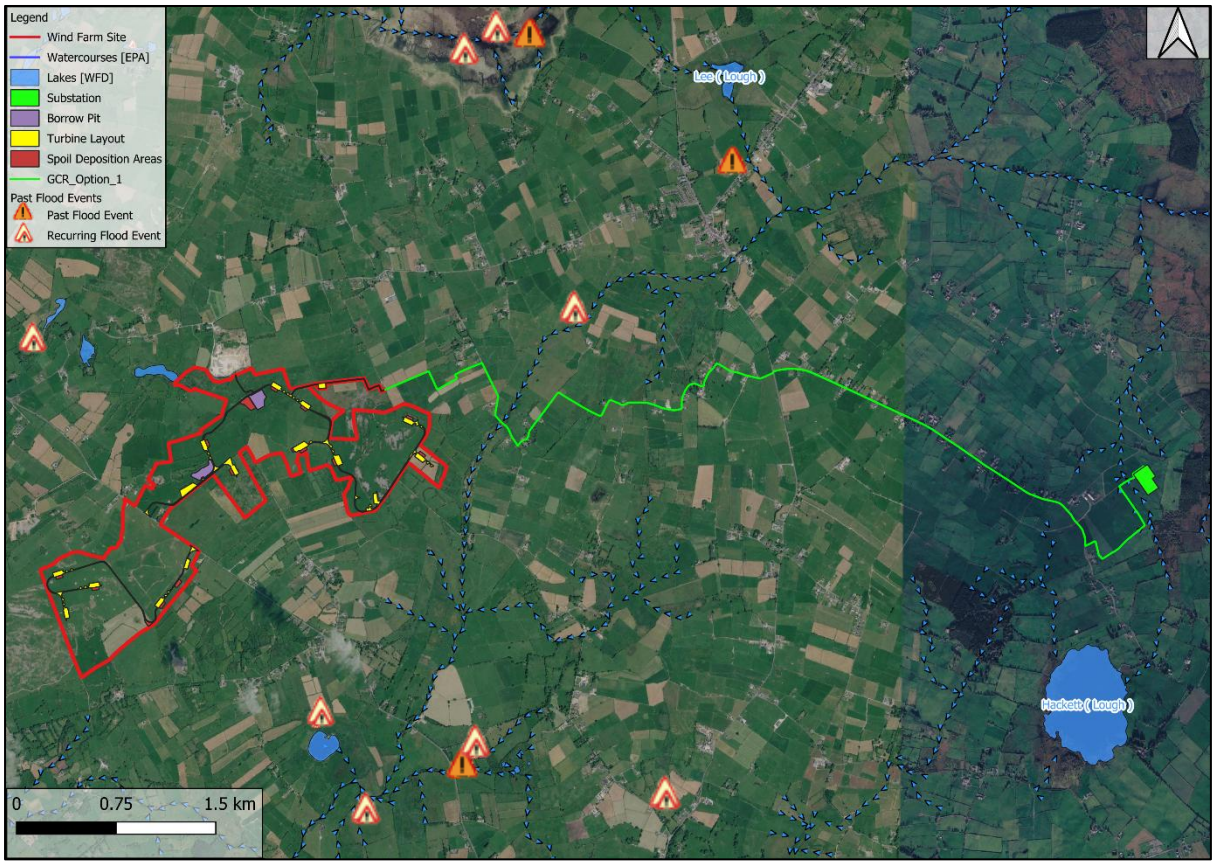


Figure 3-1: Past Flood Events

The closest recorded historical flood event to the wind farm site occurred in an area with a ground level of approximately 29 mOD. This location lies within a local topographic low point to the east of two elevated hill areas. While a lower-lying corridor exists between the two hills, its minimum ground level is approximately 32 mOD, which prevents any direct overland flow path from the historical flood location to the wind farm site. Furthermore, the nearest turbine to this flood event, located along this corridor, has a ground level of approximately 37mOD, providing an additional 8 m of elevation above the recorded flood location. (see Figure 3-2).

[4] floodinfo.ie

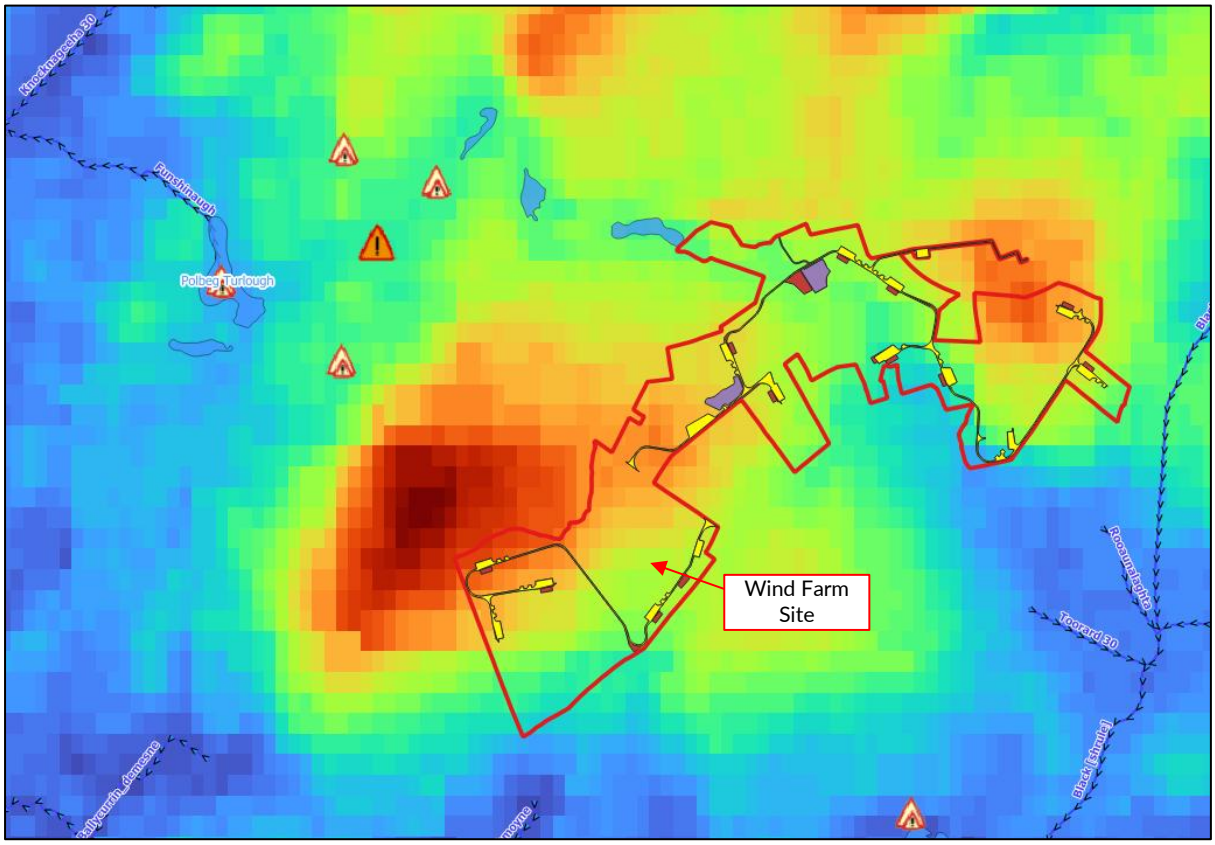


Figure 3-2: Site surface topography (red being higher elevations and blue being lower elevations)

3.2 OPW Preliminary Flood Risk Assessment (PFRA) Study

In 2009, the OPW produced a series of maps to assist in the development of a broad-scale FRA throughout Ireland. These maps were produced from several sources.

The OPW's National Preliminary Flood Risk Assessment (PFRA) Overview Report from March 2012 noted that *"the flood extents shown on these maps are based on broad-scale simple analysis and may not be accurate for a specific location"*. The PFRA was intended as a high-level screening assessment based on available information to identify Areas for Further Assessment (AFAs), rather than a detailed flood modelling exercise.

Figure 3-3 to Figure 3-6 provides an overview of the fluvial, coastal, pluvial, and groundwater indicative flood extents in the vicinity of the proposed wind farm site.

As per Figure 3-3 and Figure 3-5, the proposed wind farm site is not predicted to be liable to fluvial, coastal, or groundwater flooding during extreme events. The borrow pit and turbines T10, T6, and T1 are susceptible to pluvial flooding in a 1% AEP event. Some sections of the GCR and access tracks may also be liable to pluvial flooding. The GCR is underground and will be watertight, so the risk of flooding is very low.

As per Figure 3-4, the substation is not predicted to be liable to fluvial, coastal, groundwater, or pluvial flooding.

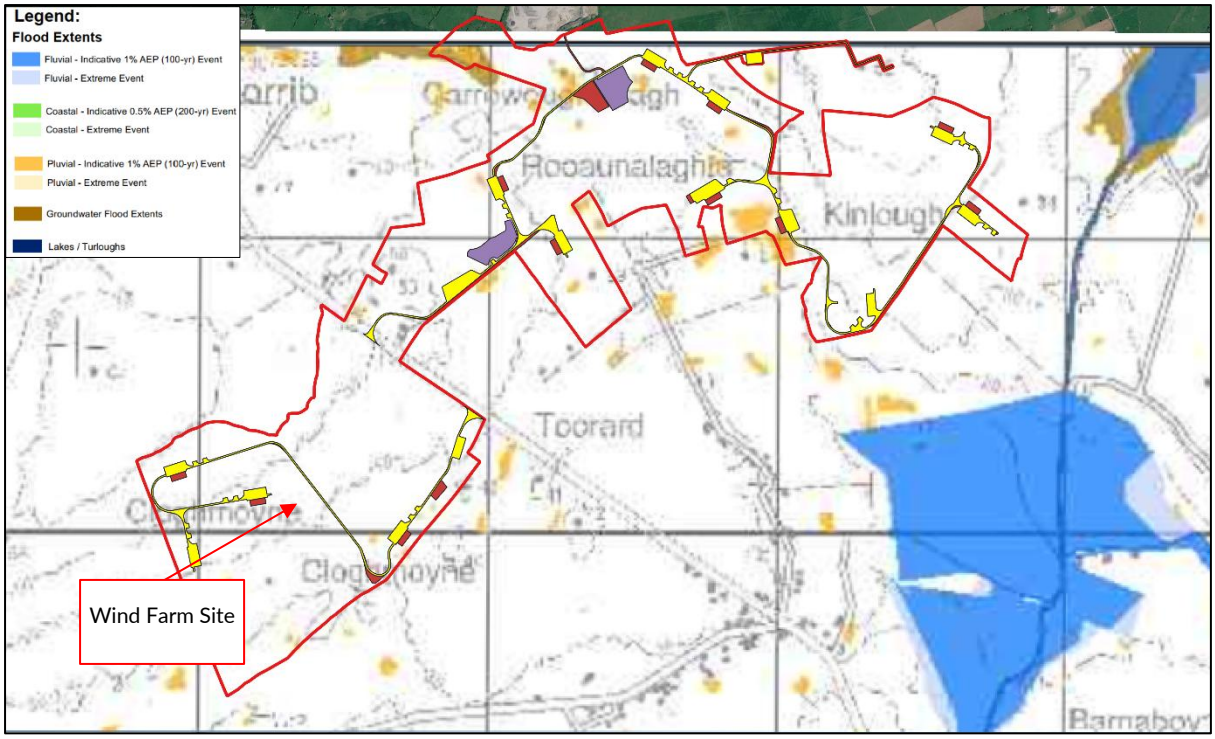


Figure 3-3: Indicative Flood Mapping [extract from PFRA Map 244]

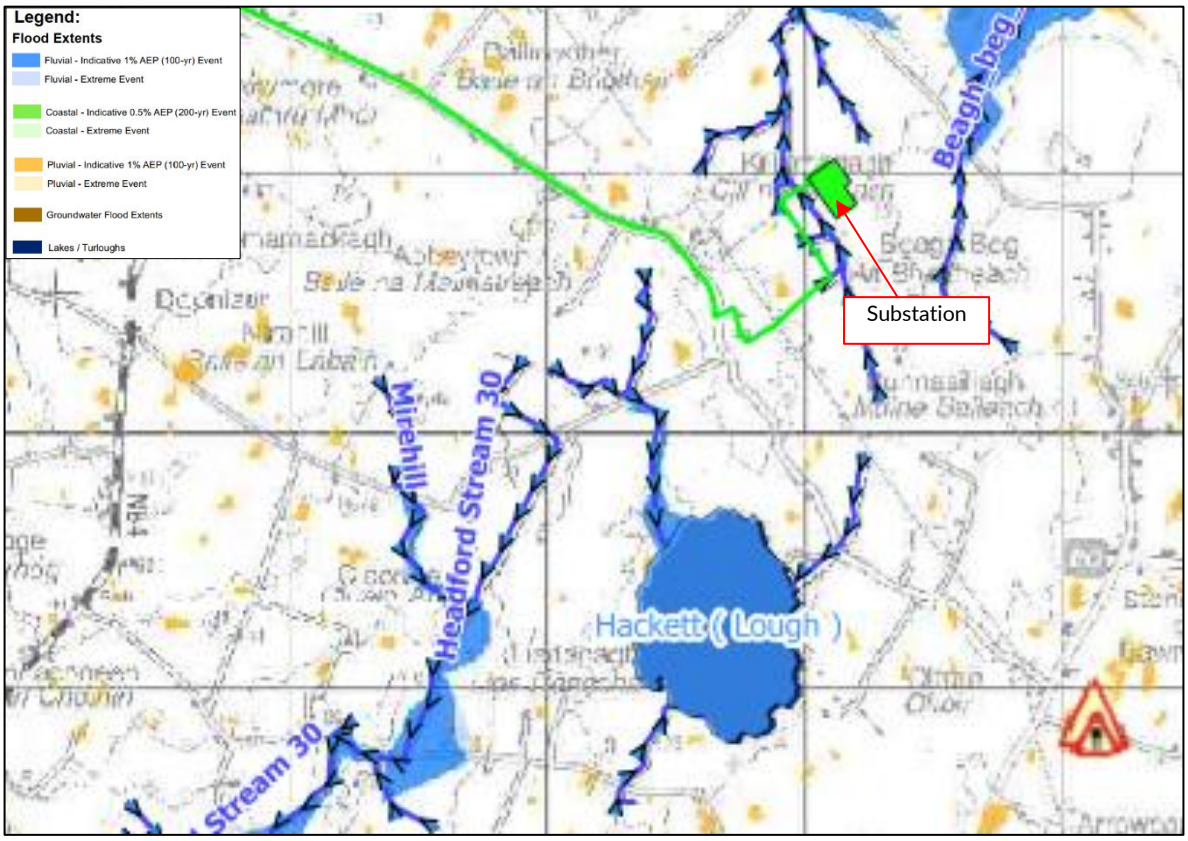


Figure 3-4: Indicative Flood Mapping [extract from PFRA Map 245]

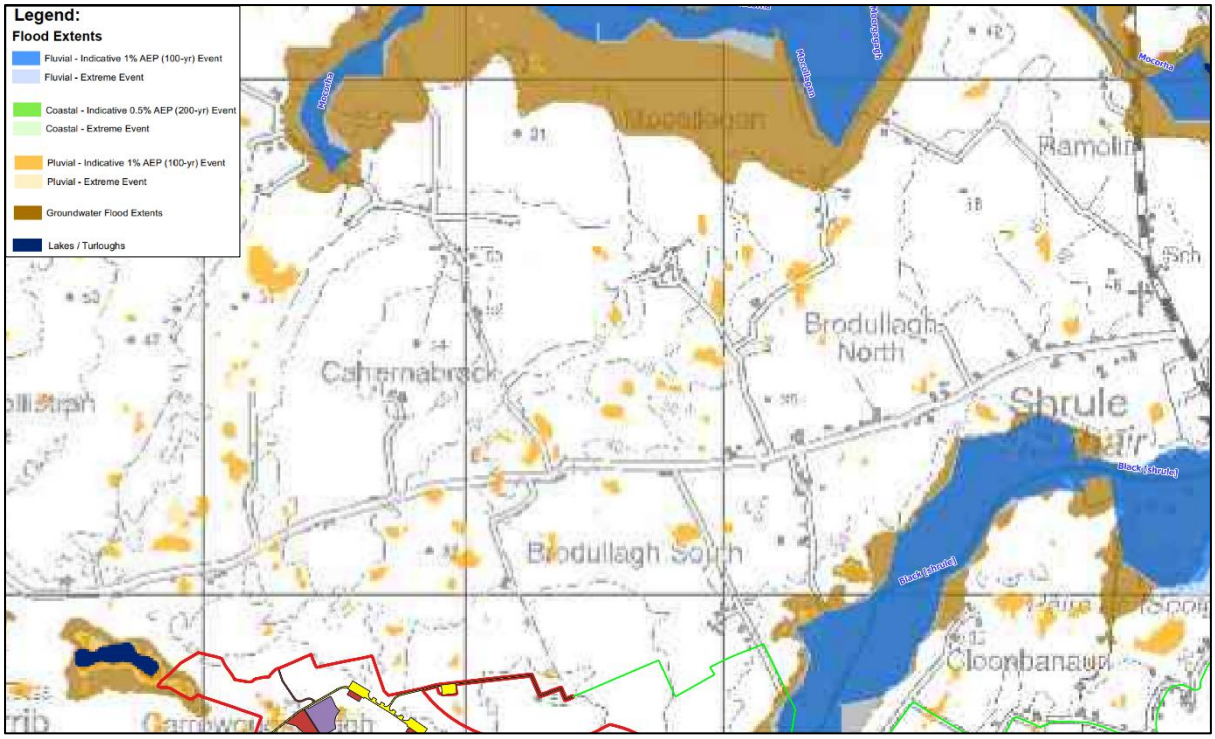


Figure 3-5: Indicative Flood Mapping [extract from PFRA Map 262]

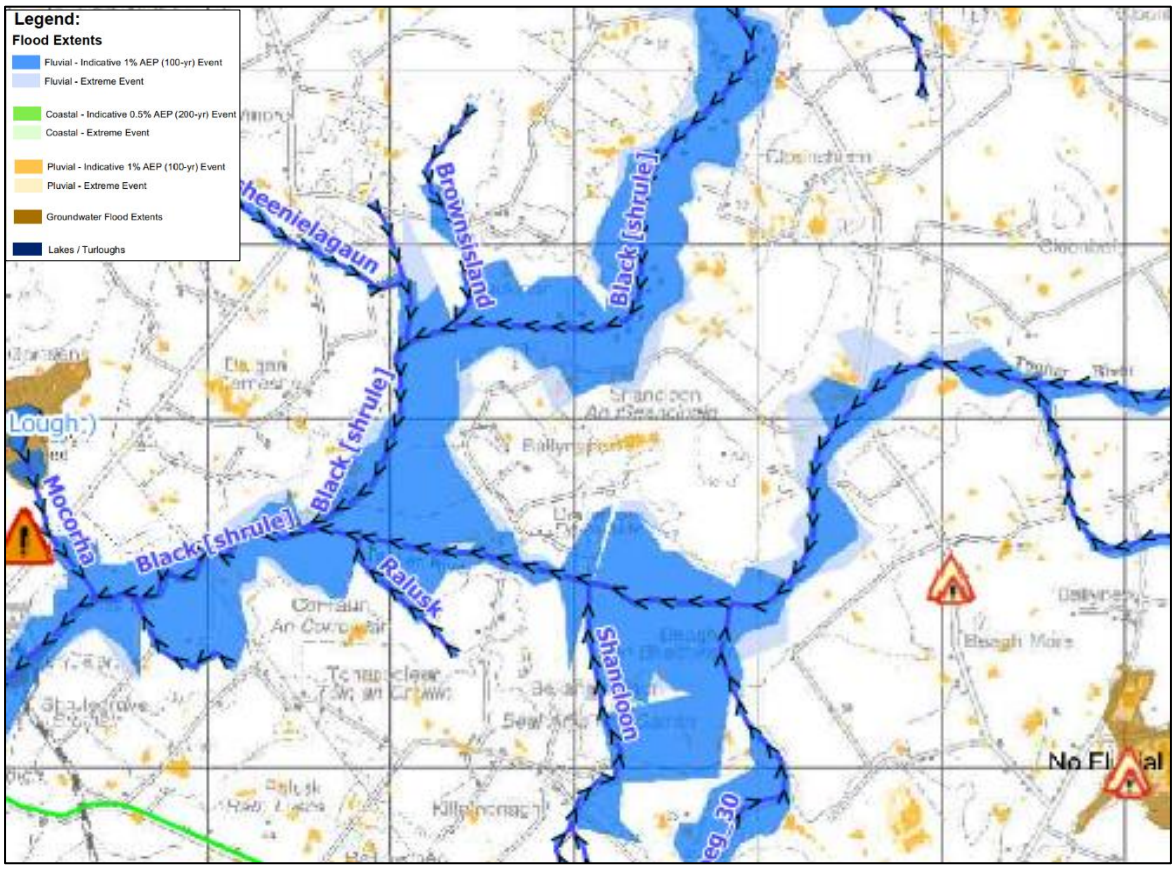


Figure 3-6: Indicative Flood Mapping [extract from PFRA Map 263]

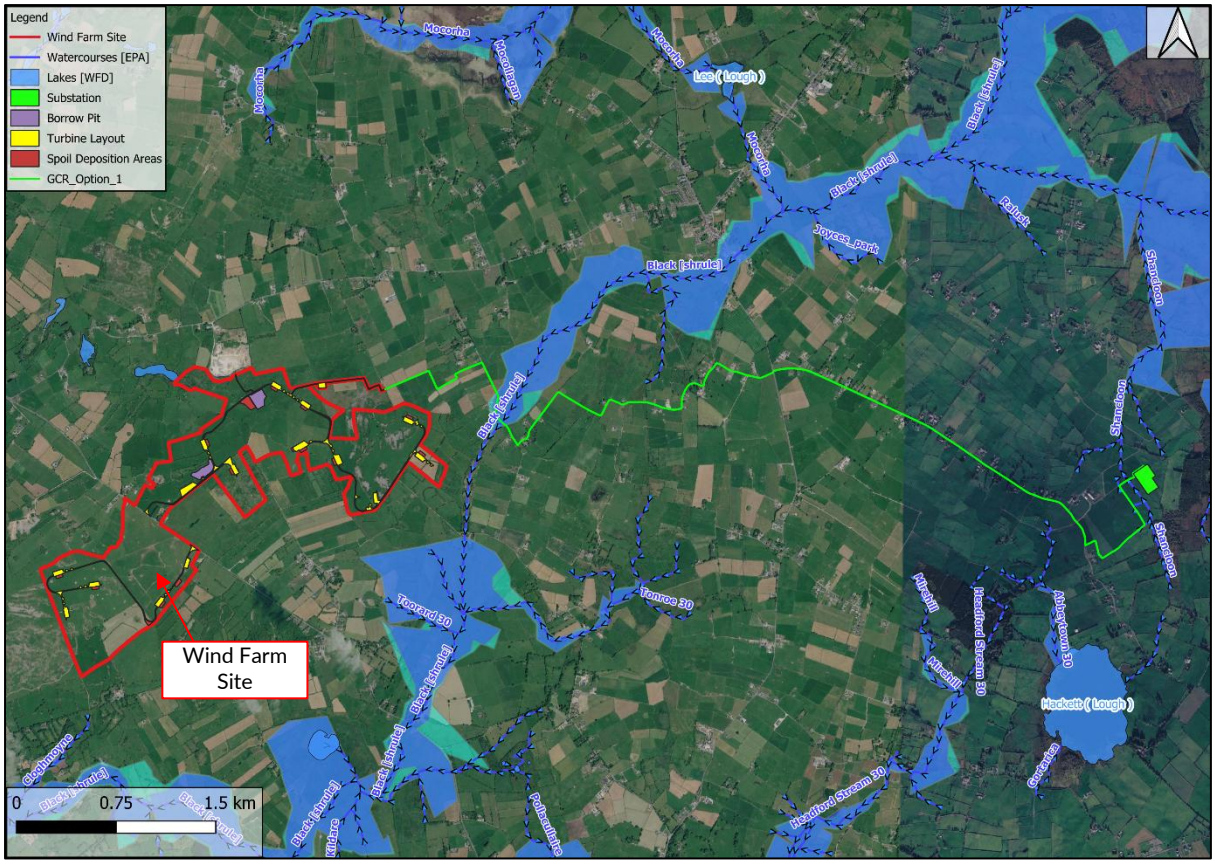


Figure 3-7: PFRA Flood Extents

The PFRA mapping indicates that the study area is not liable to fluvial flooding with the closest flood extents being 380 m northeast of the study area. The proposed 110 kV substation does not show any flood extents in its vicinity; however, it is believed that the PFRA study was not undertaken in this area, therefore, further investigation into its fluvial flood risk liability will be required, see Section 4.1. The grid connection route traverses the River *Black* and a second watercourse; however, the grid connection will be underground and watertight therefore resulting in no flood risk to the connections.

Limitations on potential sources of error associated with the PFRA maps include:

- Assumed channel capacity (due to absence of channel survey information)
- Absence of flood defences and other drainage improvements and channel structures (bridges, weirs, culverts)
- Local errors in the national Digital Terrain Model (DTM)

CFRAM mapping was not available in the vicinity of the study area and therefore was not used in this assessment.

3.3 National Indicative Fluvial Mapping (NIFM)

In 2020, the OPW produced the second-generation indicative fluvial flood mapping, improving upon the first generation PFRA and producing higher quality flood maps[5].

The NIFM Flood Mapping Technical Data notes that *"Cross sectional surveys have not been used to define the dimensions of river channels and structures within the 2D model. Channels have been represented in the 2D model by assuming their channel capacity is equivalent to the estimation of [the index flood flow]"* [6]. The 2D model uses a Digital Terrain Model with a grid scale of 5m.

Figure 3-8 provides an overview of the 1 in 100-year (1% AEP) and 1 in 1,000-year (0.1% AEP) flood event mapping for the River *Black* and some of its tributaries.

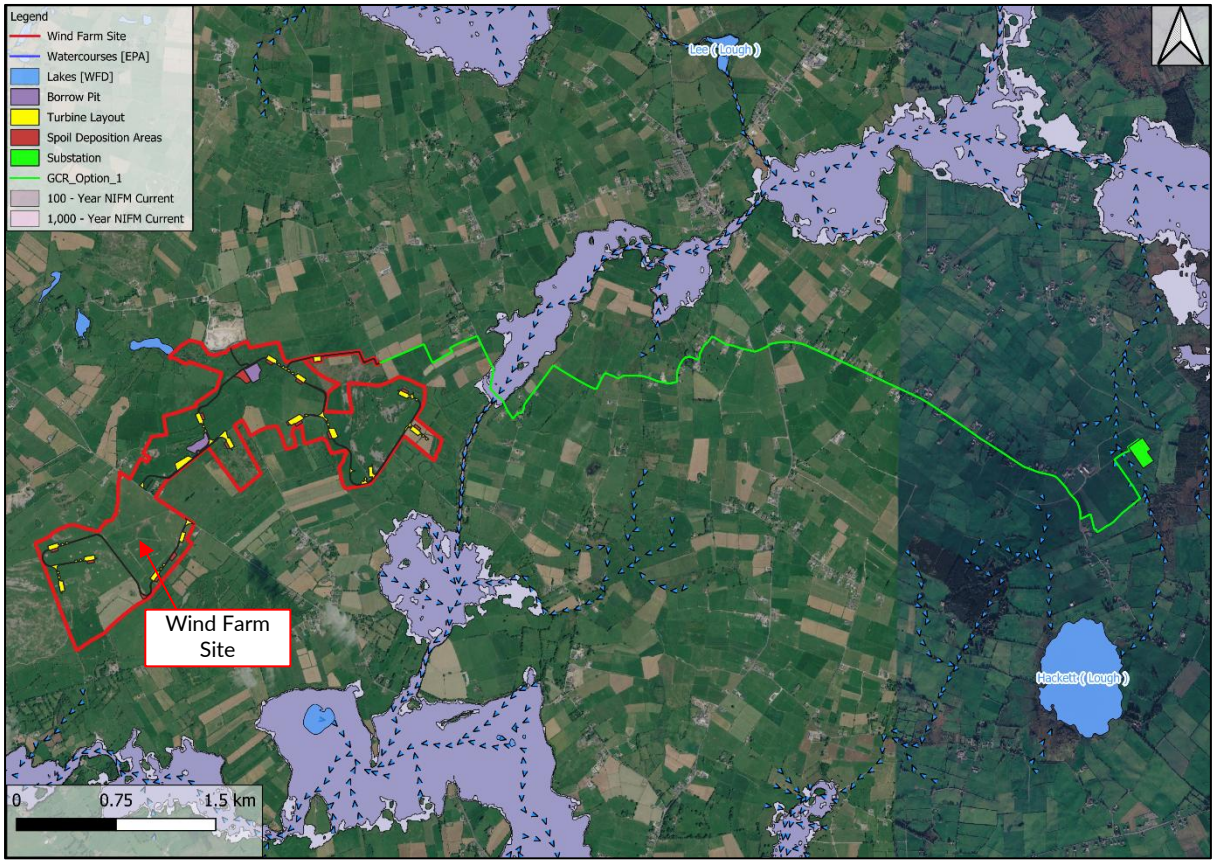


Figure 3-8: National Indicative Fluvial Mapping - Existing Scenario

The NIFM update also included an assessment of the likely impact of climate change on flood risk in the area. The flood extents for the MRFS are shown in Figure 3-9.

[5] National Indicative Fluvial Mapping; Applying and Updating FSU Data to Support Revised Flood Risk Mapping for Ireland, Brown et al., Irish National Hydrology Conference 2019
[6] https://www.floodinfo.ie/map/nifm_user_guidance_notes/

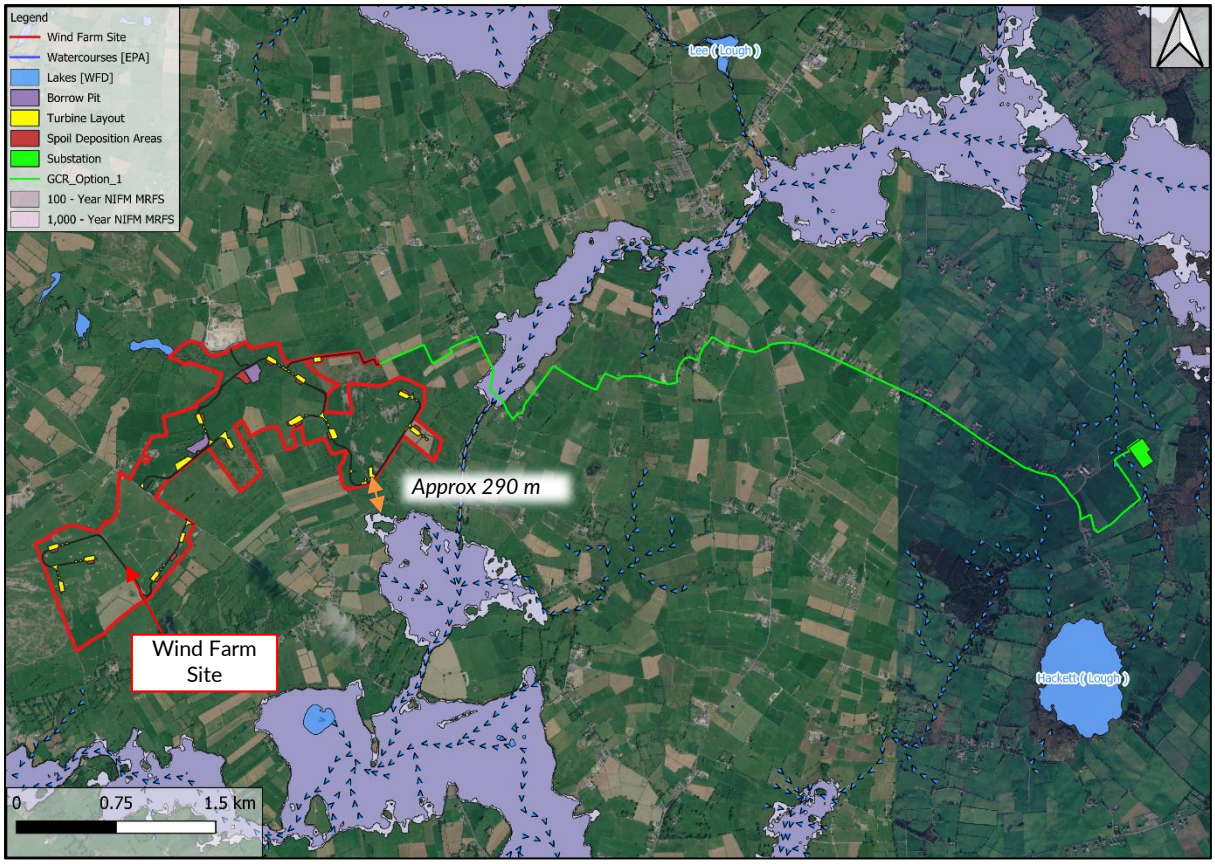


Figure 3-9: National Indicative Fluvial Mapping - Mid-Range Future Scenario

The NIFM mapping of the current scenario shows that the proposed wind farm site and 110 kV substation are not liable to fluvial flooding in a 1 in 100-year (1% AEP) and 1 in 1000-year (0.1% AEP) event. The NIFM MRFS mapping shows a slight increase in flood extents but still does not inundate any of the study area. The closest fluvial flood extents are located 290 m south of Turbine 11.

3.4 OPW Drainage Districts and Arterial Drainage Schemes

The OPW Drainage Districts were carried out by the commissioners of Public Works under a number of drainage and navigation acts from 1842 to the 1930s to improve land for agriculture and to mitigate flooding.[7] The local authorities are charged with the responsibility to maintain Drainage Districts.

Benefited lands are areas that were previously subject to poor drainage and/or flooding but that have benefited from the implementation of Arterial Drainage Schemes carried out under the Arterial Drainage Act 1945.

The River Black and all its tributaries in the vicinity of the study area are arterial drainage channels, with an area of the study area and the entire substation site benefiting from the scheme.

[7] www.floodinfo.ie

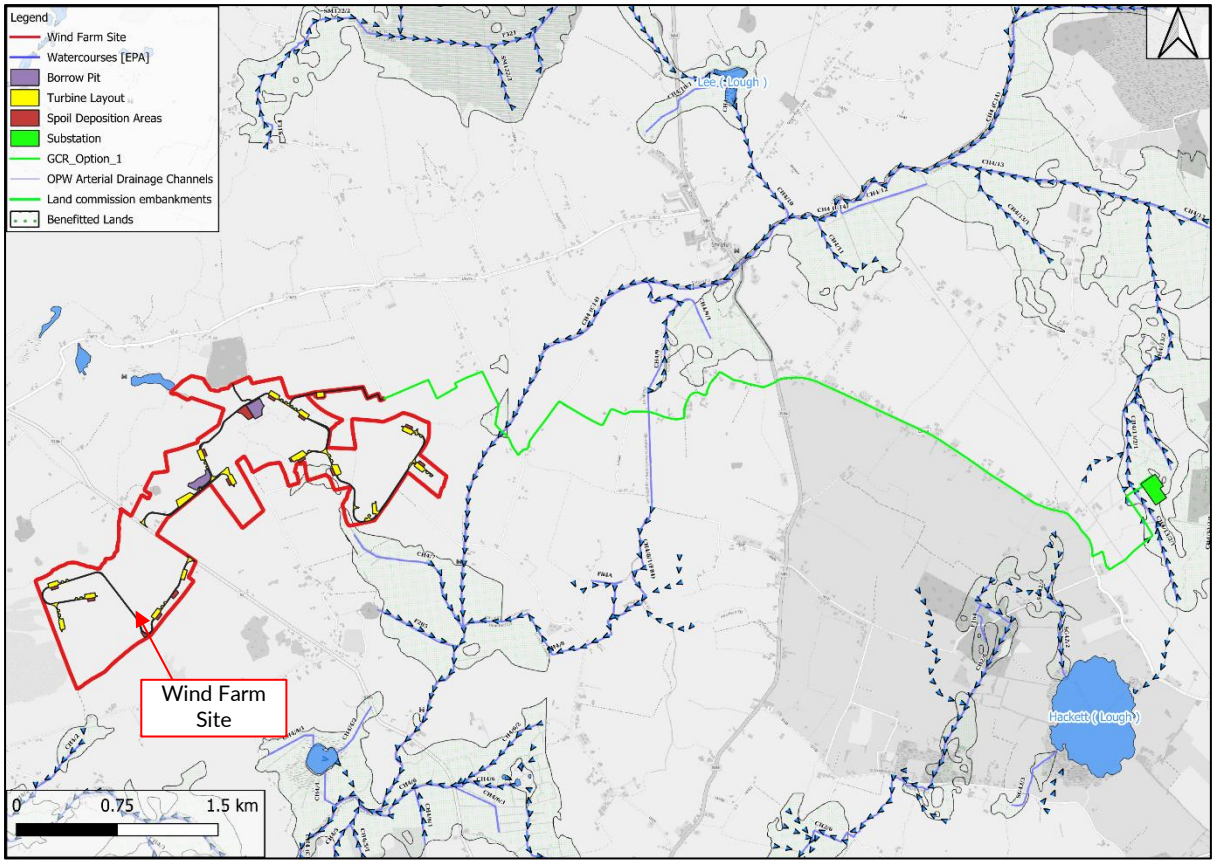


Figure 3-10: Arterial Drainage

3.5 GEOLOGICAL SURVEY IRELAND MAPPING

Based on a review of the OPW's Preliminary Flood Risk Assessment (PFRA) mapping (see Figure 3-3) there is no noted risk of groundwater flooding to the proposed wind farm site.

The historical channelisation of the Black River altered the natural drainage and it is surface water, rather than groundwater that is now the controlling factor in present day flooding. The Black River and many of the tributaries were additional drained under the Corrib-Headford arterial drainage scheme.

GSI Groundwater Flooding Probability Maps[8] for the study area were reviewed. There is one area of groundwater flooding located within the study area, it is located 300 m north of Turbine 6 and 530 m west of Turbine 7, likely due to flooding from an unnamed lake. The ground level at the flood extent is approximately 33 mOD based on Ireland DEM SRTM mapping, with elevations at Turbine 6 and 7 being approximately 42 mOD and 37 mOD respectively. The identified karst features and the potential hydrogeological pathways associated with them are assessed in Chapter 9 of the EIAR that accompanies this planning application. For the purposes of this FRA, no identified karst feature has been demonstrated to provide a groundwater flooding pathway affecting proposed infrastructure.

[8]FloodInfo.ie | National Flood Information Portal, Available at: https://www.floodinfo.ie/map/floodmaps/

There is one further groundwater flood extent which influences the GCR however, as the GCR is underground and will be watertight the risk of flooding is very low.

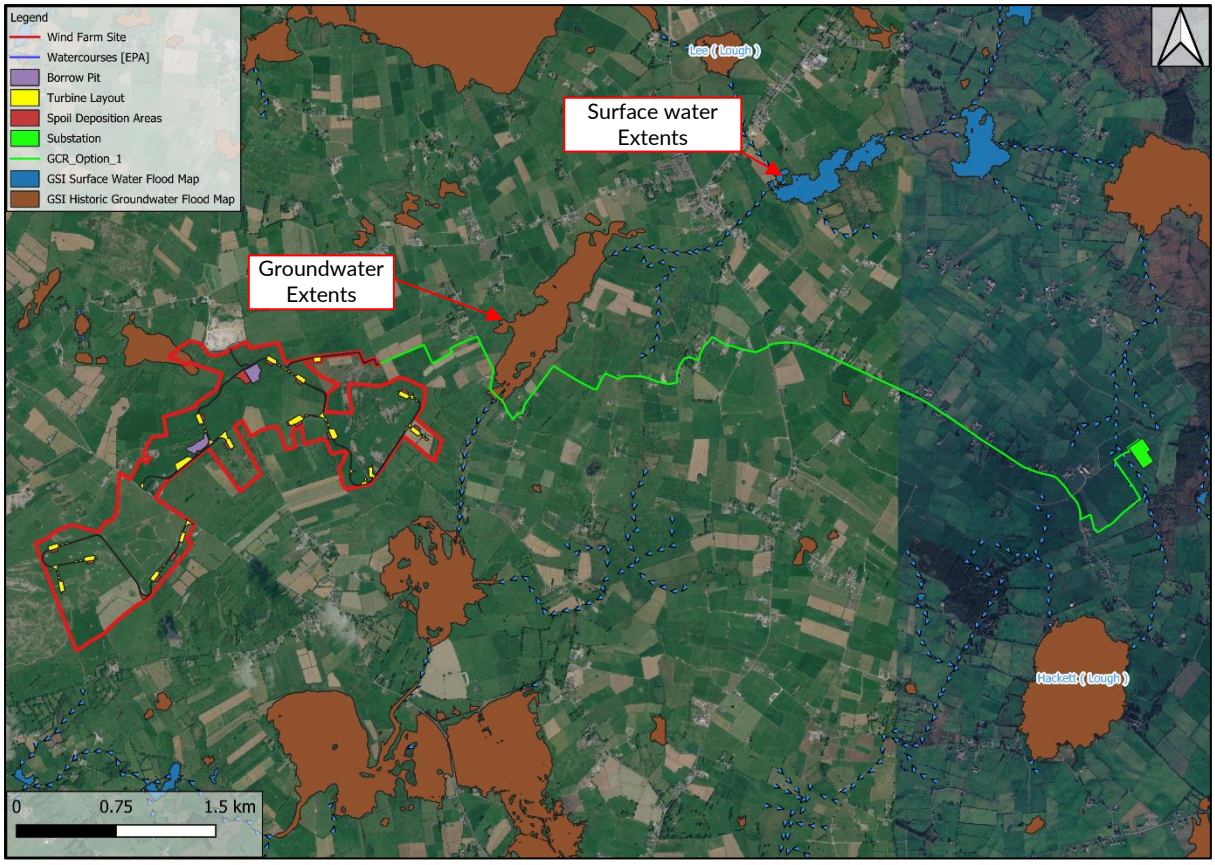


Figure 3-11: GSI Mapping of Groundwater Flooding

The closest surface water flooding is approximately 3.1 km northeast of the proposed wind farm site . The ground level at the surface water flood extent is approximately 23 mOD, compared to the ground level at the existing substation site of 26 mOD, therefore not expected to be hydraulically linked

Geological Survey Ireland (GSI) subsurface mapping of karst features[9] in the area does not show any karst features within the study area (see Figure 3-12). The closest mapped karst feature to the study area is a swallow hole located approximately 160 m east of the proposed wind farm site. The two are not expected to be hydraulically linked due to an elevation difference of 9m between the two (29 mOD at the swallow hole, 38 mOD at the closest vulnerable study area point (Turbine 12)), with the other nearby turbines ground levels being even higher.

During a site visit, a losing section of stream was identified along the drainage channel near Turbine T10, where flow is lost through the stream bed to the underlying karst bedrock. This is typical of karst areas, where such reaches flow in winter when groundwater levels are high but lose water to the bedrock in summer as the water table falls. A number of unmapped doline

[9]GSI Groundwater Data Viewer, Available at: https://dcenr.maps.arcgis.com/apps/webappviewer/index.html?id=7e8a202301594687ab14629a10b748ef

features were also found in the study area during the desk study and site walkover, although none are in the proposed infrastructure footprint area.

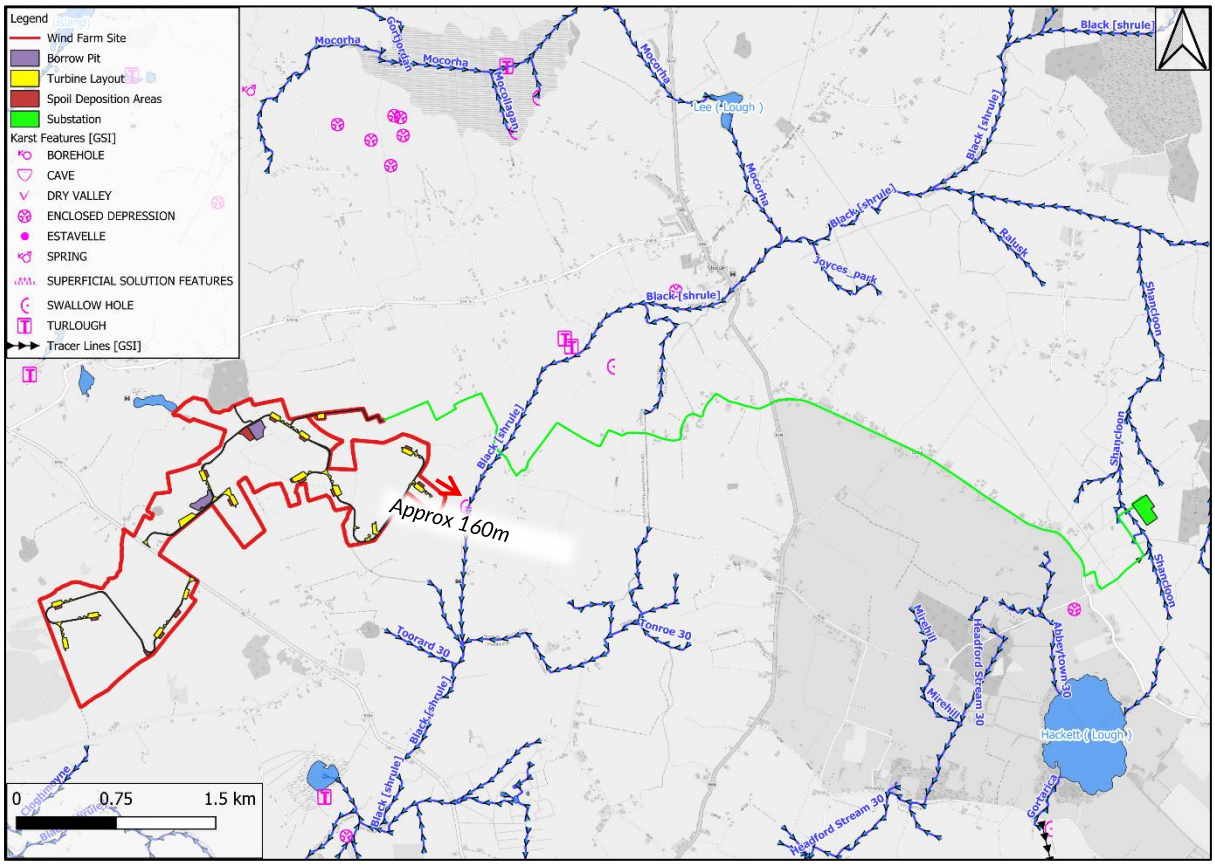


Figure 3-12: GSI Mapping of Karst Features

4. DETAILED FLOOD RISK ASSESSMENT

With reference to the PSFRM guidelines, the proposed project is comprised of 'highly vulnerable' (essential infrastructure) elements.

Therefore, essential infrastructure is considered appropriate in Flood Zone C (Low probability of flooding i.e., 0.1% AEP).

4.1 RIVER HYDROLOGY/ HYDRAULIC ASSESSMENT

Due to insufficient previous flood map information and in order to achieve a thorough understanding of the fluvial flooding regime of the small river tributaries TOBIN used data from site visits to calculate the hydraulic capacity of the *Shancloon* stream which flows adjacent to the proposed 110 kV substation location which the GCR leads to. Three points along the stream were analysed to examine their capacity and determine if there was any flood risk in the vicinity of the substation. The three points were just upstream, adjacent to, and just downstream of the substation location. The location of the points in relation to the turbines is shown in Figure 4-1 below.



Figure 4-1: River Estimation Points

The stream analysed was the *Shancloon* Stream. To allow for climate change the flows calculated were for the Mid-Range Future Scenario (MRFS), which allows for a 20% increase in flows and ensures that the development is resilient to future flood events. The objective was to calculate the 1 in 1000-year (0.1% AEP) MRFS flow as this was the worst-case scenario. The

stream has a catchment area of 1.226 km^2 based on the OPW's FSU dataset and topography of the area.

Based on the size and characteristics of the subject catchment, the Flood Estimation Handbook (FEH) methodology was deemed appropriate for estimating channel flows at the study area. The FEH methodology, developed by the Institute of Hydrology (now the Centre for Ecology & Hydrology), provides a robust framework for flood estimation across a wide range of catchments in the UK and Ireland, incorporating catchment descriptors derived from the FEH dataset. Extreme flows within the catchment were estimated based on the catchment descriptors shown in Table 4-1.

Table 4-1: Summary of Catchment Descriptors

Descriptor	Units	Value	Source
Watercourse	-	*Shancloon* Stream	EPA
Catchment Area	km^2	1.226	FSU/TOBIN
FEH	-	YES	FEH
IH124	-	YES	IH124
BFISOIL	-	0.735	FSU
SAAR	mm	1,150.100	FSU/MET
FARL	-	1.000	FSU/TOBIN
DRAIND	km/km^2	2.622	FSU
S1085	m/km	0.920	FSU/DEM
ARTDRAIN2	-	0.533	FSU
URBEXT	-	0.000	FSU

Using the FEH methodology, the 1 in 1000-year (0.1% AEP) MRFS flow was determined to be 1.52m^3/s.

In order to determine if the 1 in 1000-year (0.1% AEP) MRFS flows would break the banks of the river, the channel capacity was calculated using Mannings equation for three points along the *Shancloon* Stream.

The river slope was conservatively estimated to be 0.001 using Irish Digital Elevation Model (DEM) mapping. A conservative Manning's roughness coefficient of 0.04 was also applied. The maximum allowable discharge in the channel, before the water breaks the banks, was calculated to be 3.103m^3/s at Point 1 and 3.787m^3/s at Point 2, and 4.192m^3/s at point 3. All three values are significantly higher than the 1 in 1000-year (0.1% AEP) MRFS calculated flow (1.52m^3/s), indicating a very low risk of the *Shancloon* Stream breaking its banks.

The above indicates that the *Shancloon* Stream has capacity to convey the 1 in 1000-year (0.1% AEP) MRFS flood event without breaking its banks and therefore there is very little risk of flooding affecting the proposed 110 kV substation in the vicinity of the stream. The proposed new upgraded culvert, which is to be replaced for the farm track crossing, will be appropriately

sized to convey the applicable design flow, including climate-change allowance, without causing an increase in upstream or downstream flood risk. The final culvert design will be subject to a Section 50 application.

4.2 FLUVIAL FLOODING

Based on a comprehensive review of available datasets and detailed hydraulic assessment, the overall fluvial flood risk to the proposed project is considered to be low to negligible.

The OPW Preliminary Flood Risk Assessment (PFRA) mapping indicates that the study area is not located within any indicative fluvial flood extents, with the nearest mapped extent approximately 380 m from the site. This position is further supported by the more recent and higher-resolution National Indicative Fluvial Mapping (NIFM), which confirms that both the proposed wind farm site and the proposed 110 kV substation remain outside the 1% AEP and 0.1% AEP fluvial flood extents, including under the Mid-Range Future Scenario (climate change allowance).

In addition to the national-scale mapping, a site-specific hydraulic assessment of the *Shancloon* Stream, which flows adjacent to the proposed 110 kV substation, was undertaken to better define local fluvial flood risk. This assessment demonstrates that the channel has sufficient capacity to convey the 1 in 1000-year (0.1% AEP) event with climate change allowance, with calculated channel capacities (3.1 m^3/s to 4.2 m^3/s) significantly exceeding the design flow (1.5 m^3/s). This confirms that the stream is not predicted to overtop or break its banks and therefore poses no fluvial flood risk to the proposed 110 kV substation.

With respect to the GCR, while sections are acknowledged to traverse areas potentially associated with fluvial floodplains (e.g. watercourse crossings), the infrastructure will comprise underground, sealed, and watertight cabling systems. As such, even where fluvial inundation may occur locally, the design ensures that the assets are not vulnerable to flood ingress or damage, and therefore the residual fluvial flood risk is negligible.

In summary:

- The study area and proposed 110 kV substation are not identified as being at risk of fluvial flooding in either PFRA or NIFM mapping.
- The adjacent *Shancloon* Stream has been robustly assessed and demonstrates sufficient capacity with no risk of overtopping.
- The GCR infrastructure, although potentially located within areas liable to flooding, is appropriately designed (underground and watertight) and is therefore resilient to fluvial flood conditions.

Accordingly, it is concluded that fluvial flooding does not pose a constraint to the proposed project, and the project is considered compliant with the requirements of the Planning System and Flood Risk Management Guidelines.

4.3 COASTAL FLOODING

The study area is located approximately 27 km inland from the sea and has a minimum existing ground level of 25 mOD, therefore, it is estimated that the risk of coastal flooding associated with the development is minimal.

4.4 PLUVIAL FLOODING

Based on the PFRA indicative pluvial flood mapping identifies parts of the proposed development area as potentially susceptible to surface water flooding during extreme rainfall events, including the locations of Turbines T1, T6 and T10, sections of access tracks and the borrow pit area (Figure 3-3). It should be noted that the PFRA mapping is a strategic national-scale dataset prepared to identify areas that may be susceptible to flooding and is intended for high-level screening purposes. The mapping does not account for detailed site-specific topographical features, local drainage/geological characteristics, or the final engineered ground levels associated with a development. The GSI historical flood mapping and Groundwater Flooding Probability Maps[10] (Section 3.5) are likely to provide a more accurate assessment of potential pluvial flooding.

Review of the site topography indicates that the areas identified by the PFRA mapping are generally associated with localised low points where surface water may temporarily accumulate following intense rainfall. No critical electrical infrastructure, such as the proposed 110 kV substation, is located within an area identified as being at significant risk from pluvial flooding.

The proposed turbine bases will be constructed on engineered hardstandings designed to provide stable working platforms and safe operational access throughout the lifetime of the development. The construction of these hardstandings will remove any small-scale local depressions present at the turbine locations and establish positive surface gradients that direct runoff away from the turbine foundations. As a result, conditions that could lead to localised ponding immediately surrounding the turbines will be eliminated.

Surface water generated within the development will be managed through the SuDS drainage design set out in the Surface Water Management Plan (SWMP). Drainage measures will attenuate and convey runoff in a controlled manner, maintaining greenfield runoff characteristics and ensuring that flows are discharged at appropriate locations. The hardstanding areas represent a very small proportion of the overall site area and are not expected to materially alter catchment runoff patterns or increase flood risk elsewhere within the site or downstream.

Furthermore, due to the slightly elevated and free-draining nature of the proposed turbine platforms, the risk of inundation of turbine infrastructure from localised surface water flooding is considered negligible. Any temporary accumulation of runoff during extreme rainfall events would remain shallow, localised and short-lived, with runoff naturally draining towards surrounding drainage features and topographic low points.

[10]FloodInfo.ie | National Flood Information Portal, Available at: https://www.floodinfo.ie/map/floodmaps/

The borrow pit will be reinstated following completion of the construction phase such that no long-term flood risk impact will arise from its use.

Taking account of the indicative nature of the PFRA mapping, the local topography, the proposed hardstanding design, and the implementation of a dedicated SuDS-based drainage strategy, the risk of pluvial flooding to the proposed development is considered low. The development is not expected to increase pluvial flood risk elsewhere.

4.5 Groundwater Flooding

Based on a review of Geological Survey Ireland (GSI) subsurface mapping of karst features (Figure 3-12), predicted groundwater flooding in the area (Figure 3-11), and the PFRA study (Figure 3-3), there is no evidence to suggest liability to groundwater flooding for the proposed project. The mapped groundwater flood extents within the wider area are limited in extent, locally constrained, and situated at lower elevations than the proposed infrastructure, with no plausible hydraulic connectivity to the proposed project. In addition, although some karst features have been identified within or in close proximity to the study area, none were found that could give rise to groundwater flooding pathways. Accordingly, the risk of groundwater flooding to the proposed project is considered to be negligible.

4.6 The Justification Test

The proposed project and the critical infrastructure are appropriately located in Flood Zone C, therefore, no justification test is required.

5. CONCLUSIONS

TOBIN was appointed by Rooaunalaghta Green Energy Limited to carry out a Stage 2 FRA for a proposed wind energy project.

With reference to the PSFRM guidelines, the proposed project is comprised of "highly vulnerable" (essential infrastructure) elements.

Fluvial Flooding

The overall fluvial flood risk to the proposed project is considered to be low to negligible. Both PFRA and NIFM mapping confirm that the site and proposed 110 kV substation lie outside mapped fluvial flood extents, including under climate change scenarios. A site-specific assessment of the *Shancloon* Stream demonstrates sufficient channel capacity to convey extreme flood events without overtopping, confirming no risk to the proposed 110 kV substation. While sections of the grid connection route may traverse flood-prone areas, the underground, watertight design ensures no vulnerability to flooding and no impact to the existing flood extent. Accordingly, fluvial flooding does not pose a constraint to the proposed project and the project complies with the requirements of the Planning System and Flood Risk Management Guidelines.

Coastal Flooding

The study area is not at risk of coastal flooding due to its distance inland from coastal waters.

Pluvial Flooding

The PFRA indicative mapping indicates that the borrow pit along with turbines T10, T6, and T1 are susceptible to pluvial flooding in a 1% AEP event.

Surface water will be managed by the SuDS drainage set out in the SWMP, which limits discharge to greenfield runoff rates and will be maintained for the lifetime of the project.

The landscaping and topography of the site will provide safe exceedance flow paths and prevent surface water ponding to minimise residual risks associated with an extreme flood event or a scenario where the SuDS-based drainage system becomes blocked.

The risk of pluvial flooding to the study area is therefore low, and the proposed project will not increase flood risk elsewhere.

Groundwater Flooding

There is no evidence to suggest groundwater as a potential source of flood risk to the proposed subject study area.

Based on the results of this flood risk assessment, it is estimated that the risk of flooding to the proposed project will be minimal, and that the development will not increase the risk of flooding elsewhere.





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