TOBIN

Ballyfasy Wind Farm

Co. Kilkenny

Flood Risk Assessment

BUILT ON KNOWLEDGE

Document Control Sheet	
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1. INTRODUCTION

TOBIN were appointed by Manogate Ltd to undertake a Flood Risk Assessment (FRA) for the proposed Ballyfasy Wind Farm project in County Kilkenny (see Figure 1-1).

The proposed project comprises:

- The wind farm site to include a wind farm of 10 no. turbines, onsite 110 kilovolt (kV) substation and ancillary infrastructure such as turbine foundations, hardstanding areas, borrow pits and access roads;
- Grid Connection Options (GCO) (two options being considered); and
- Works along the proposed Turbine Delivery Route (TDR).

Two options for the grid connection are currently being considered to connect the proposed project to the national grid. A single grid connection will be constructed for the proposed project.

GCO One, proposes to install a 110 kV underground cable from the proposed onsite substation to the consented Castlebanny Wind Farm 110 kV substation approximately 12 km to the north.

GCO Two will connect the onsite substation with the existing 110 kV Great Island-Kilkenny overhead line which crosses approximately 2.3 km to the east of the proposed wind farm site.

The proposed project also comprises facilitating works on the public road network and at private properties to accommodate the delivery of turbine components.

The site of the proposed wind farm is located in the southern portion of County Kilkenny between the villages of Listerlin (approximately 3 kilometres (km) northeast), Mullinavat (approximately 4 km west), Glenmore (approximately 5 km southeast), and Slieverue (approximately 9 km south). The landscape is predominantly agricultural with areas of coniferous forestry occurring.

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

The ground levels of the site vary from around 140 mOD to 207 mOD. The highest points are found in the north-central and east-central areas, while the southwest corner has the lowest elevation.

There are three hydraulic features of particular interest to the project: the Smartscastle Stream, Smithstown River, and the Ballyknockbeg River.

The Smartscastle Stream is located in the southeastern area of the proposed wind farm site. The stream originates in its headwaters just north of Turbine 9, before flowing in a southerly direction through the wind farm study area and approximately 330 m west of Turbine 8. The river then flows for approximately 12 km before discharging into the River Suir, south of the proposed wind farm site. This watercourse is within the proposed wind farm application area.

The Smithstown River is located in the northeastern area of the proposed wind farm site. The river originates in its headwaters 220 m west of Turbine 6 and flows in a northerly direction 180 m west of Turbine 5. The river then flows for approximately 1.8 km in a northerly direction before discharging into the River Arrigle, north of the proposed wind farm site. This watercourse is within the proposed wind farm application area.

The Ballyknockbeg river originates in its headwaters 1 km northwest of the proposed wind farm site and flows in a southerly direction, flowing approximately 300 m east of Turbines 1 and 10. The river then flows for approximately 17 km in a southerly direction before discharging into the River Suir, south of the site. This watercourse is not within the proposed wind farm application area, it runs to the west of the wind farm study area. It will not be crossed by the proposed wind farm infrastructure.

The purpose of this Stage 2 FRA report is to identify, quantify, and communicate the risks of flooding, if any, to the proposed project.

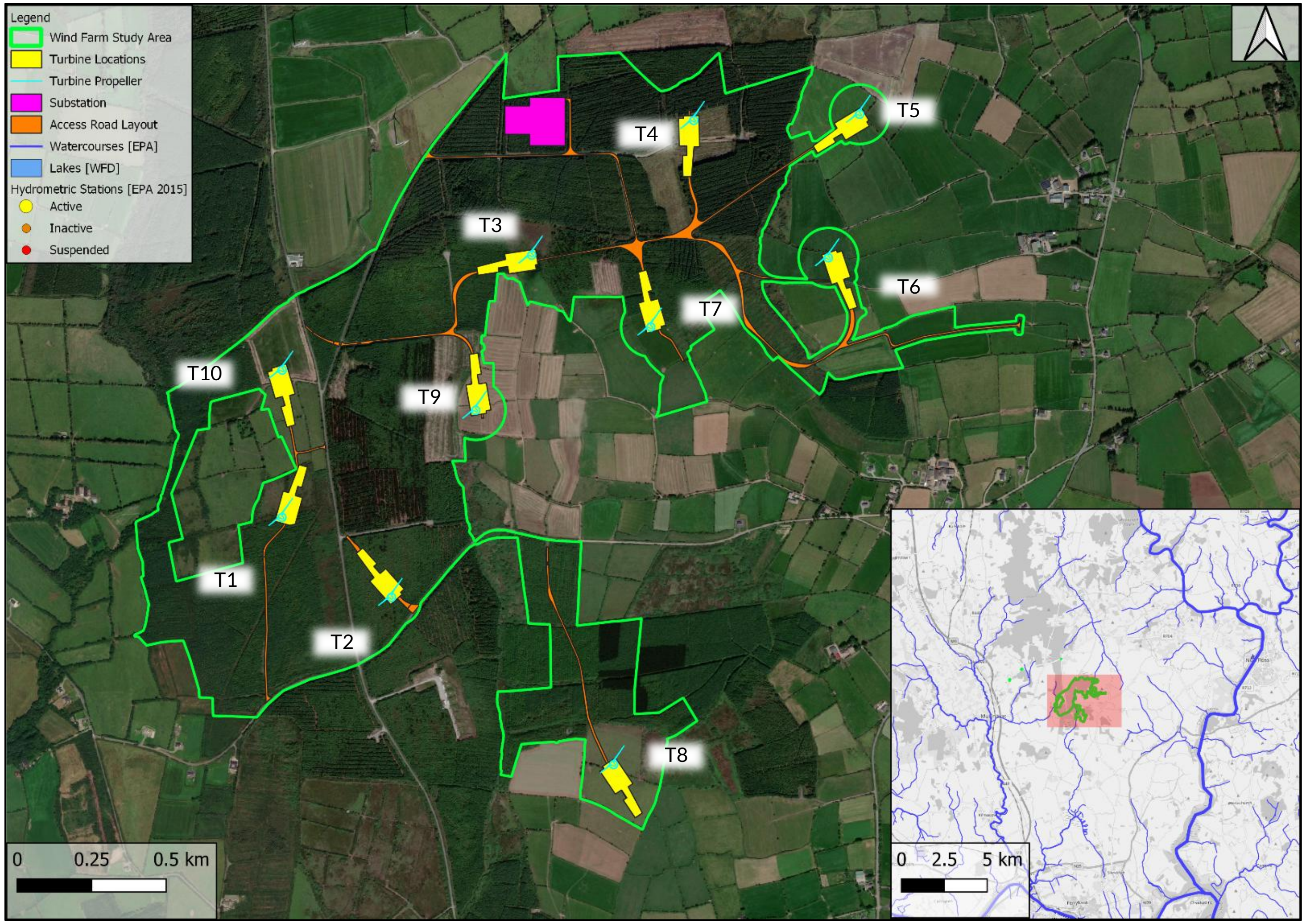

Figure 1-1: Site Location

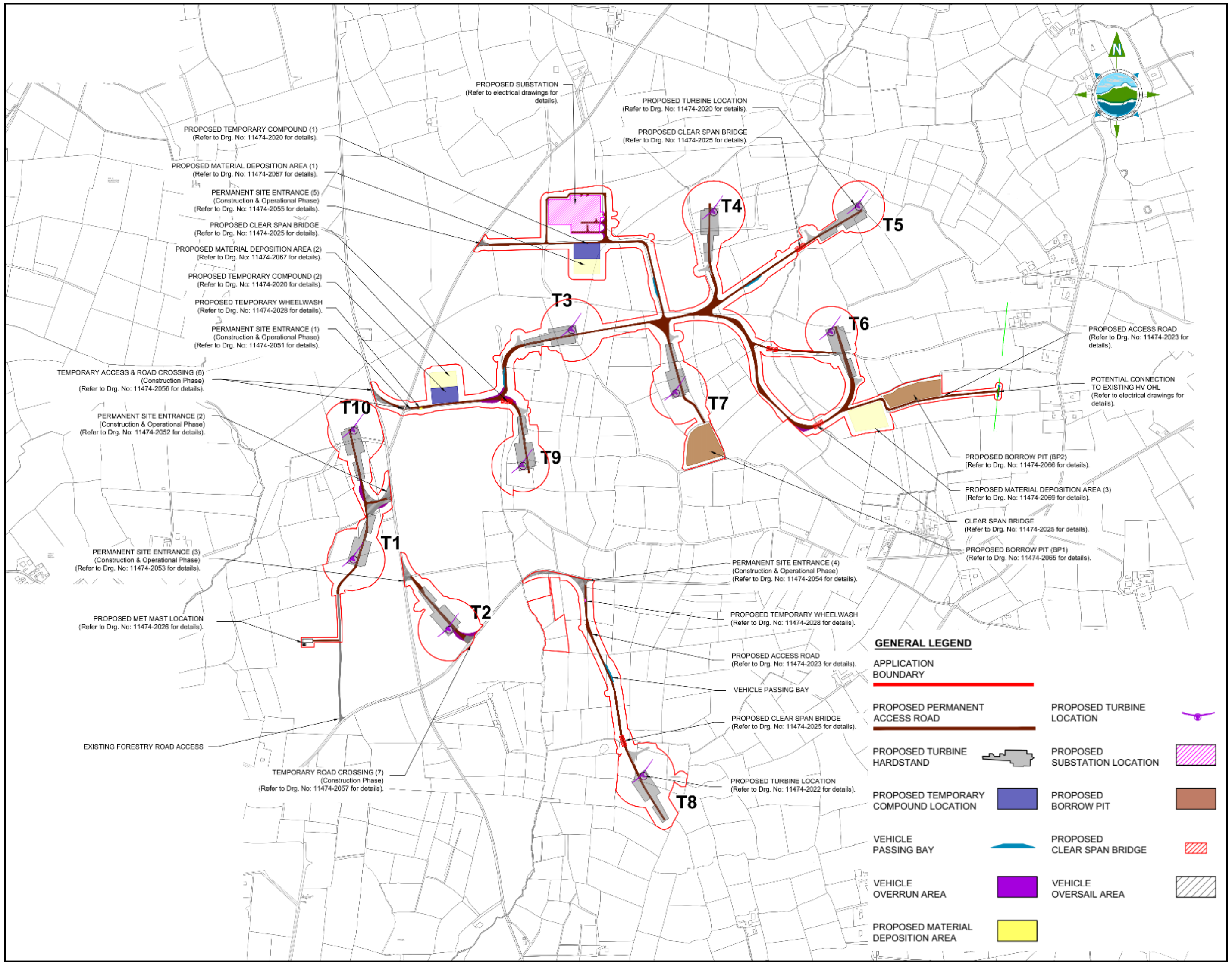

Figure 1-2: Site Layout

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; and
- Kilkenny County Development Plan (2021 – 2027).

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 PSFRM Guidelines state that electricity generating infrastructure such as wind turbines and substations are classified as "essential infrastructure". The proposed wind farm has therefore been assessed against a 1-in-1,000-year flood event (1 in 1000-year (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)	Fluvial & Pluvial Flooding More frequent than 1% AEP Coastal Flooding More frequent than 0.5% AEP	Justification Test Required	Justification Test Required	Appropriate
B (Medium)	Fluvial & Pluvial Flooding 0.1% to 1% AEP Coastal Flooding 0.1% to 0.5% 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 ADAPTION PLAN

The Flood Risk Management Climate Change Sectoral Adaptation Plan was published in 2019 under the National Adaptation Framework and Climate Action Plan. This plan outlines 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); and
- 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 wind farm and grid connection options have been assessed against the Mid-Range Future Scenario as it represents a likely future scenario.

2.3 KILKENNY COUNTY DEVELOPMENT PLAN (2021 – 2027)

The Kilkenny City and County Development Plan for 2021 to 2027 was adopted on the 3rd of September 2021 and came into effect on the 15th of October 2021. The plan aims to further develop and improve the County in a sustainable manner. Volume 1 Chapter 10 relates to Kilkenny County Council's updated strategy for the management of Infrastructure & Environment, including a section on flood risk management and the revised Strategic Aim, as follows "To ensure a sufficient level of water services within the county for the implementation of the core strategy, provide a framework for the protection of the environment, including water quality, the avoidance of flood risk and the provision of a high-quality telecommunications infrastructure".

The policy and objectives included in the plan related to flooding largely reflect the OPW's recommendations in the PSFRM guidelines and the previous development plans for the City and County. Following key policies and objectives are settled out:

10.2.6 Flooding

Flooding is a natural phenomenon of the hydrological cycle. There are many factors that influence flood behaviour and the degrees of risk that it possesses. Like other natural processes, flooding cannot be completely eliminated, but its impacts can be minimised with proactive and environmentally sustainable management. The accepted national policy response to flood protection is now to manage the risk to life and property as sustainably as possible and to consider flood risk and its related impacts on development on a catchment basis, rather than on an individual location basis. This will facilitate sustainable development through the reduction of future flood damage, and hence reduce the associated potential economic and social costs.

The Office of Public Works (OPW) is the lead agency for flood risk management in Ireland. The Planning System and Flood Risk Management – Guidelines for Planning Authorities were published in 2009 and these are incorporated here.

The Guidelines outline three key principles that should be adopted by regional authorities, local authorities, developers and their agents when considering flood risk. These are:

- *Avoid the risk, where possible,*
- *Substitute less vulnerable uses, where avoidance is not possible, and*
- *Mitigate and manage the risk, where avoidance and substitution are not possible*

Avoidance of development in flood risk areas

Flood zones are geographical areas within which the likelihood of flooding is in a particular range and they are a key tool in flood risk management within the planning process as well as in flood warning and emergency planning. There are three types or levels of flood zones defined for the purposes of the guidelines:

- *Flood zone A – where the probability of flooding is highest (greater than 1% or 1 in 100 for river flooding or 0.5% or 1 in 200 for coastal flooding) and where a wide range of receptors would be vulnerable;*
- *Flood zone B – where the probability of flooding 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 is low (less than 0.1% or 1 in 1000 for both river and coastal flooding).

A Strategic Flood Risk Assessment has been carried out for the County as part of the Strategic Environmental Assessment. This sets out the requirements for a Flood Risk Assessment, see Section 6.1.1 of the SFRA.

10.2.6.1 Flood Management:

It is Council policy to adopt a comprehensive risk-based planning approach to flood management to prevent or minimise future flood risk. In accordance with the Planning System and Flood Risk Management – Guidelines for Planning Authorities, the avoidance of development in areas where flood risk has been identified shall be the primary response.

The Council will ensure that new developments do not reduce the effectiveness or integrity of any existing or new flood defence infrastructure, and will facilitate the provision of new, or the reinforcement of existing, flood defences and protection measures where necessary.

2.3.1 Consolidated Strategic Flood Risk Assessment 2021-2027

Kilkenny City and County Strategic Flood Risk Assessment includes key points to be considered for FRA for all types of developments within Kilkenny:

- *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.*

- *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 development 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.*

- *For less vulnerable development, it may be that a finished floor level as low as the 1% AEP level could be adopted, provided the risks of climate change are included in the development through adaptable designs or resilience measures. This approach should reflect emergency planning and business continuity to be provided within the development. It may reflect the design life of the development, the proposed use, the vulnerability of items to be kept in the premises, the occupants and users, emergency plan and inclusion of flood resilience and recovery measures*

3. INITIAL FLOOD RISK ASSESSMENT

3.1 PAST FLOOD EVENTS

The OPW's National Flood Information Portal[1] 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 historical flood events recorded in the vicinity of the proposed wind farm site or grid connection options. The closest past flood event is located approximately 2.5 km north of the proposed wind farm site. The flood event results in the road being impassable and farmlands flooded 2 to 4 times a year. The event is not hydraulically linked to the study area due to the large distance between the two.

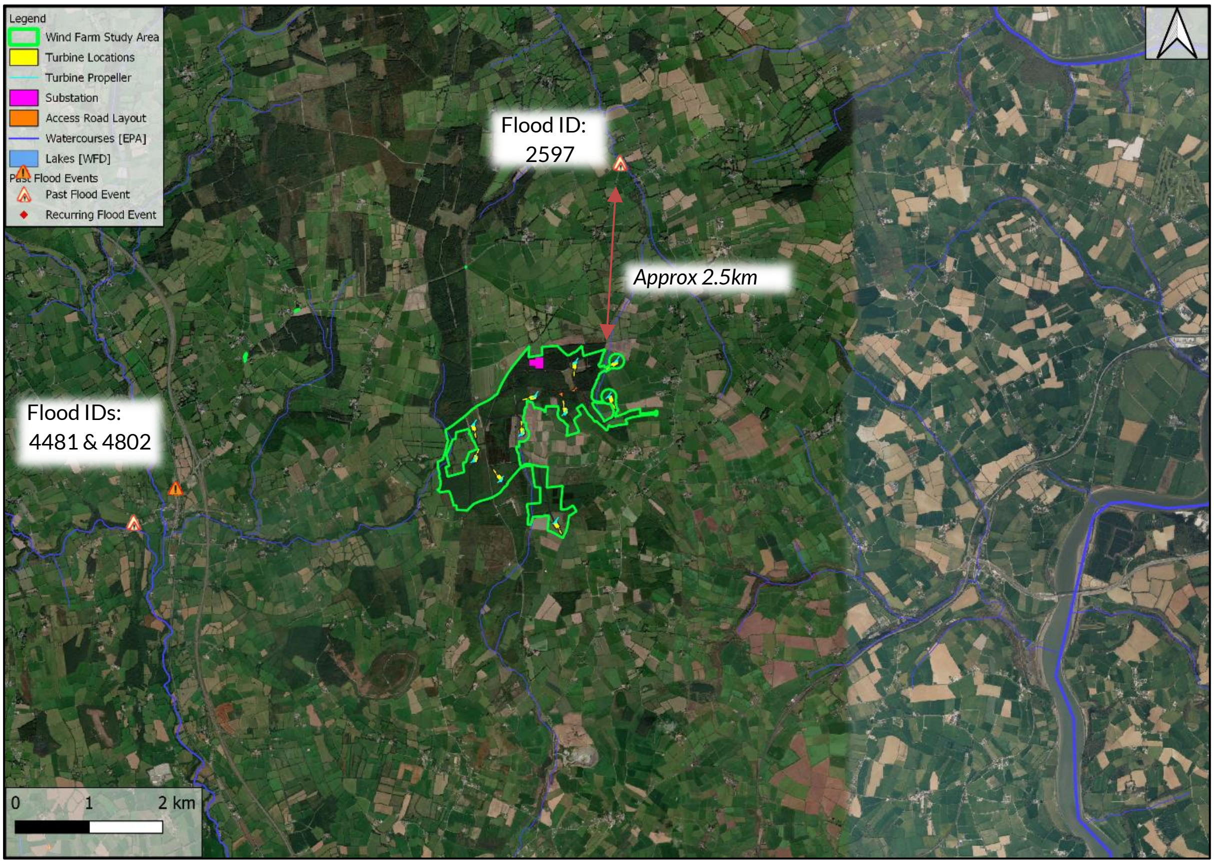

Figure 3-1: Past Flood Events

[1] floodinfo.ie

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"*.

Figure 3-2 provides an overview of the fluvial, coastal, pluvial, and groundwater indicative flood extents in the vicinity of the study area.

As per Figure 3-2, the proposed wind farm site is not predicted to be liable to coastal or groundwater flooding during extreme events.

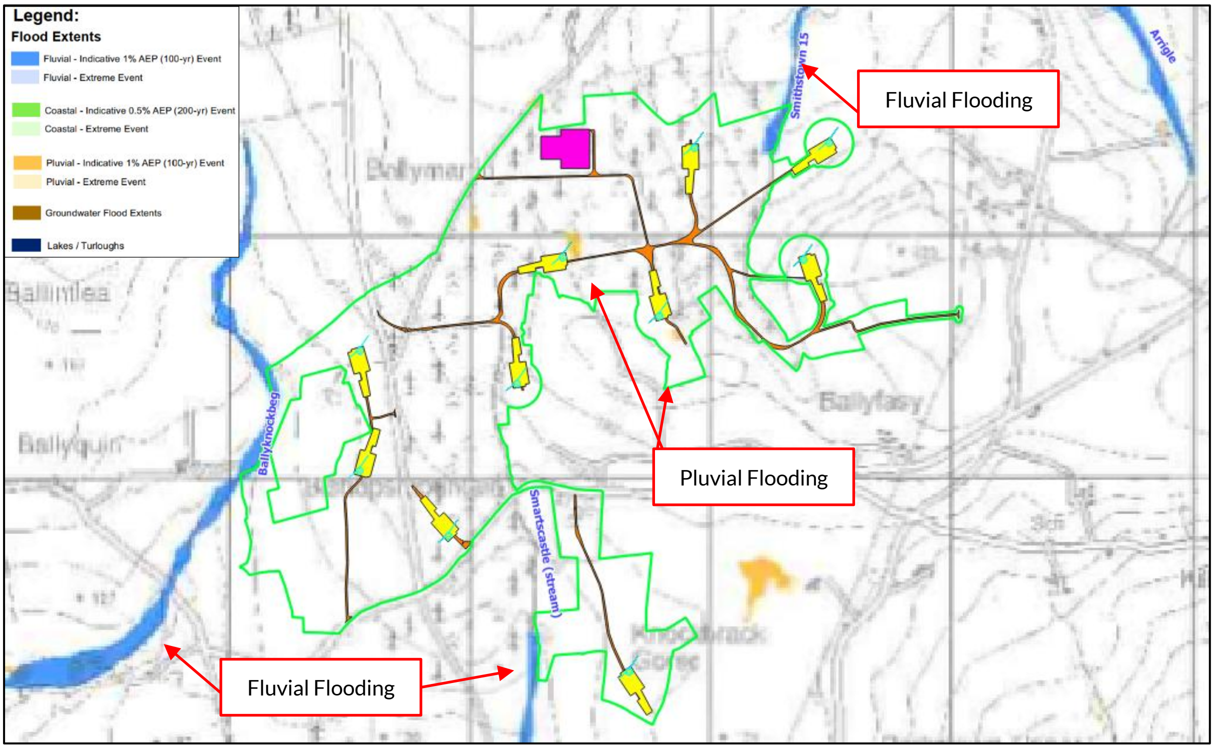

Figure 3-2: Indicative Flood Mapping [extract from PFRA Map 106]

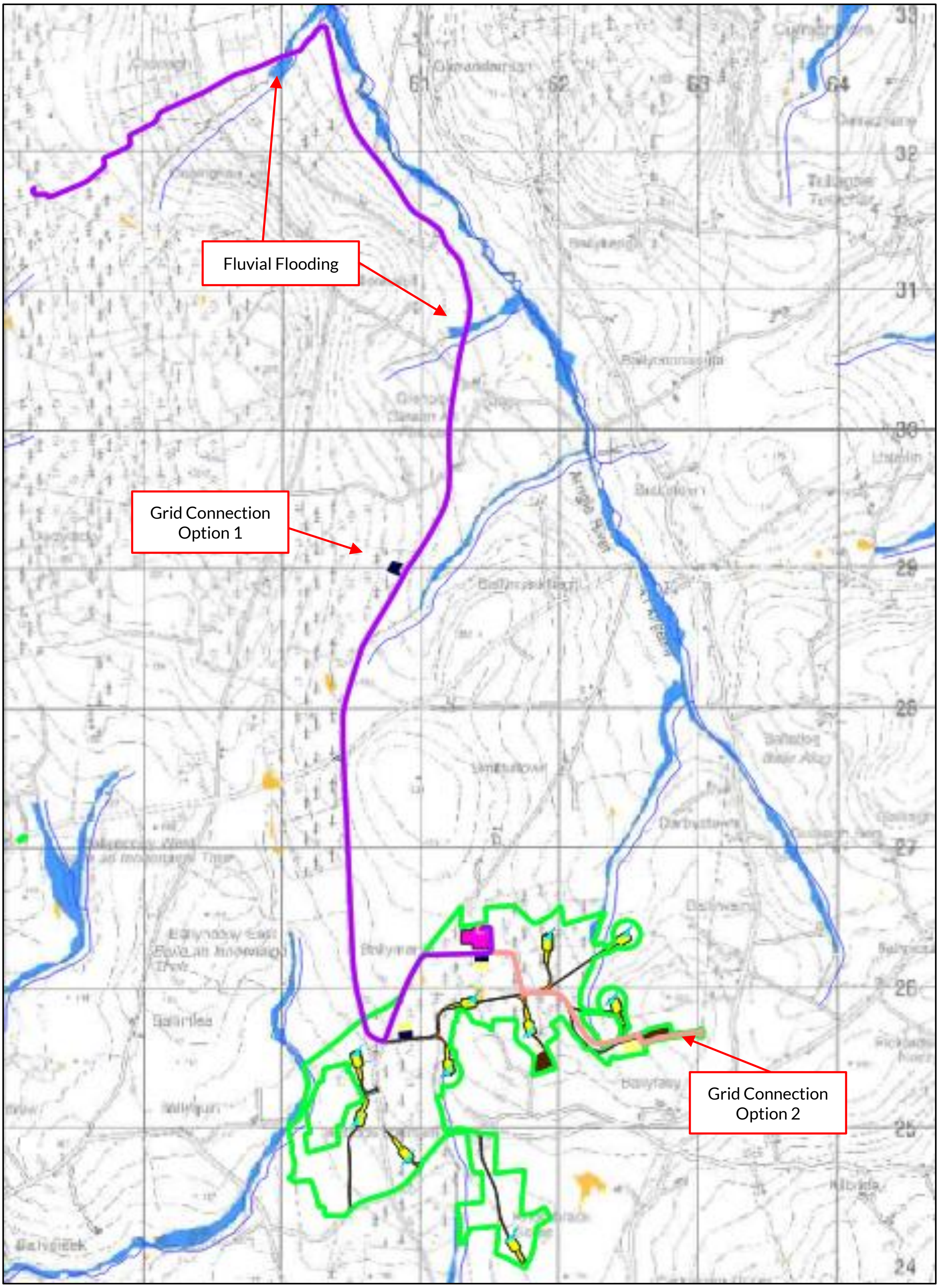

Figure 3-3: GCO Indicative Flood Mapping [extract from PFRA Map 106 & 122]

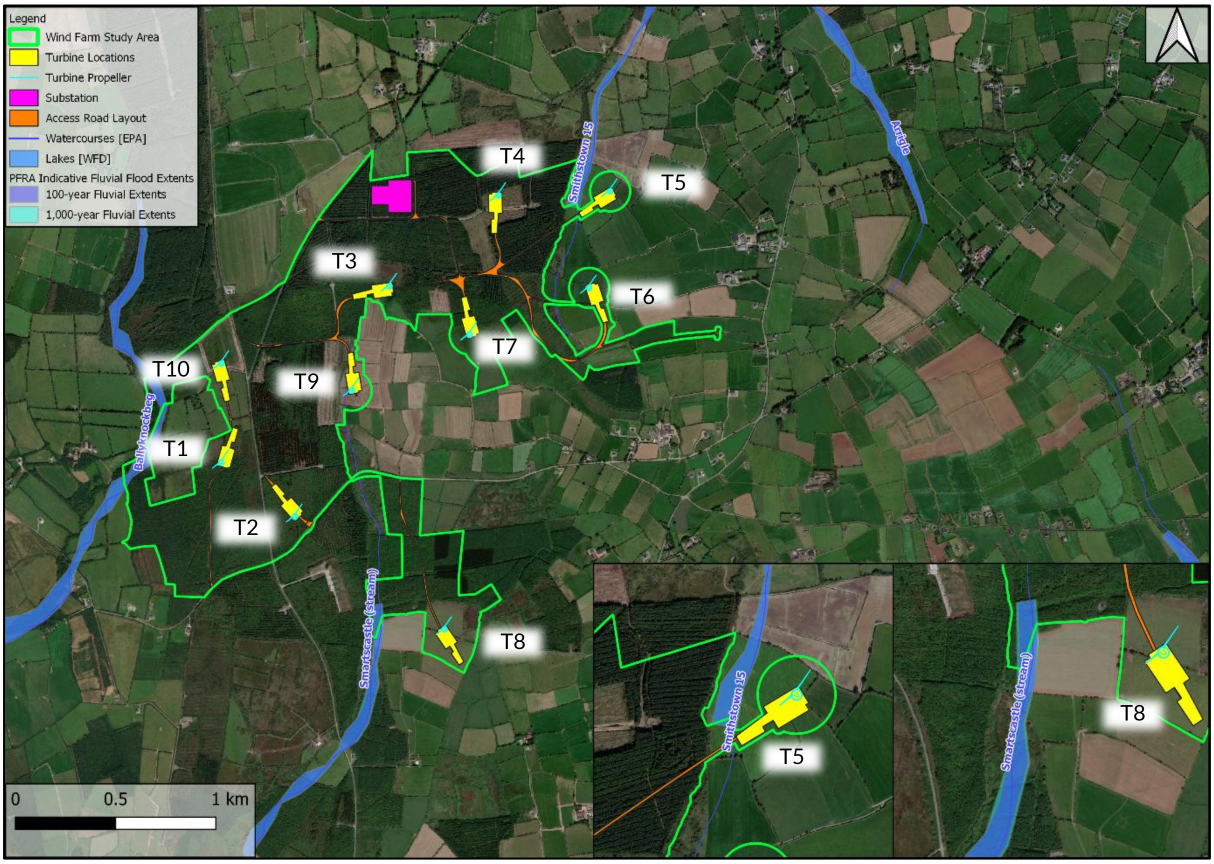

Figure 3-4: PFRA Flood Extents

The PFRA mapping indicates 1 in 100-year (1% AEP) pluvial flooding to two locations in the vicinity of the turbines: Turbine 3 and Turbine 7 as seen on Figure 3-2. There is no pluvial flooding shown near the proposed substation.

There are also two areas of fluvial flooding noted on the PFRA mapping. Fluvial flooding is noted approximately 90 m west of Turbine 5, as a result of flooding from the Smithstown River. The second area of fluvial flooding is to the south of the study area as a result of flooding from the Smartscastle Stream and is located 330 m west of Turbine 8.

Figure 3-3 shows that along the GCO one, there are two areas where the cable connection goes through PFRA flood extents.

There are no coastal or groundwater flood extents within the study area as part of PFRA assessment.

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); and
- Lack of detailed hydrology and river hydraulic analysis.

3.3 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.[2] 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 wind farm study area has not benefited from any arterial drainage scheme and is not located in a Drainage District.

[2] www.floodinfo.ie

3.4 GEOLOGICAL SURVEY IRELAND MAPPING

Based on a review of the OPW's Preliminary Flood Risk Assessment (PFRA) mapping (see Figure 3-2) there is no noted risk of groundwater flooding to the study area.

GSI Groundwater Flooding Probability Maps[3] for the study area were reviewed (see Figure 3-5). The closest groundwater flooding is located approximately 5 km southwest of the wind farm study area. Based on Irish DEM mapping, there is over 100 m difference in ground level between the study area and the groundwater flooding, therefore, posing no risk to the study area.

The closest surface water flooding is approximately 5.7 km South of the study area and is not expected to have any effect on the proposed wind farm site's hydrology.

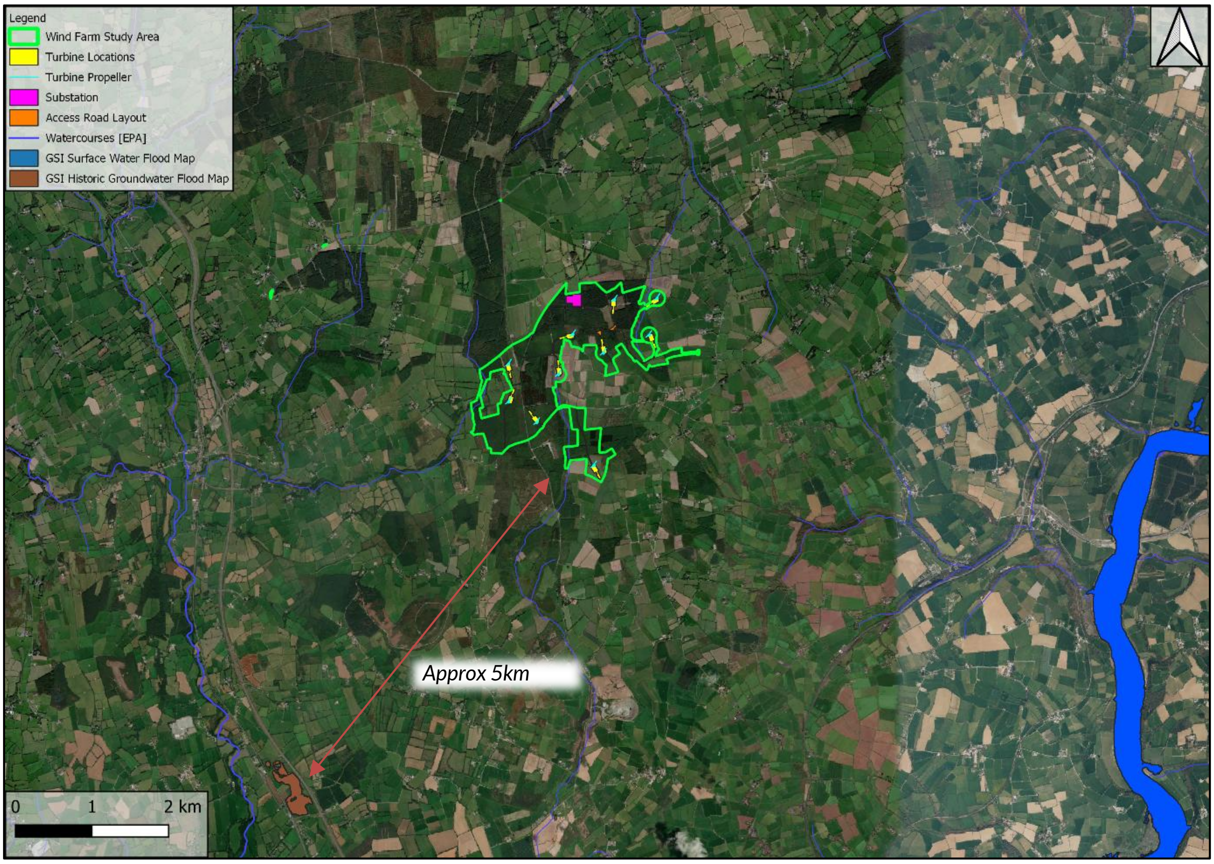

Figure 3-5: GSI Mapping of Groundwater Flooding

Geological Survey Ireland (GSI) subsurface mapping of karst features[4] in the area show that there are no karst features located in the vicinity of the proposed wind farm site (see Figure 3-6). The closest karst feature to the proposed wind farm site is a spring located 7.6 km southwest of the study area. This karst feature is not present in any of the catchment areas corresponding to the three rivers located within, or adjacent to the proposed wind farm site, therefore, the risks resulting from karst features are minimal.

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

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

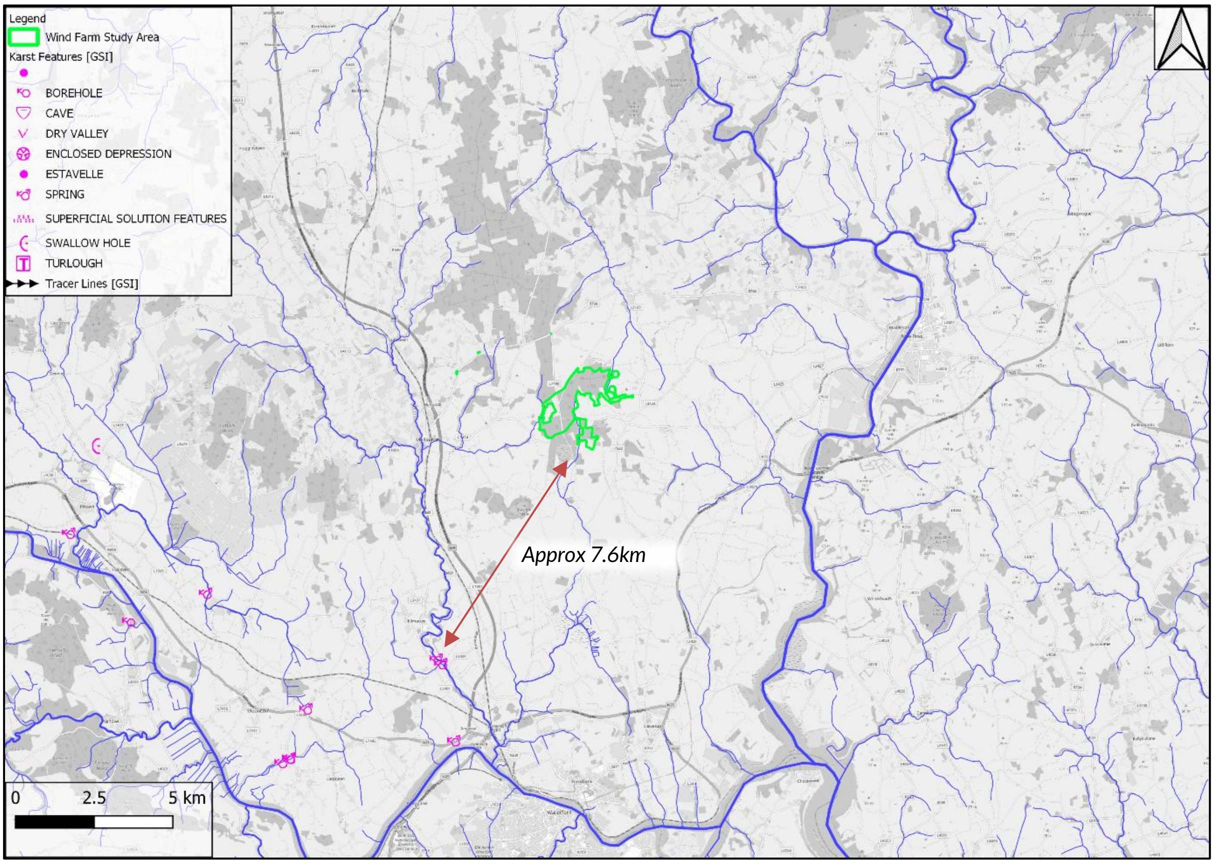

Figure 3-6: GSI Mapping of Karst Features

4. DETALED FLOOD RISK ASSESMENT

With reference to the PSFRM guidelines, the proposed wind farm site is comprised of 'highly vulnerable' (electricity generating power stations) and "less vulnerable" access roads.

Therefore, wind turbines and substations are considered appropriate in Flood Zone C (Low probability of flooding i.e., 0.1% AEP) and Access Roads are appropriate in Flood Zone B (medium probability of flooding i.e., 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 two streams which flow through the proposed wind farm site and are near to the proposed wind turbine locations. Point 1 is near Turbine 6, Point 2 is near Turbine 5, and Point 3 is near Turbine 9. The location of the points in relation to the turbines is shown in Figure 4-1 below.

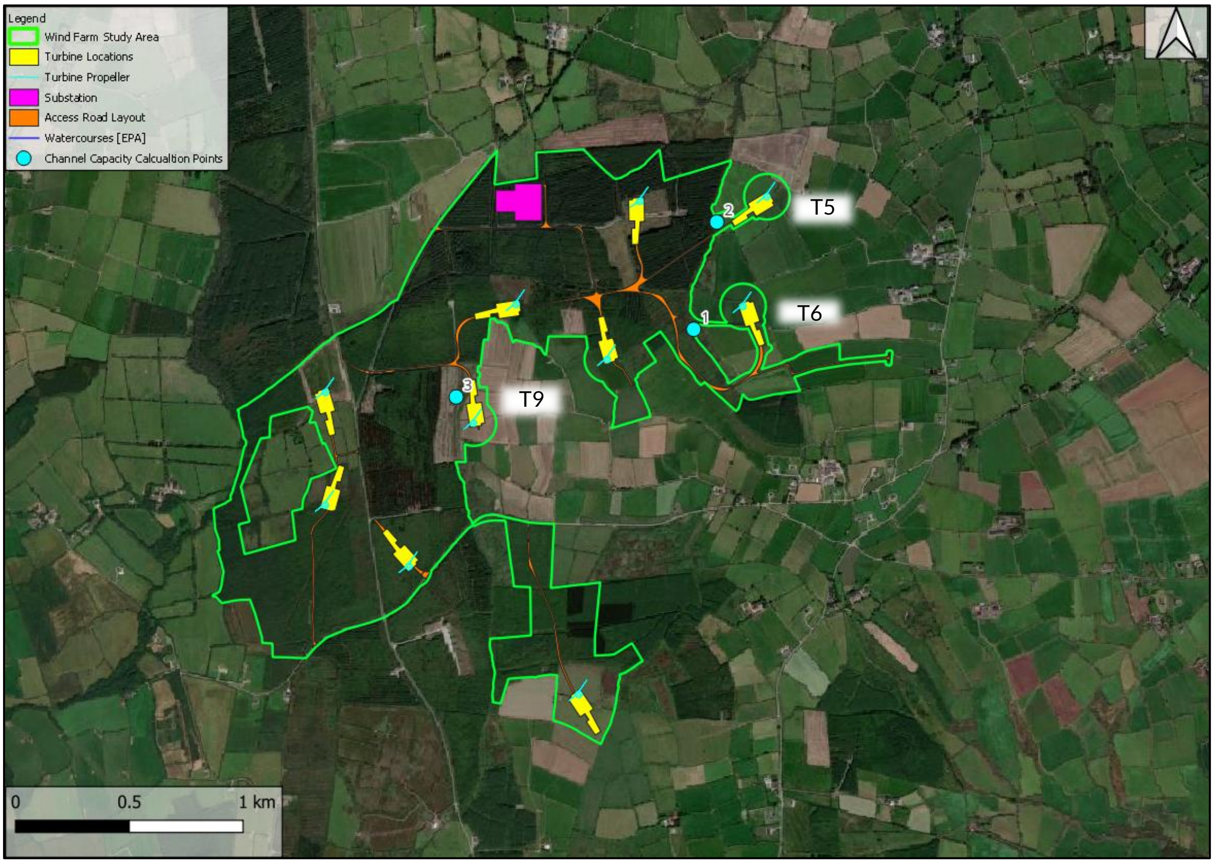

Figure 4-1: River Estimation Points

The first stream analysed was the Smithstown Stream. To allow for climate change the flows calculated were for the High-End Future Scenario (HEFS), which allows for a 30% 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) HEFS flow as this was the worst-case scenario. The stream has a catchment area of 1.615km^2 based on the OPW's FSU dataset and topography of the area.

Based on the size of the subject catchment, the institute of Hydrology Report No. 124 (IH124) methodology was deemed suitable to estimate the channel flows at the study area. The IH124 methodology, developed by D.C.W Marshall and A.C. Bayliss from the Institute of Hydrology, is specifically designed for use on catchments between 0.4 and 25 km^2. Extreme flows within the catchment were estimated based on the catchment descriptors shown in Table 4-1. The table also details the catchment descriptors for the Smartcastle Stream, which was the second stream analysed.

Table 4-1: Summary of Catchment Descriptors

Descriptor	Units	Value	Value	Source
Watercourse	-	Smithstown Stream	Smartcastle Stream	EPA
Catchment Area	km^2	1.615	1.998	FSU/TOBIN
FEH	-	YES	YES	FEH
IH124	-	YES	YES	IH124
BFISOIL	-	0.604	0.518	FSU
SAAR	mm	1,011.600	1,025.450	FSU/MET
FARL	-	1.000	1.000	FSU/TOBIN
DRAIND	km/km^2	0.744	0.913	FSU
S1085	m/km	25.287	24.444	FSU/DEM
ARTDRAIN2	-	0.000	0.000	FSU
URBEXT	-	0.000	0.000	FSU

Using the Institute of Hydrology Report No. 124 (IH124) methodology, the 1 in 1000-year (0.1% AEP) HEFS flow was determined to be 5.9 m^3/s.

In order to determine if the 1 in 1000-year (0.1% AEP) HEFS flows would break the banks of the river, the channel capacity was calculated using Mannings equation for the two points along the Smithstown Stream, and one point on the Smartcastle Stream.

The river slope was estimated to be 0.03 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 170.8 m^3/s at Point 1 and 19.8 m^3/s at Point 2. Both values are significantly higher than the 1 in 1000-year (0.1% AEP) HEFS calculated flow (5.9 m^3/s), indicating a very low risk of the Smithstown Stream breaking its banks.

The second stream analysed was the Smartcastle Stream. The 1 in 1000-year (0.1% AEP) HEFS flow using the same methodology as above was calculated to be 5.7 m^3/s using the Institute of Hydrology report no. 124 (IH124) methodology.

The river slope was estimated to be 0.029 using Irish Digital Elevation Model (DEM) mapping, and a conservative Manning's roughness coefficient of 0.04 was applied. The maximum allowable discharge in the channel, before the water breaks the banks, was calculated to be 17.345 m^3/s at Point B3. This value is significantly higher than the 1 in 1000-year (0.1% AEP)

HEFS calculated flow, indicating a very low risk of the Smartcastle Stream breaking its banks near Turbine 9.

The above indicates that both the Smithstown and Smartcastle Streams have capacity to covey the 1 in 1000-year (0.1% AEP) HEFS flood event without bursting it banks and therefore there is very little risk to affect the proposed turbines in the vicinity of the streams (Turbines 5, 6 & 9).

4.2 FLUVIAL FLOODING

There are three hydraulic features of particular interest to the wind farm study area; the Smartscastle Stream, the Smithstown River, and the Ballyknockbeg River.

The Smartscastle Stream is located in the southeastern area of the proposed wind farm site. The stream originates in its headwaters just north of Turbine 9, before flowing in a southerly direction through the study area and approximately 315 m west of Turbine 8. The river then flows for approximately 12 km before discharging into the River Suir, south of the study area.

The Smithstown River is located in the northeastern area of the study area. The river originates in its headwaters 220 m west of Turbine 6, and flows in a northerly direction 180 m west of Turbine 5. The river then flows for approximately 1.8 km in a northerly direction before discharging into the River Arrigle, north of the study area.

The Ballyknockbeg river originates in its headwaters 1 km northwest of the proposed wind farm site and flows in a southerly direction, flowing approximately 300 m east of Turbines 1 and 10. The river then flows for approximately 17 km in a southerly direction before discharging into the River Suir, south of the site. The Smartscastle Stream and Smithstown Stream are not mapped by the CFRAM or NIFM Studies but are mapped by the PFRA study. However, the mapping does not extend up the study area due to the headwaters of both the stream and river originating within the study area. As noted in Section 3.2 there is some uncertainty around the accuracy of the PFRA mapping, and the potential impact of climate change was not considered by the PFRA study.

Using Lidar data, current ground levels were analysed around the two areas which were liable to fluvial flooding. The flooding as a result of the Smartscastle Stream has an estimated water level of approximately 148 mOD. Turbine 8 which is in this location is approximately 380 m from the extents and has a current ground level of 156 mOD, this gives a freeboard of 8 m.

The flooding as a result of the Smithstown River has an estimated water level of 164 mOD. Turbine 5 which is in this location is approximately 150 m from the flood extents and has a ground level of 166 mOD, this gives a freeboard of 2 m.

Turbine 2 which is located 300 m west of the Smartscastle Stream has a current ground level of 168 mOD and the area of the Smartscastle Stream closest to it has an approximate current ground level of 166 mOD, this gives a freeboard of 2 m to the turbine.

Although the two turbines are not within the flood extents and have appropriate freeboards, their access roads go over a water course, A Section 50 application will therefore be needed to ensure the proposed access roads will not have any impact on the flood risk.

Further to the above discussed fluvial flood risk, there are two areas at risk of fluvial flooding along the GCO one. The underground cables along GCO one will be positioned predominantly within the local road network or horizontally directional drilled under watercourses. It is recommended that any construction works for the grid connection are not undertaken during a flood event. There are no flood risk areas along GCO two.

Therefore, it is expected that the fluvial flood risk to the proposed wind farm site and GCOs is minimal.

4.3 Coastal Flooding

The proposed wind farm site is located approximately 17 km inland from the sea and therefore it is estimated that the risk of coastal flooding associated with the development is minimal.

4.4 Pluvial Flooding

The PFRA indicative mapping indicates that there are two areas of pluvial flooding within the proposed wind farm study area, adjacent to Turbine 3 and Turbine 7.

Surface water arising on the proposed wind farm and access roads will be managed by a dedicated stormwater drainage system in accordance with Sustainable Drainage Systems (SuDS) principles, limiting discharge from the site to greenfield runoff rates.

Upon review of the Lidar topographic data, there are no localised depressions noted within the proposed wind farm site. The two areas marked as liable to pluvial flooding slope towards their adjacent streams and ponding is not expected to occur.

The landscaping and topography of the developed wind farm 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 stormwater drainage system becomes blocked.

Therefore, it is estimated that risk of pluvial flooding is minimal.

4.5 Groundwater Flooding

Based on a review of Geological Survey Ireland (GSI) subsurface mapping of karst features (see Figure 3-6), predicted groundwater flooding in the area (see Figure 3-5), and the PFRA study (see Figure 3-2), there is no evidence to suggest liability to groundwater flooding at the proposed wind farm site.

5. CONCLUSIONS

TOBIN was appointed by Manogate Ltd to carry out a Stage 2 FRA for the proposed construction of a wind farm, substation, grid connection and all associated works at Ballyfasy, Co. Kilkenny.

With reference to the PSFRM guidelines, the proposed wind farm is comprised of "highly vulnerable" (wind turbines, substations) and "less vulnerable" access roads.

Fluvial Flooding

The Smartscastle Stream and Smithstown Stream are not mapped by CFRAM or NIFM Studies but are mapped by the PFRA study. However, the mapping does not extend up the study area due to the headwaters of both the stream and river originating within the study area. As noted in Section 3.2 there is some uncertainty around the accuracy of the PFRA mapping, and the potential impact of climate change was not considered by the PFRA study.

Using Lidar data, current river cross sections were analysed around the two areas which were liable to fluvial flooding. The flooding as a result of the Smartscastle Stream has an estimated water level of approximately 148 mOD. Turbine 8 which is in this location is approximately 380 m from the extents and has a current ground level of 156 mOD, this gives a freeboard of 8 m. The flooding as a result of the Smithstown River has an estimated water level of 164 mOD. Turbine 5 which is in this location is approximately 150 m from the flood extents and has a ground level of 166 mOD, this gives a freeboard of 2 m.

Although the two turbines are not within the flood extents and have appropriate freeboards, their access roads go over a water course, Therefore, a Section 50 application will be needed to ensure an appropriate crossing is put in and that the proposed access roads will not have any impact on the flood risk.

Turbine 2 which is located 300 m west of the Smartcastle Stream has a current ground level of 168 mOD and the area of the Smartscastle Stream closest to it has an approximate current ground level of 166m OD, this gives a freeboard of 2 m to the turbine.

Channel capacity calculations showed that both the Smithstown and Smartcastle Streams have capacity to covey the 1 in 1000-year (0.1% AEP) HEFS flood event without bursting it banks and therefore there is very little risk to the proposed turbines in the vicinity of the streams (Turbines 5, 6 & 9).

Although there are two areas prone to fluvial flooding along GCO One),

The underground cables along GCO One will be positioned predominantly within the local road network or horizontally directional drilled under watercourses. It is recommended that any construction works for the grid connection are not undertaken during a flood event. There are no flood risk areas along GCO Two.

Therefore, it is expected that the fluvial flood risk is minimal.

Coastal Flooding

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

Pluvial Flooding

The PFRA indicative mapping indicates that there are two areas of pluvial flooding within the proposed wind farm site boundaries, adjacent to Turbine 3 and Turbine 7.

Surface water arising on the proposed wind farm and access roads will be managed by a dedicated stormwater drainage system in accordance with Sustainable Drainage Systems (SuDS) principles, limiting discharge from the site to agricultural lands runoff rates.

Upon review of the Lidar topographic data, there are no localised depressions noted within the study area. The two areas marked as liable to pluvial flooding slope towards their adjacent streams and ponding is not expected to occur.

The landscaping and topography of the developed 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 stormwater drainage system becomes blocked.

Therefore, it is estimated that risk of pluvial flooding associated with the proposed wind farm is unlikely.

Groundwater Flooding

There is no evidence to suggest groundwater as a potential source of flood risk to the proposed wind farm site.

Based on the results of this flood risk assessment, it is estimated that the risk of flooding to the proposed wind farm, substation, and all associated works will be minimal.

The “Highly vulnerable” wind turbines are located at least 150 mm from fluvial flood extents, ensuring their safety from potential flooding

Grid connections are typically installed underground, which provides resilience against flood impacts and makes them suitable for placement within any flood zone. These connections will primarily follow the alignment of site access roads and the existing local road network. It is advised that construction activities related to the grid connection be avoided during active flood events to ensure safety and minimize disruption.

Given that the maintenance requirements for the wind farm are expected to be low, the risk of disruption is minimal. In the event that flooding does occur on these access roads, any planned access to the wind farm can be delayed until the floodwaters recede and conditions are safe for travel. This ensures that the overall operation and maintenance of the wind farm remain unaffected by occasional flooding.