8. HYDROLOGY AND HYDROGEOLOGY

8.1 INTRODUCTION

This chapter of the EIAR assesses the likely significant effects of the proposed project on the hydrological and hydrogeological environment.

Information on the existing hydrological (surface water) and hydrogeological (groundwater) environment is presented as the baseline for the proposed wind farm site, the proposed grid connection route (GCR) and proposed limited accommodation areas along the turbine delivery route (TDR). The potential likely significant effects of the proposed project are presented together with appropriate mitigation measures if required. Any residual and cumulative effects are also assessed.

The chapter includes an assessment of compliance with the Water Framework Directive (WFD) for surface water and groundwater bodies (Appendix 8-1) and a Flood Risk Assessment (FRA) to identify, quantify, and assess the risks of flooding, if any, to the proposed project, and the potential for flooding elsewhere as a result of the proposed project (Appendix 8-2).

The proposed project is described in full in Chapter 2 – Description of the Proposed Project.

8.1.1 Statement of Authority

John Dillon and Peter McSherry of TOBIN have completed this chapter, in collaboration with Frank O'Connor.

John Dillon (BSc., MSc., DIC, MCIWM, PGeo) is an environmental and hydrogeological specialist with over 18 years of experience in geological and hydrogeological assessment for Environmental Impact Assessment (EIA)s. He has contributed to a wide range of project EIA Reports across sectors such as infrastructure, extractive industries, renewable energy, and land development.

Peter McSherry (BSc., PGDip) is a hydrogeologist with over 5 years hydrogeological experience in groundwater resources, contaminated land, ground investigation and various infrastructure developments. Peter was involved in the site supervision of site investigation and the completion of the EIAR chapter.

Frank O'Connor is a hydrologist/ engineer with 5 years' experience in Flood Risk Assessment (FRA). Frank has authored a number of (Stage 1 to Stage 3) FRAs for EIARs for various renewable projects.

Site investigations were co-ordinated and reviewed by Gabriella Horan from Causeway Geotech, Tony Lombard of APEX geophysics and Diarmaid MacLoughlin of Ground Investigations Ireland (GII).

Further details related to relevant inputs of the various contributors and competent experts of the Project Team are provided in Table 1-4, of Chapter 1, Introduction.

8.1.2 Transboundary Hydrological Impacts

The site of the proposed project is located approximately 3 km from the Northern Ireland border and is proposed within a river catchment (Drowes_010) that drains into Lough Melvin, which partially lies within Northern Ireland. The following assessment therefore considers both transboundary hydrological and hydrogeological effects, with the former generally being potentially more significant.

The likely cumulative effects of other wind farm developments located in Northern Ireland are also assessed where required. Consultation responses from relevant Northern Ireland agencies regarding the proposed project are summarised below.

8.1.3 Relevant Legislation and Guidance

8.1.3.1 Legislation

The requirements of the following EU and national legislation, have been complied with in this assessment:

EU Directives:

- Drinking Water Directive – European Union Directive (2020/2184) on the quality of water intended for human consumption (recast);
- Environmental Impact Assessment (EIA) Directive - European Union Directive (2011/92/EU & 2014/52/EU) on the assessment of the effects of certain public and private projects on the environment (as amended);
- Environmental Quality Standards Directive – European Parliament and of the Council (2008/105/EC) on environmental quality standards in the field of water policy (as amended);
- Groundwater Directive – European Union Directive (2006/118/EC) on the protection of groundwater against pollution and deterioration (as amended);
- Habitats Directive - European Union Directive (92/43/EEC) on the conservation of natural habitats and of wild fauna and flora (as amended);
- Water Framework Directive - European Union Directive (2000/60/EC) establishing a framework for Community action in the field of water policy (as amended); and
- Waste Framework Directive - European Union Directive (2008/98/EC) on waste and repealing certain Directives (as amended).

National Legislation:

- Local Government (Water Pollution) Act 1977 and (Water Pollution)(Amendment) Act 1990;
- Water Services Act 2007 (as amended);
- Planning and Development Act, 2000 (as amended);Planning and Development Regulations 2001 (as amended);
- S.I. No. 293 of 1988: European Communities (Quality of Salmonid Waters) Regulations 1988;
- S.I. No. 722 of 2003: European Communities (Water Policy) Regulations 2003 (as amended);
- S.I. No. 684 of 2007: Wastewater Discharge (Authorisation) Regulations 2007;
- S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended);
- S.I. No. 296 of 2009: The European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009 (as amended);

- S.I. No. 99 of 2023: European Union (Drinking Water) Regulations 2023 (as amended); and
- S.I. No. 9 of 2010: European Communities Environmental Objectives (Groundwater) Regulations 2010 (as amended).

The EU Water Framework Directive (2000/60/EC) (WFD) established a framework for the protection of both surface water and groundwater. The transposing legislation in Ireland (S.I. No. 272 of 2009, European Communities Environmental Objective (Surface Water) Regulations 2009 (as amended), outlines the water protection and water management measures required in Ireland to maintain high or good status of waters.

The first cycle of the River Basin Management Plan (RBMP) ran from 2009-2015, where eight separate plans were devised for all of the River Basin Districts (RBDs) with the objective of achieving at least 'good' water quality status for all waters by 2015 (noting that later dates were set for certain waterbodies noted to be under significant pressures). The second cycle of the RBMP 2018-2021, was published by the Department of Housing, Planning and Local Government in April 2018 (Government of Ireland, 2018). The third cycle of the RBMP: 2022 – 2027, was published by the department in 2024 (Government of Ireland, 2024).

The WFD establishes common principles and an overall framework for action in relation to water protection and developed the overall principles and the structure for protection and sustainable use of water in the European Union.

The European Communities Environmental Objectives (Surface Waters) Regulations, S.I. No. 272 of 2009 give effect to the criteria and standards to be used for classifying surface waters in accordance with the ecological objectives approach of the WFD. In accordance with the regulations, waters classified as 'High' or 'Good' must not be allowed to deteriorate. Waters classified as less than good must be restored to at least good status within a prescribed timeframe. In addition, the regulations address certain shortcomings identified by the European Court of Justice in relation to Ireland's implementation of the Dangerous Substances Directive (76/464/EEC), as amended (repealed by the Water Framework Directive, 2000/60/EC as amended). The regulations set standards for biological quality elements and physico-chemical conditions, supporting biological elements (e.g., temperature, oxygen balance, pH, salinity, nutrient concentrations and specific pollutants), which must be complied with. These parameters establish the 'ecological status' of a water body.

Relevant Northern Irish Legislation was also reviewed and considered during the assessment of transboundary hydrological effects.

8.1.3.2 Guidance

The principal guidance and best practice documents complied with in the assessment of likely significant impacts on hydrology and hydrogeology are summarised below. The documents represent current best practice in Ireland.

- CIRIA (2001) Control of Water Pollution from Construction Sites – Guidance for Consultants and Contractors, CIRIA C532;
- CIRIA (2023) Environmental good practice on site guide (fifth edition) C811
- CIRIA (2016) Groundwater control – design and practice, 2nd Ed, CIRIA C750;
- National Roads Authority (NRA) (2008a) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;

- National Roads Authority (NRA) (2008b) Environmental Impact Assessment of National Road Schemes – A Practical Guide;
- Office of Public Works (OPW) (2019) The Flood Risk Management Climate Change Sectoral Adaptation Plan;
- Office of Public Works (OPW) and Department of the Environment, Heritage and Local Government (DoEHLG) (2009) The Planning System and Flood Risk Management Guidelines; and
- The Institute of Geologists Ireland (IGI) (2013) Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements.

In addition to specific hydrology and hydrogeology guidance documents, the EIA guidelines listed in Section 1.7.2, Chapter 1 were complied with in the preparation of this chapter.

8.1.4 Scoping and Consultation

The scope of this chapter has also been informed by consultation with statutory bodies and other bodies with environmental responsibility, as outlined in Section 1.8.2, Chapter 1 - Introduction. The purpose of scoping is to provide a framework for the approach to be taken by the individual specialists in carrying out their evaluations, identifying environmental aspects for which potential significant environmental effects may arise.

Responses relevant to this chapter were received from the Development Applications Unit (DAU) (of the Department of Housing, Local Government and Heritage), Leitrim County Council, the Geological Survey of Ireland (GSI), Inland Fisheries Ireland (IFI), the Office of Public Works (OPW), Fermanagh and Omagh District Council (FODC) and Uisce Eireann (UE). Copies of the consultation responses are included in Appendix 1-4 and summarized in Table 8-1.

Table 8-1: Consultation Response Summary.

Consultee	Summary of Response	EIAR Chapter / Section
Development Applications Unit	Highlighted a number of environmental sensitivities of relevance, including; Indirect impacts on Qualifying Interests of downstream Lough Gill SAC and Lough Melvin SAC.	• Ch5 Biodiversity • Ch7 Land, Soils and Geology • Ch8 Hydrology and Hydrogeology
Leitrim County Council	Requests that EIAR includes an assessment of water quality and ecology, including an assessment of impacts on soil, peat, hydrology and groundwater. Any proposed repositories would need to be demonstrated as being effective in providing for the permanent retention of peat and other materials and the mitigation measures, inclusive of the proposed drainage system, would be adequate to ensure the protection of the environment. The hydrology of the surrounding lands and peatlands needs to be given due consideration in any EIAR of the proposal as well as the potential of proposed drainage schemes to serve the proposed development on the wider receiving environment and cumulatively in	• Ch5 Biodiversity • Ch7 Land, Soils and Geology • Ch8 Hydrology and Hydrogeology

	conjunction with existing drainage schemes such as those associated with forestry sites in the locality. A robust and comprehensive assessment of the potential impacts of the proposed development on the water quality objectives of adjacent waterbodies shall be undertaken also.	
Geological Survey of Ireland (GSI)	Encourages the use of their datasets. Confirmation that there is one County Geological Site (CGS) near the proposed project (Dough Mountain, Co. Leitrim (GR 593945, 842361). The correspondence also provided information on groundwater, geological mapping, geotechnical database resources, geohazards, natural resources, geochemistry (of soils, surface waters and sediments). They also requested that a copy of any reports detailing site investigations be sent to them to add to their data.	• Ch14 Archaeological, Architectural & Cultural Heritage • Ch7 Land, Soils and Geology • Ch8 Hydrology and Hydrogeology
Inland Fisheries Ireland (IFI)	No response received to 2025 consultation. A response was received following a previous consultation exercise in 2021. In their response, IFI emphasized the importance of assessing all watercourses receiving drainage from the construction site. They recommended implementing a construction and operational water quality monitoring program to track surface water flows and potential impacts during and after construction. Surface water hydrology impact assessment was also recommended, including protection of natural flow paths from erosion and the avoidance of catchment water diversion are critical. Drainage solutions such as settlement ponds and silt traps must be engineered for effective sediment control, especially during heavy rain, and be designed with ease of maintenance and monitoring in mind. Watercourse crossings must minimize environmental disruption, ideally using clear span structures to avoid impacting fish movement. IFI also emphasized fuel and chemical storage protocols to prevent contamination and called for detailed geotechnical surveys assessing soil stability and landslide risks.	• Ch7 Land, Soils and Geology • Ch8 Hydrology and Hydrogeology
Office of Public Works (OPW)	Any new or modified bridges or culverts (as part of the development or its access roads) crossing watercourses require Section 50 consent from the Commissioners of Public Works (OPW) under the Arterial Drainage Act, 1945, regardless of planning permission. The current standard for bridge/culvert design is based on the 100-year flood (1% AEP), increased by 20% for climate change, and designs must not alter watercourse hydraulics. This requirement does	• Ch7 Land, Soils and Geology • Ch8 Hydrology and Hydrogeology

	not apply to ducts or cables buried under the riverbed but applies if they pass through or are attached to bridges/culverts. Flood risk assessment is also recommended, following OPW and planning system guidance, as flood risk can affect landscape, infrastructure, and residents.	
Uisce Éireann (UE)	Outlines key considerations for Water Services within the scope of an EIA. For developments with potential impacts on Uisce Éireann's Drinking Water Sources, applicants must detail measures to prevent negative effects during construction and operation, identifying hydrological pathways between the applicant's site and receiving waters. Other requirements include waste sampling strategies for backfilled materials, mitigations for potential negative impacts on nearby water sources, assessments of impacts on public water supply reservoirs, and confirmation of water service capacity through a Confirmation of Feasibility (COF). For connections to a public water supply or sewage collection system, advised to submit a Pre-Connection Enquiry (PCE). Additionally, proposal should identify necessary upgrades to water services infrastructure, address trade effluent discharge considerations, and assess the management of surface water, including potential impacts on combined sewer networks. Physical impacts on Uisce Éireann assets must also be identified, encompassing reservoirs, drinking water sources, treatment works, pipes, pumping stations, and discharge outfalls, including any required asset relocations.	• Ch7 Land, Soils and Geology • Ch8 Hydrology and Hydrogeology
Fermanagh and Omagh District Council (FODC)	Fermanagh and Omagh District Council (FODC) acknowledge the thorough Land, Soils and Geology assessment in the draft EIAR but recommends Peat Landslide Hazard and Peatland Heritage Impact Assessments to address geological stability and archaeological risks on peatlands, alongside consideration of hydrologically connected Areas of Special Scientific Interest (ASSI), e.g., Lough Melvin ASSI as sensitive receptors comparable to NHAs/pNHAs.	• Ch7 Land, Soils and Geology • Ch8 Hydrology and Hydrogeology

The issues raised in the aforementioned responses have been addressed within this chapter. Comprehensive geological, hydrological and hydrogeological assessments have been undertaken, including appropriate seasonal monitoring programmes in respect of surface water and groundwater. Recommendations including the use of clear span bridges were incorporated into the design of the proposed wind farm.

8.2 ASSESSMENT METHODOLOGY

8.2.1 Difficulties Encountered in Compiling Information

No significant difficulties or limitations have been identified that apply to the hydrology and hydrogeology assessment. Where standard or routine assumptions have been made, these are documented within the baseline environment.

The assessment draws on the best available hydrological and hydrogeological data, supported by site-specific information and online publicly available datasets in conjunction with professional judgment where quantitative site data gaps occur. Typical gaps include sparse groundwater level measurements, and absent water quality time series. Natural seasonal and interannual variability has been considered in interpreting baseline conditions.

Where analytical or modelling techniques have been applied, these have been developed and validated using available datasets, with conservative parameters adopted to address uncertainty.

No limitations are considered to materially affect the reliability or robustness of the assessment outcomes.

8.2.2 Desk Study

The baseline environment of the proposed project (the proposed wind farm site, proposed GCR and proposed TDR) was investigated through comprehensive desk studies, site visits and intrusive site investigation.

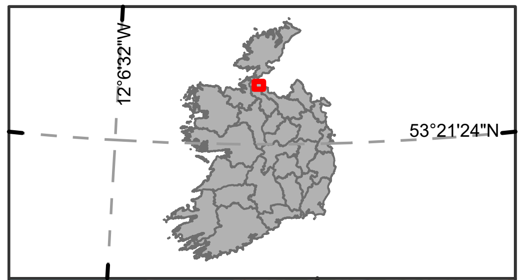
For the purposes of this Hydrology and Hydrogeology chapter, the study area, comprising the proposed project is illustrated in Figure 8-1.

The study areas have been defined in accordance with best practice guidance and professional judgement to identify potential source-pathway-receptor linkages and likely significant effects associated with the construction, operation and decommissioning phase of the proposed project. The assessment of the potential significant effects of the proposed project on hydrology and hydrogeology is limited to within the study area as defined on Figure 8-1. The study area is defined as 2 km from the proposed wind farm boundary and 200 m from the proposed GCR works and TDR accommodation areas, based on conservative best-practice. Hydrological / hydrogeological pathways in the downgradient receiving waters are identified as part of the assessment.

A desk study of the study area i.e. the proposed project was undertaken to collate and review background information of the receiving environment during the assessment. The sources of information reviewed are listed below:

- Geological Survey of Ireland (GSI) online databases showing hydrological, hydrogeological and geological mapping (GSI, Accessed July 2025);
- Environmental Protection Agency (EPA) databases showing hydrological and hydrogeological Water Framework Directive mapping, monitoring, protected areas and water environment pressures (EPA, 2024a);
- EPA water quality data was obtained from the Catchments.ie collaborative website (EPA, 2024b);
- Met Éireann Meteorological Databases (Met Éireann, 2024);

- GSI Groundwater Body Characterisation Report for the area (GSI, 2003); and
- Office of Public Works Flood Maps (OPW, 2024).



Legend

Application Boundary

Study Area

0 1 2

Kilometers

Spatial Reference	Copyrights:
Datum: IRENET95 EPSG: 2157	Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community,

Rev	Date	Description	By	Chkd.
A	11/03/2026	First issue	K.K	S.R

Client:

FuturEnergy Ireland

Project:

Lissinagroagh Wind Farm

Title:

Figure 8-1:
Study Area - Proposed Wind Farm

Scale @ A3: 1:50,000

Prepared by:	Checked by:	Date:
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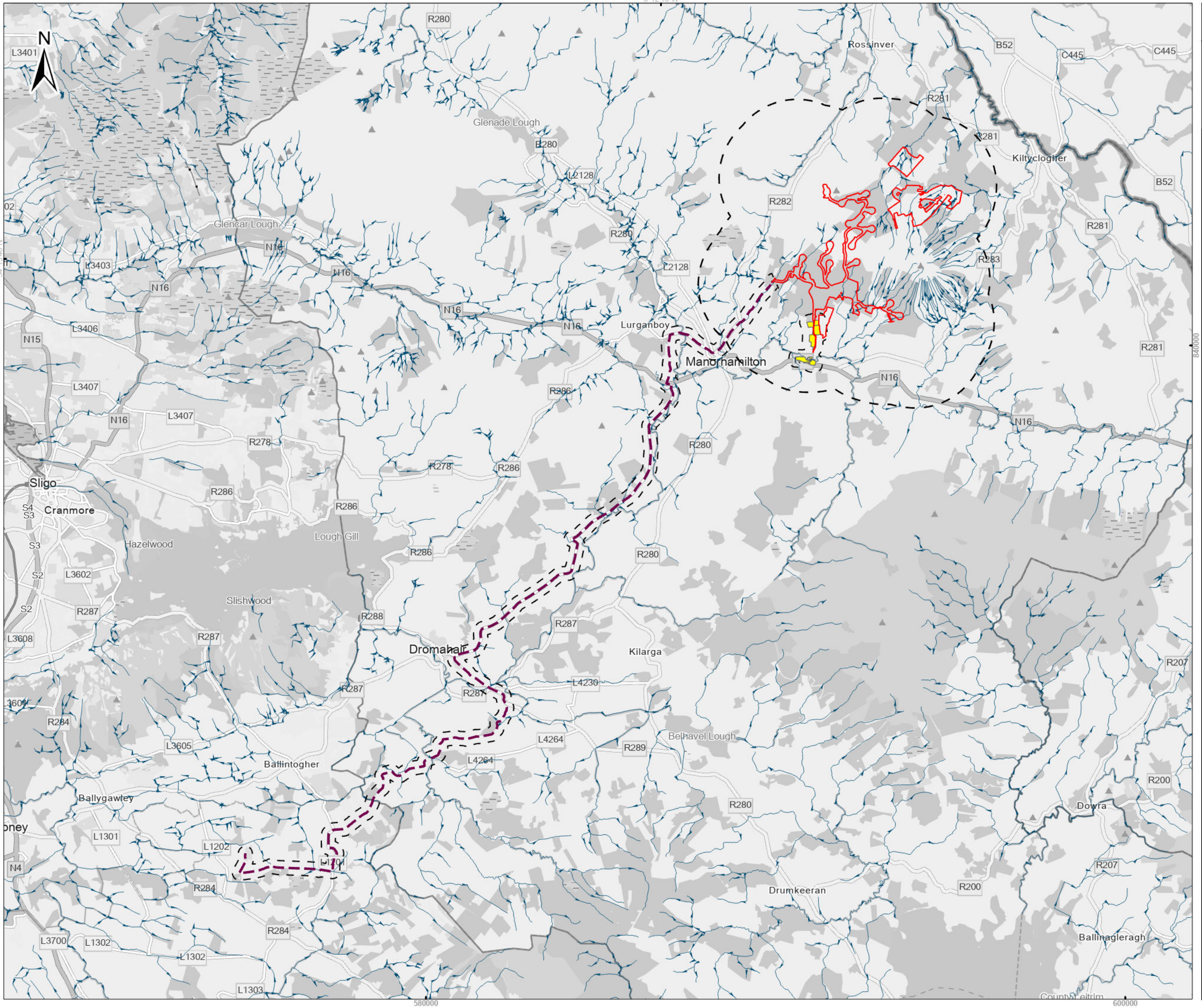
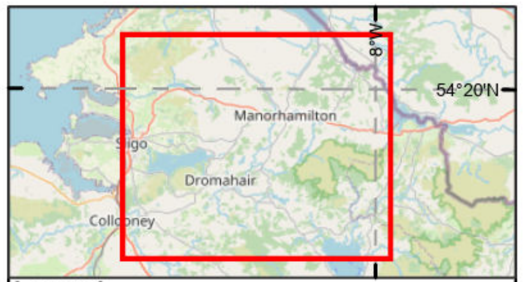
Map Ref: 10955-001-AE-P.App.BO-TOB-A

Draft: A





Legend

- Application Boundary
- Grid Connection Route
- GCR: Study Area
- Site Boundary: Study Area
- TDR Works Area
- TDR Works Area : Study Area
- WFD - River Water Bodies

0 1 2
Kilometers

Spatial Reference
Datum: IRENET95
EPSG: 2157

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REV	12/03/2026	Draft issue	K.K	S.R
Rev	Date	Description	By	Chkd.

Client:

FuturEnergy Ireland

Project:

Lissinagroagh Wind Farm

Title:

Figure 8-2
Study area for GCR

Scale @ A3: 1:100,000

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Map Ref: 10955-026-GCR-TDR-TOB-D01

Draft:

8.2.3 Field Surveys

As part of the assessment of the proposed project, a series of structured field investigations were undertaken, at the proposed wind farm site, over a five-year period, commencing in October 2020, to evaluate site conditions, both at the surface and subsurface level. These field activities were informed by desk study findings and designed to validate desktop assumptions, assess geomorphological features, and characterise underlying ground conditions. This focused approach targeted the area where the majority of project works will be concentrated, including deeper excavation activities, to evaluate site conditions at both surface and subsurface levels.

A total of 13 walkovers were undertaken of the proposed wind farm site and auxiliary areas to review the ground conditions and assess the topography and geomorphology. These were carried out by members of the TOBIN hydrogeological team in October 2020, July 2021, October 2021, December 2021, January 2022, July 2022 October 2022, June 2024, December 2024, January 2025, April 2025, May 2025, July 2025.

Initial walkover surveys and hydrological mapping of the proposed project were undertaken in October 2021 whereby water flow directions and drainage patterns were recorded.

Targeted walkovers were completed to support specific elements of the investigation. Surface water sampling was also carried out at selected locations in October 2020, July 2021 and January 2025, as shown in Figure 8-7. Following sample collections, samples were submitted to Eurofins Chemtest Laboratories for analysis of a suite of parameters. The results are summarised in Section 8.3.1.4. Continuous monitoring of turbidity was undertaken since January 2025 at three surface water locations, as illustrated in Figure 8-7.

Intrusive site investigations were conducted by Ground Investigations Ireland (GII) in November 2021, and October/November 2025 and by Causeway Geotech (CG) in September/October 2024. This included trial pitting, rotary coring, additional peat probing (gouge augering), and geotechnical and environmental laboratory testing.

Several bedrock exposures were surveyed within the proposed wind farm site, during site surveying completed in October 2021 and June 2024. These surveys aided in the development of a hydrogeological conceptual model of the proposed wind farm site, which is further discussed in section 8.3.4.

8.2.4 Assessment Methodology

The best practice source-pathway-receptor model for surface water and groundwater attributes is applied to assess likely significant effects on the hydrological and hydrogeological environment, specifically sensitive receptors downstream of the proposed wind farm site.

In order for a likely significant effect to be realised, three factors or the source-pathway-receptor model must be present. These are:

1. A source of a potential significant effect;
2. An environmental attribute, known as a receptor, which can be affected; and
3. A pathway or connection which allows the source to affect the receptor.

In this chapter, the likely effects on the water environment resulting from the proposed project are evaluated and mitigation measures are proposed to reduce any significant effects. Based on the mitigation measures proposed, the significance of the residual effects on the water environment are assessed.

The assessment in this chapter has considered the mitigation that has been embedded into the design to avoid or reduce environmental effects. Embedded mitigation is integral to the project design and therefore the assessment of effects assumes all embedded design measures are in place. Relevant embedded mitigation for this topic is detailed in Section 8.4.2.

8.2.4.1 Design Flexibility

The assessment in this EIAR takes account of the design flexibility parameters (varying turbine dimensions) set out in Chapter 2 (Description of the Proposed Project). The assessment has taken account of the range of design flexibility as defined within the project description. The environmental effects have been assessed for both the minimum and maximum parameters within this range to ensure that all reasonable permutations are represented. This approach identifies any potential variation in the significance of effects and confirms that the conclusions on likely environmental effects are robust across the full range of design options. The reasonable worst-case scenario describes the conditions considered to represent the most serious potential environmental effects. The options considered within the approved design flexibility do not change the conclusions on likely significant effects for hydrology or hydrogeology due to the limited variation in turbine base and hardstand types. Section 1.8.2.3 of Chapter 1 – Introduction, provides further details related to project Design Flexibility.

8.2.4.2 Sensitivity of Receptor

The importance or sensitivity rating criteria of the hydrological and hydrogeological attributes within the baseline environment are presented in Table 8-2 and Table 8-3 respectively. These tables are from the National Roads Authority (NRA, 2008a) and presented in Appendix C2 of the IGI Guidance Document (IGI, 2013).

These criteria in conjunction with the desk study will identify the environment type and the extent of site investigation required to gain a comprehensive understanding of the baseline environment and the conceptual site model. This will also contribute toward identifying potential effects and mitigation measures required.

Table 8-2: Sensitivity Rating of Hydrological Attribute (NRA, 2008a)

Importance	Criteria	Typical Example
Very High	Attribute has a high quality or value on a regional or national scale.	• River, wetland or surface water body ecosystem protected by EU legislation, e.g., 'European sites' designated under the Habitats Regulations, or 'Salmonid waters' designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988. • River, wetland or surface water body ecosystem protected by national legislation – NHA status. • Regionally important potable water source supplying >2500 homes. • Quality Class (Biotic Index Q4-5). • Flood plain protecting more than 50 residential or commercial properties from flooding. • Nationally important amenity site for wide range of leisure activities.
High	Attribute has a high quality or value on a local scale.	• Salmon fishery locally important potable water source supplying >1000 homes. • Quality Class (Biotic Index Q4).

Importance	Criteria	Typical Example
		• Flood plain protecting between 5 and 50 residential or commercial properties from flooding.
Medium	Attribute has a medium quality or value on a local scale.	• Coarse fishery. • Local potable water source supplying >50 homes. • Quality Class (Biotic Index Q3, Q3-4). • Flood plain protecting between 1 and 5 residential or commercial properties from flooding.
Low	Attribute has a low quality or value on a local scale.	• Local potable water source supplying <50 homes. • Quality Class D (Biotic Index Q2-3) Flood plain protecting 1 residential or commercial property from flooding. • Amenity site used by small numbers of local people.
Negligible	Attribute has a low quality or value on a local scale.	• Quality Class D (Biotic Index Q2, Q1) • Amenity site used by small numbers of local people.

Table 8-3: Sensitivity Rating of Hydrogeological Attribute (NRA, 2008a)

Importance	Criteria	Typical Example
Very High	Attribute has a high quality or value on a regional or national scale.	• Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation, e.g., SAC or SPA status. • Regionally Important Aquifer with multiple wellfields. • Groundwater supports river, wetland or surface water body ecosystem protected by national legislation - NHA status. • Regionally important potable water source supplying >2500 homes. Inner source protection zone for regionally important water source.
High	Attribute has a high quality or value on a local scale.	• Regionally Important Aquifer Groundwater provides large proportion of baseflow to local rivers. • Locally important potable water source supplying >1000 homes. • Outer source protection area for regionally important water aquifer. • Inner source protection area for locally important water source.
Medium	Attribute has a medium quality or value on a local scale.	• Locally Important Aquifer. • Potable water source supplying >50 homes. • Outer source protection area for locally important water source.
Low	Attribute has a low quality or value on a local scale.	• Poor Bedrock Aquifer (Pl) Potable water source supplying <50 homes.
Negligible	Attribute has a low quality or value on a local scale.	• Poor Bedrock Aquifer (Pu) Potable water source supplying <10 homes. No groundwater abstractions within 250m.

8.2.4.3 Overview of effects assessment process

The conventional source-pathway-receptor model for groundwater and surface water protection was applied to assess potential effects on groundwater and surface water specifically on downstream sensitive ecological receptors and local groundwater supplies.

The magnitude of any impacts considers the likely scale of the predicted change to the baseline conditions, resulting from the predicted effect and considers the duration of the effect i.e., temporary or permanent. Definitions of the magnitude of any effects are provided in Table 8-4.

Table 8-4: Definitions of Magnitude (Based on NRA, 2008a)

Magnitude	Magnitude Criteria	Typical Example[1]
Large Negative	Results in loss of attribute and/or quality and integrity of attribute	Loss or extensive change to a waterbody or water dependent habitat. Increase in predicted peak flood level >100mm. Extensive loss of fishery. Extensive reduction in amenity value. Changes to aquifer or unsaturated zone resulting in extensive change to existing water supply springs and wells, river baseflow or ecosystems. Potential high risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >2% annually.
Moderate Negative	Results in effect on integrity of attribute or loss of part of attribute	Increase in predicted peak flood level >50mm. Partial loss of fishery. Partial reduction in amenity value. Changes to aquifer or unsaturated zone resulting in moderate change to existing water supply springs and wells, river baseflow or ecosystems. Potential medium risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >1% annually.
Low Negative	Results in slight effect on integrity of attribute or loss of small part of attribute	Increase in predicted peak flood level >10mm. Minor loss or fishery. Slight reduction in amenity value. Changes to aquifer or unsaturated zone resulting in change to water supply springs and wells, river baseflow or ecosystems. Potential low risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >0.5% annually.
Negligible	Results in an effect on attribute but of insufficient magnitude to affect either use or integrity.	Negligible change in predicted peak flood level. Calculated risk of serious pollution incident < 0.5% annually.
Low Beneficial	Results in improvement of attribute quality	Reduction in predicted peak flood level >10mm Calculated reduction in pollution risk of 50% or more where existing risk is <1% annually.
Moderate Beneficial	Results in moderate improvement of attribute quality	Reduction in predicted peak flood level >50mm Calculated reduction in pollution risk of 50% or more where existing risk is >1% annually.

[1] The NRA (2008a) magnitude criteria for linear road schemes have been adapted for this wind farm EIAR by: (i) adjusting spatial scale descriptors from "road length km" to "site area/ha and track length km"; and (ii) incorporating peatland-specific examples (e.g. peat depth disturbance, stability risk) relevant to upland wind farm construction.

Magnitude	Magnitude Criteria	Typical Example[1]
Major Beneficial	Results in major improvement of attribute quality	Reduction in predicted peak flood level >100mm

Terms relating to the duration of impacts are as described in the EPA's Guidelines on the Information to be contained in Environmental Impact Assessment Reports (2022), Table 3.4.[2]

Throughout the development of the proposed project, measures have been adopted as part of the evolution of the project design and approach to construction, to avoid or otherwise reduce adverse effects on the environment ('embedded mitigation'). They are an inherent part of the proposed project and are effectively 'built in' to the assessment of effects. Where moderate to profound effects are identified, mitigation measures are proposed. Some effects do not require mitigation beyond the embedded mitigation measures described. The additional measures outlined in Section 8.5 will also be implemented during the construction, operational and decommissioning phase of the proposed project.

Table 8-5: Significance of Effect (Adapted from EPA Guidelines 2022 and IGI Guidelines 2013)

Magnitude of Impacts	Sensitivity of Receptor				
	Negligible	**Low**	**Medium**	**High**	**Very High**
Negligible	Imperceptible	Not significant	Not significant	Not significant	Not significant
Low	Not significant	Slight /Not Significant	Slight	Moderate	Significant
Medium	Not significant	Slight	Moderate	Significant	Very Significant
High	Not significant	Moderate	Significant	Very Significant	Profound

Likely significant effects may have negative, neutral or positive effects on the water environment. Terms relating to the duration and probability of effects are described in accordance with EPA EIAR Guidelines (2022) set out in Table 1-2 of Chapter 1 - Introduction.

The EPA (2022) and IGI (2013) matrices form the basis for the above table, adapted specifically for hydrology and hydrogeology receptors by: (i) streamlining terminology to match project-specific descriptors (e.g. "Slight/Not Significant" explicitly); and (ii) aligning thresholds with NRA (2008a) magnitude criteria for consistency across infrastructure EIARs.

Table 8-4 shows a comparison of the magnitude of the predicted effect and example effects and Table 8-5 presents how the significance of effects for the hydrological and hydrogeological receptors are assessed in this chapter.

[2] Environmental Protection Agency (2022) Guidelines on the Information to be contained in Environmental Impact Assessment Reports. Johnstown Castle, Co. Wexford: Environmental Protection Agency.

In order for a potential significant effect to be realised, three factors must be present. There must be a source of a potential significant effect, a receptor which can be affected and a pathway or connection which allows the source to affect the receptor. Only when all three factors are present can an effect be realised.

8.3 Receiving Environment

The existing water environment is discussed in terms of hydrological and hydrogeological conditions. The proposed project location is described in Chapter 2 - Description of the Proposed Project. The hydrological and hydrogeological features such as rivers, catchments, aquifers and waterbodies within the study area are shown on Figures 8-3 to 8-11.

8.3.1 Surface Water

The existing surface water environment within the study area is described under the following headings:

- Catchment Overview;
- Surface Water Features and Drainage;
- Surface Water Quality;
- Hydrometric Data;
- Surface Water Abstractions; and
- Flood Risk Assessment (FRA).

8.3.1.1 Catchment Overview

8.3.1.1.1 Proposed Wind Farm

The proposed wind farm is located approximately 3 km northeast of Manorhamilton, Co. Leitrim. The European Union (EU) Water Framework Directive (WFD) (2000/60/EC) provides a comprehensive framework for the protection of surface water bodies including rivers, lakes, coastal waters, estuaries, and heavily modified water bodies as well as groundwater. A catchment, also known as a drainage basin or watershed, is defined as a topographic area that collects surface runoff and discharges it through a single outlet or mouth. The catchment boundary marks the divide between land draining toward one stream and land draining toward another. In Ireland, there are 46 catchment management units based on the country's major river systems. These 46 catchments are further subdivided into 583 sub-catchments, which together cover the entire country. These 583 sub-catchments contain a total of 4,842 water bodies/sub-basins.

The topography of the proposed wind farm site can be described as gradual to steeply rising ranging in elevation from 170 m to 380 m Above Ordnance Datum (AOD) with the eastern part of the site bordering Dough Mountain (462m). The northern turbines are situated within the Saddle Hill (375m) Coillte property at elevations between 280 and 350 m AOD generally in undulating terrain. The southern turbines are located between 170 m and 260m AOD.

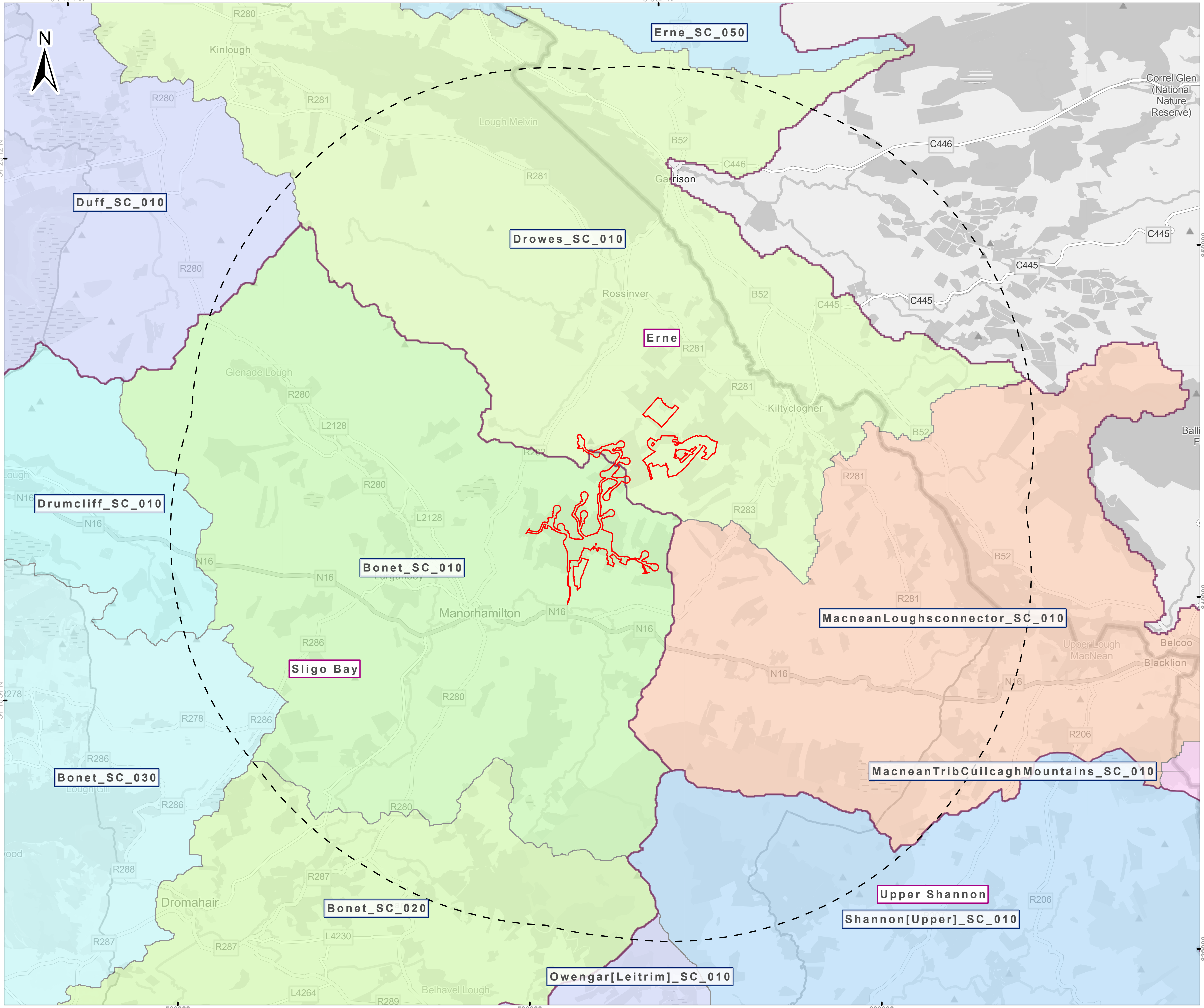
The proposed wind farm study area is characterised by a large number of watercourses. These range from naturally occurring upland streams to modified drainage channels within forested areas at mid to lower elevations. The eastern is part of the site is characterised by several flashy watercourses in deep ravines the majority of which have existing crossings in place as part of the existing forestry road network. All of these watercourses are of moderate to steep gradient and higher flow rate, representing natural watercourses typical eroding/upland rivers, which are actively eroding or unstable and where there is little or no deposition of fine sediment. Many of the naturally-occurring streams have been modified by agricultural and forestry activities in the area. Streams and drainage channels were assessed and mapped during field surveys. This resulted in an update of the published EPA mapping at some locations, particularly in the southeastern part of the site. The updated mapping is used in the relevant figures in this chapter.

The EPA has mapped waterbodies based on their risk of not meeting WFD objectives by 2027. This was determined by the assessment of monitoring data and data on the pressures and measures that have been implemented. Waterbodies that are at risk are prioritised for implementation of measures. This assessment was completed in 2020 by the EPA Catchments Unit in conjunction with other public bodies and was primarily based on monitoring data up to the end of 2018. In relation to the proposed wind farm site, as detailed in Table 8-6, the Owenmore (Manorhamilton)_020 and the Brackary_010 WFD river waterbodies are considered 'Not at risk', while the Lattone_010, the Ballagh_010 and the Rosfriar_010 are currently 'Under Review'.

The proposed wind farm site is located on the boundary of the Sligo Bay and Drowse (ID: 35) WFD Catchment and the Erne (ID: 36) WFD Catchment. The site is also subdivided between the WFD sub-catchment of Drowes_SC_010, Bonet_SC_010 and MacneanLoughs connector _SC_010, as shown in Figure 8-3. The Sligo Bay and Drowes Catchment includes streams entering tidal water in Sligo Bay and between Lenadoon Point and Aughrus Point, Co. Donegal. The catchment area is 1,866 km². The largest urban centre is Sligo. The other main urban centres are Ballymote, Collooney, Ballysadare and Manorhamilton. The catchment is divided into 13 sub-catchments and has 100 surface water bodies and 43 groundwater bodies. The Erne catchment includes the area drained by the River Erne and all streams entering tidal water between Aughrus Point and Kildoney Point, Co. Donegal. This is a cross-border catchment with a surface area of 4,415 km², 2,512 km² of which is located within the Republic. The largest urban centre is Cavan Town. The other main urban centres are Bundoran, Ballyshannon, Clones, Ballybay, Cootehill and Belturbet. The Erne Catchment is divided into 28 sub-catchments and has 259 surface water bodies and 66 groundwater bodies.

For river monitoring and water quality management under the WFD, each lake, stream and river is associated with a watershed area known as a river sub-basin. Clusters of these river sub-basins are grouped together to form sub-catchments, which are further grouped together to form catchments. WFD catchment boundaries are delineated based on natural hydrological and watershed divides, so each catchment area represents a distinct hydrological unit where surface drainage flows internally within the catchment and does not cross over into adjacent catchments. EPA monitoring locations within the proposed wind farm study area are shown on Figure 8-6.

The proposed wind farm site is subdivided between seven WFD river sub-basins. These include the Owenmore (Manorhamilton)_020, which occupies a significant proportion in the central region and to the north of the site, the Lattone_010, to the north east, with a small segment if Rosfriar_010 also located to the north east, the Ballagh_010 to the north, the Brackary_010 to the west, with the Owenmore (Manorhamilton)_010 and the Cornavannoge_010 located to the south east of the site. An assessment of compliance with the WFD is included in Appendix 8-1.



Legend

- Application Boundary
- 10km Buffer

Catchments

- WFD Catchments

WFD - Subcatchments

- Bonet_SC_010
- Bonet_SC_020
- Bonet_SC_030
- Drowes_SC_010
- Drumcliff_SC_010
- Duff_SC_010
- Erne_SC_050
- MacneanLoughsconnector_SC_010
- MacneanTribCuilcaghMountains_SC_010
- Owengar[Leitrim]_SC_010
- Shannon[Upper]_SC_010

0 2 4
Kilometers

Spatial Reference
Datum: IRENET95
EPSG: 2157

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Rev	Date	Description	By	Chkd.
A	11/03/2026	First issue	K.K	S.R

Client:

FuturEnergy Ireland

Project:

Lissinagroagh Wind Farm

Title:

Figure 8-3:
Regional Catchments
& Sub-Catchments

Scale @ A3: 1:100,000

Prepared by:	Checked by:	Date:
K.Kale	S.Ryan	March 2026

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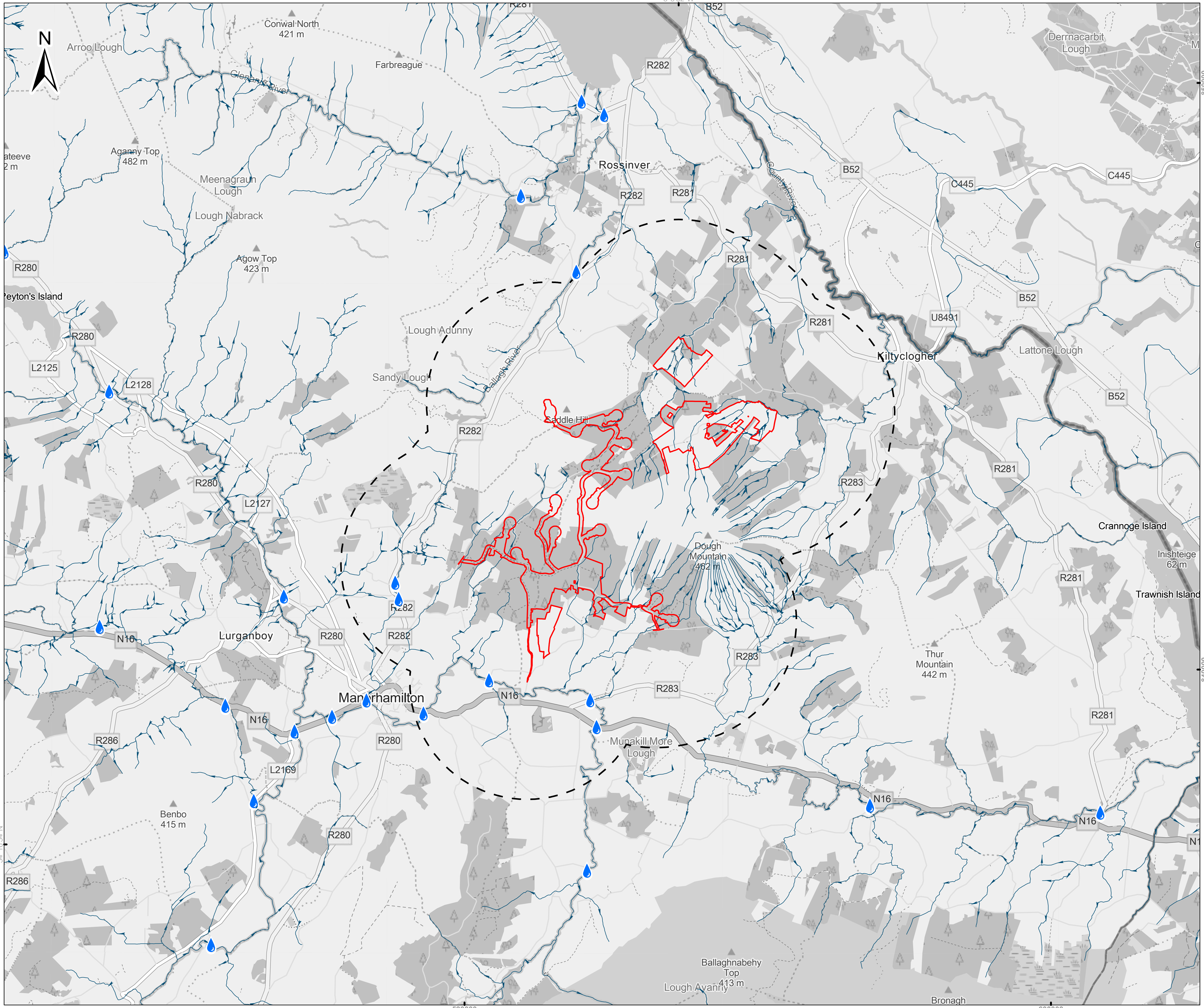
Map Ref: 10955-002-CAs-P.App.BO-TOB-A

Draft: A



Legend

- Application Boundary
- Application Boundary: Study Area
- WFD - River Water Bodies

EPA surface water monitoring locations

- Q4 - Q5 Unpolluted

0 2 4
Kilometers

Spatial Reference
Datum: IRENET95
EPSG: 2157

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Rev	Date	Description	By	Chkd.
A	11/03/2026	First issue	K.K	S.R

Client:

FuturEnergy Ireland

Project:

Lissinagroagh Wind Farm

Title:

Figure 8-4:
EPA Surface Water
Monitoring Locations

Scale @ A3: 1:60,000

Prepared by:	Checked by:	Date:
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Map Ref: 10955-003-EPA.SWML-P.App.BO-TOB-A

Draft: A

Table 8-6: Catchment Summary - Proposed Wind Farm Site

Catchment (Catchment ID)	WFD Sub-catchment (Sub catchment ID)	River Network EPA Name (Segment Code)	River Waterbody WFD Status 2019-2024 (River Name & Code)	River Waterbody WFD Risk 2019-2024
Sligo Bay & Drowse (35)	Bonnet_SC_010 (35_8)	Skreeny (35_1147)	Good Owenmore (Manorhamilton)_020 (IE_WE_35O080400)	Not at risk
		Skreeny (35_1148)		
		Skreeny (35_4030)		
		Null (35_1146)		
		Null (35_2951)		
		Saddle_Hill (35_2785)		
		Tawnyfeacle (35_3306)		
		Null (35_2909)		
		Null (35_4070)		
		Null (35_3973)		
		Null (35_4086)		
		Mt_Dough (35_3841)		
		Mt Dough (35_3971)		
		Null (35_3726)		
		Null (35_3727)		
		Null (35_3907)		
		Null (35_4059)		
		Null (35_4204)		
		Null (35_565)		
		Null (35_4003)		
		Moneenshinnagh35 35_2814)		
		Moneenshinnagh35 35_2999)		
		Moneenshinnagh35 35_4204)		
		Moneenshinnagh35 35_3834)		
		Null (35_2998)		
		Lissinagroagh 35 (35_4210)		
		Lissinagroagh 35 (35_219)		
		Tawnylust (35_518)		
		Null (35_4203)		
		Curraghfore (35_3220)	Good Brackary_010 (IE_WE_35B100500)	Not at risk
		Curraghfore (35_3221)		
		Faughary (35_3219)		
		Moneenshinnagh 35(35_4208)	Good Owenmore (Manorhamilton)_010 (IE_WE_35O080220)	Not at risk
		Owenmore (35_965)		
		Loughaphonta 35 (35_4207)		
		Loughaphonta 35 (35_279)		
Erne (36)	Drowes_SC_010 (36_20)	Lisdarush (36_7150)	Good Lattone_010 IE_NW_35L660960	Under Review
		Lisdarush (36_7062)		
		Null (36_7063)		
		Lattone_35 (36_7118)		
		Null (36_7264)		
		Null (36_7107)		

Catchment (Catchment ID)	WFD Sub-catchment (Sub catchment ID)	River Network EPA Name (Segment Code)	River Waterbody WFD Status 2019-2024 (River Name & Code)	River Waterbody WFD Risk 2019-2024
		Null (36_6843)		
		Null (36_6778)		
		Null (36_6507)		
		Null (36_6508)		
		Lattone 35 (36_6842)		
		Null (36_6596)		
		Null (36_7264)		
		Ballagh 35 (36_6370)	Good Ballagh_010 IE_NW_35B010400	Under Review
		Ballagh 35 (36_6369)		
		Ballagh 35 (36_6369)		
		Shasmore (36_6368)		
		Rosfriar (36_6811)	Good Rosfriar_010 IE_NW_35R320460	Under Review
Erne (36)	MacneanLoughsconnector_SC_010 36_24	Tawnylust_Barr (36_1756)	High Cornavannoge_010 IE_NW_36C040400	Not at Risk
		Tawnylust_Barr (36_871)		
		Tawnylust_Barr (36_552)		
		Tawnylust_Barr Upper (36_2050)		
		Cornavannoge (36_2159)		
		Cornavannoge (36_2107)		
		Cornavannoge (36_2108)		
		Cornavannoge (36_2051)		
		Cornavannoge (36_2551)		
		Cornavannoge (36_2552)		
		Cornavannoge (36_1173)		
		Cornavannoge (36_1726)		
		Cornavannoge (36_1721)		
		Tawnyunshinagh (36_2188)		
		Tawnyunshinagh (36_2393)		
		Tawnyunshinagh (36_2338)		
		Tawnyunshinagh (36_873)		
		Tawnyunshinagh (36_875)		
		Tawnyunshinagh (36_335)		
		Lissinagroagh 36 (36_868)		
		Lissinagroagh 36 (36_869)		
		Blackmountain (36_2109)		
		Lughawnagh (36_2553)		
		Lissinagroagh 36 (36_870)		
		Mullaun 36 (36_2019)		

8.3.1.1.2 Proposed GCR Works and TDR Accommodation Areas

The proposed GCR varies in elevation between the proposed onsite substation (160 mOD) and the proposed connection point at the existing 220kV Srananagh substation (70 mOD) in Co. Sligo. The overall length of the grid connection between the proposed substation and the existing substation is approximately 32 km, most of which is located within the public road corridor with a short section being within the proposed wind farm site, and the remainder being located within private lands.

In relation to the proposed Turbine Delivery Route (TDR), it is proposed that the turbine components will be delivered to the proposed wind farm site via Killybegs Port in south County Donegal. The only significant works relate to the construction of a temporary access for the delivery of large turbine components to the south of the wind farm. All other accommodations along the TDR relate to trimming of hedges and temporary extension of road edge.

The proposed GCR is located in the catchment of Sligo Bay and intercepts the sub catchments of Bonet_SC_020 and Owenmore [Sligo]_SC_030. The proposed TDR accommodations are located in the catchments of Donegal Bay North, Erne and Sligo Bay catchments. The proposed GCR and TDR are located within several river basins as detailed in Table 8-7.

Table 8-7: Catchments, Sub-Catchments & Waterbodies - Proposed TDR and GCR

Catchment (Catchment ID)	WFD Sub-catchment (Sub-catchment ID)	River Network EPA Name (Segment Code)	River Waterbody WFD Status 2019-2024 (River Name & Code)	River Waterbody WFD Risk 2019-2024	Project Work Area
Donegal Bay North (37)	Stragar_SC_010 (37_3)	Oily_020 (37-1273)	Moderate Oily_020 IE_NW_37O010200	At Risk	TDR
Sligo Bay (35)	Bonet_SC_030 (35_10)	Garavogue_010 (35_3792)	Poor Garavogue_010 (IE_WE_35G010200)	At Risk	GCR
Sligo Bay (35)	Bonet_SC_030 (35_10)	Willsborough Stream_010 (35_3278)	Moderate Willsborough Stream_010 (IE_WE_35W010300)	At Risk	TDR
Sligo Bay (35)	Bonet_SC_010 (35_8)	Owenmore Manorhamilton_020 (35_978)	Good Owenmore Manorhamilton_020 (IE_WE_35O080400)	Not at Risk	GCR
Sligo Bay (35)	Bonet_SC_020 (35_6)	Bonet_050	Good Bonet_050 IE_WE_35B060630	Review	GCR

Catchment (Catchment ID)	WFD Sub-catchment (Sub-catchment ID)	River Network EPA Name (Segment Code)	River Waterbody WFD Status 2019-2024 (River Name & Code)	River Waterbody WFD Risk 2019-2024	Project Work Area
Erne (36)	Erne_SC_050 (36_27)	Abbey_010	Good Abbey_010 IE_WE_35A010300	Review	TDR

8.3.1.2 Site Surface Water Features & Drainage

8.3.1.2.1 Proposed Wind Farm Site

The regional natural surface water drainage pattern in the environs of the proposed wind farm site is shown on Figure 8-5.

Bonet_SC_010

The Brackary_010 and Owenmore (Manorhamilton)_020 and their tributaries drain the southern and western section of the proposed wind farm site. T2, T6- T14 are located in the Owenmore (Manorhamilton)_020 river basin, with the western site entrance located in the Brachary_010. The Brackary_010 and Owenmore (Manorhamilton)_020 flow to the southwest, before joining Lough Gill located approximately 13 km downstream of the proposed wind farm site.

The Owenmore (Manorhamilton)_010 drains a small portion of the south of the site, flowing in a southerly direction, before ultimately flowing into Munakill More Lough.

Drowes_SC_010

The northern and northwest section of the proposed wind farm are located in the Ballagh_010 and Lattone_010 rivers and their tributaries. T1 is located in the Ballagh river basin with T1, T4 and T5 located in the Lattone river basin. The Ballagh, drains to the northeast and into Lough Melvin, located approximately 5.2 km downstream of the proposed wind farm site. The Lattone_010 flows to the northeast and north of the proposed wind farm to the Rosfriar River and Lough Melvin. T1 – T5 are all located within the Drowes_SC_010 sub catchment. T2 and T5 turbine hardstands are divided between the Drowes_SC_010 and Bonet_SC_010. T2 is located between the Owenmore (Manorhamilton)_020 and the Lattone_010 river basin, while T1 is located within the Ballagh_010 river basin.

MacneanLoughsconnector_SC_010

There is no proposed infrastructure in the MacneanLoughsconnector_SC_010 sub catchment. The Cornavannoge_010 and its tributaries are located to the east and northeast of T14, flowing in a southeast direction, eventually draining into Lough Macnean Upper.

Site Specific Information

Following site surveys between 2021 and 2025, surface water features were mapped on site. These are illustrated on Figure 8-5. Examples of the scale of the onsite streams is detailed in Photo 1 and Photo 2. All streams on the proposed wind farm site are small upland eroding streams.

Photo 1 – Stream/forestry drainage 50m east of T14.

Photo 2 – Stream 150m east of T11.

Drainage within the site is predominantly via streams and man-made drainage channels. Several streams/drainage channels were identified to be flowing through or adjacent to the proposed wind farm site. The man-made drainage channels flow to the watercourses identified in Figure 8-5 and assist in the drainage of forested and agricultural lands. Extensive arterial drainage occurs on the Coillte site. Eleven streams are crossed by the proposed access tracks or turbine locations. A number of drainage ditches will be crossed, there may be some realignment of drains throughout the site, which will be discussed below.

8.3.1.2.2 *Proposed GCR and Proposed TDR Accommodation Areas*

Table 8-8 illustrates the EPA stream name and code, the order (1 is the outermost tributary and order 5 is where the river flows into an estuary) and the Water Framework Directive water body code for water courses which will be intercepted by the proposed GCR. A total of 16 waterbodies will be crossed by the GCR. The rivers and tributaries associated with the proposed wind farm site have been reviewed in terms of their respective WFD Status as detailed in Table 8-10. No TDR work areas will interact with any EPA-registered watercourse. Proposed accommodations, including verge widening, and vegetation clearance along the TDR, avoid crossings or direct impacts on such watercourses. All necessary watercourse crossings, where applicable, are limited to routine public road infrastructure.

Table 8-8: Hydrology overview of proposed GCR

Site nr	Site name	Order	EPA code	WFD River Waterbody Code
13	Curraghfore Stream	2	35C68	Brackary_010
14	Brackary River	3	35B10	Brackary_010
15	Bonet River	4	35B06	Bonet_030
16	Cornstauk Drain Stream	1	35C09	Bonet_040
17	Shanvaus 35 River	4	35S01	Bonet_040
18	Gortgarrigan Stream	1	35G61	Bonet_040
19	Boihy Stream	2	35B76	Bonet_040
20	Lough_Carrigeencor Stream	1	35L88	Bonet_040
21	Rubbal Stream	2	35R44	Bonet_050
22	Bonet River	5	35B06	Bonet_050
23	Killananima Stream	1	35K09	Cashel Stream (Bonet)_010
24	Killanummery River	3	36K03	Killanummery_020
25	Bawn 35 Stream	1	35B11	Killanummery_020
26	Barroe 35 Stream	1	35B97	Killanummery_020
27	Rathgeean Stream	2	35R37	Killanummery_020
28	Curraghfore Stream	2	35C68	Brackary_010

8.3.1.3 Surface Water Quality

8.3.1.3.1 Proposed Wind Farm Site

The EPA has conducted biological water quality monitoring on Irish watercourses since the 1970s. To assess historical water quality in rivers and streams hydrologically connected to the proposed project, EPA water quality data was reviewed. Under the WFD, waterbodies are classified as having bad, poor, moderate, good, or high status, based on biological conditions, chemical quality, hydromorphology, and flow regime. The biological status is assessed using the Q-value index, which rates water quality from Q1 (poor) to Q5 (high), based on macroinvertebrate communities (Table 8-9). The latest water quality monitoring is detailed in the EPA's Water Quality in Ireland 2023 Report.

Table 8-9: Biotic Index of Water Quality

Biotic Index (Q-Value)	WFD Status	Pollution Status	Condition
Q5, Q4-5	High	Unpolluted	Satisfactory
Q4	Good	Unpolluted	Satisfactory
Q3-4	Moderate	Slightly polluted	Unsatisfactory
Q3, Q2-3	Poor	Moderately polluted	Unsatisfactory
Q2, Q1-2, Q1	Bad	Seriously polluted	Unsatisfactory

Within the vicinity of the proposed wind farm, the nearest EPA biological monitoring point is located on a bridge near Black Park House and located downstream, along the Owenmore River, as shown in Figure 8-6. Relevant Q-values for connected watercourses are presented in Table 8-10. The most recent EPA monitoring was undertaken in 2021 in the Bonet sub-catchment and 1990 on the Lattone sub-catchment.

Table 8-10: Q-values at EPA Monitoring Locations in the vicinity of the Proposed Wind Farm

Monitoring Station Details					
WFD Sub-catchments	Bonet_SC_010				Drowes_SC_010
WFD River Sub Basin	Brackary_010	Owenmore (Manorhamilton)_010	Owenmore (Manorhamilton)_020		Ballagh_010
Station Name	Bridge u/s Owenmore River –D/S of PWF	Br near Black Park-House- U/S of PWF	Bridge W. of Leminea D/S of PWF	Curley Bridge D/S of PWF	Bridge W. of Tullyskerherny D/S of PWF
Station Code	RS35B100500	RS35O080220	RS35O080260	RS35O080300	RS35B010200
Date	**Q-Value**				

1990	3-4	ND[3]	4-5	5	5
1994	3-4	4	ND	ND	ND
1997	3	ND	ND	ND	ND
2000	4	4-5	ND	ND	ND
2003	4	4	ND	ND	ND
2006	4	4-5	ND	ND	ND
2009	4	4	ND	ND	ND
2012	4	4	ND	ND	ND
2015	4	4	ND	ND	ND
2018	3-4	4	ND	ND	ND
2021	4	4	ND	ND	ND

Based on the data presented in Table 8-10, the overall water quality in the area surrounding the proposed wind farm site, has been of 'moderate' to 'good' status, with occasions of 'high' status. However, as outlined in Table 8-10, regular monitoring did not occur in the Owenmore (Manorhamilton)_020 or Ballagh_010 WFD River Sub-Basin, with monitoring ceasing in 1990. The rivers and tributaries associated with the proposed wind farm site, as illustrate din Figure 8-5 and Table 8-8, have been reviewed in terms of their respective WFD Status as detailed in Table 8-11.

Table 8-11: Q values at Proposed Wind Farm

Site	Q-value	WFD Ecological Status	SSRS	SSRS Category
1	3-4	Moderate	7.2	Probably not at risk
2	NA	NA	NA	NA
3	3-4	Moderate	8	Probably not at risk
4	3-4	Moderate	7.2	Probably not at risk
5	3-4	Moderate	8.8	Probably not at risk
6	4	Good	8.8	Probably not at risk
7	3-4	Moderate	5.6	At risk
8	4	Good	9.6	Probably not at risk
9	3-4	Moderate	4	At risk
10	3-4	Moderate	8	Probably not at risk
11	NA	NA	NA	NA
12	NA	NA	NA	NA
13	3-4	Moderate	8	Probably not at risk
14	3-4	Moderate	8.8	Probably not at risk

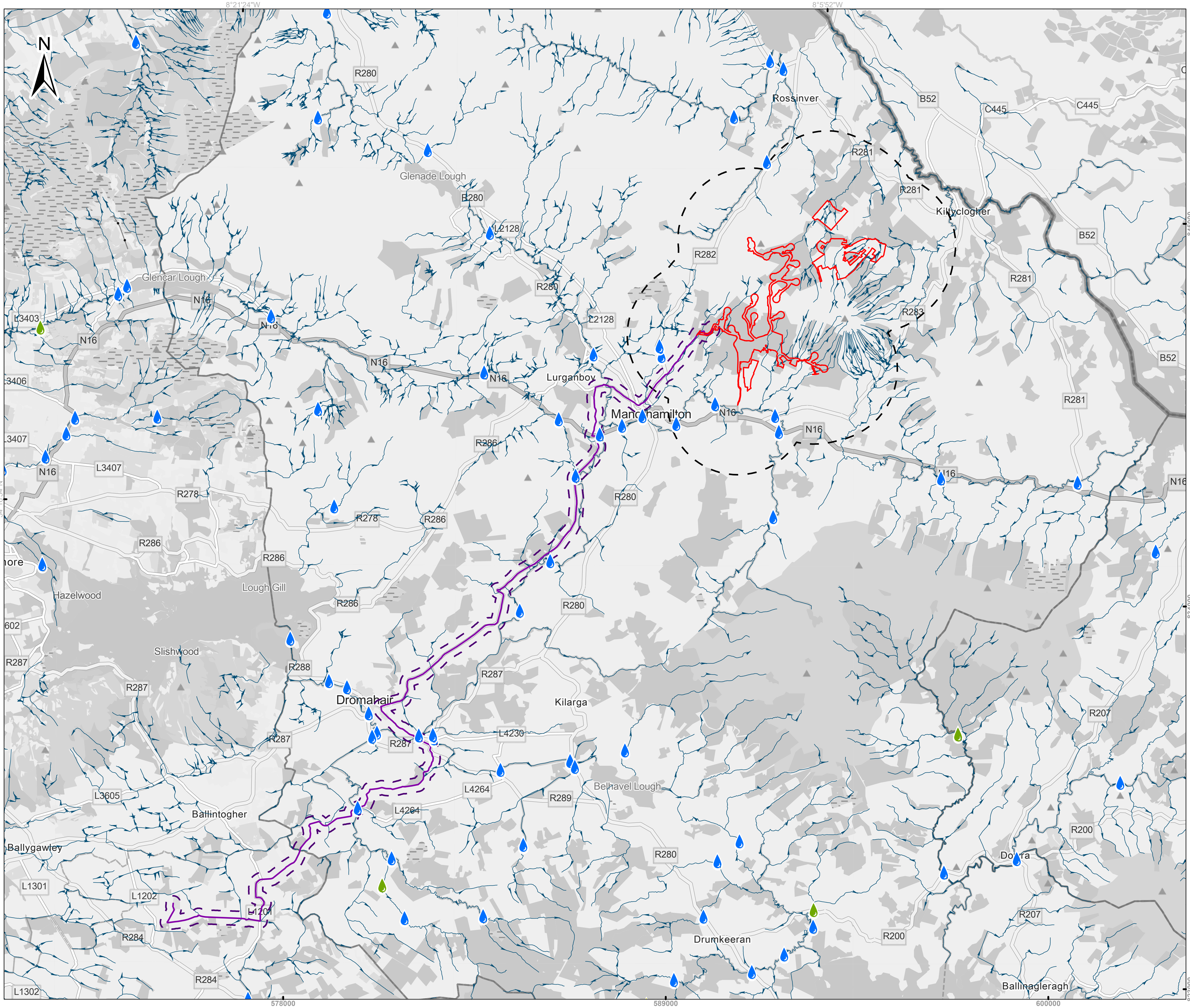
[3] No data

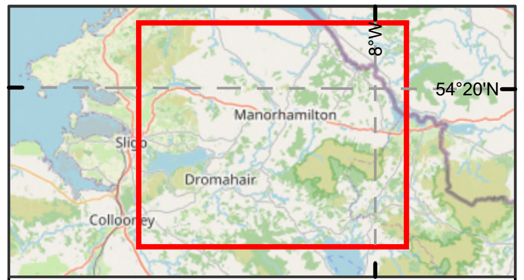
Site	Q-value	WFD Ecological Status	SSRS	SSRS Category
15	3-4	Moderate	8	Probably not at risk
16	NA	NA	NA	NA
17	NA	NA	NA	NA
18	NA	NA	NA	NA
19	3	Poor	5.6	At risk
20	NA	NA	NA	NA
21	3-4	Moderate	8	Probably not at risk
22	3-4	Moderate	8	Probably not at risk
23	NA	NA	NA	NA
24	4	Good	8.8	Probably not at risk
25	NA	NA	NA	NA
26	NA	NA	NA	NA
27	NA	NA	NA	NA
28	NA	NA	NA	NA

The Small Stream Risk Score (SSRS) is calculated from the presence and abundance of macroinvertebrate groups (e.g. mayflies, stoneflies, etc.) that have well-known sensitivity or tolerance to pollution. The resulting numerical score is then classified into risk categories using threshold values. Scores for proximate streams ranged across the risk bands, with values <6.5 indicating streams at risk, 6.5–7.25 indeterminate (may be at risk), and >7.25 probably not at risk, based on macroinvertebrate assemblage sensitivity to pollution.

Sites within the proposed wind farm site boundary where proposed infrastructure (e.g. roads and turbine hardstands) are proposed to be constructed in proximity to a watercourse were selected (Site 1 to 12). Sites where the GCR crosses a waterbody were also selected (Site 13 to 28). Water quality results (Q-values) at the sampled locations generally indicate moderate to good ecological quality within watercourses of the study area. The Q-values on the Ballagh_010, Lattone_010, Rosfair_010, Brackary_010, (Manorhamilton)_020 and Cornavannoge_010 indicate the overall water quality is good and are reaching the target Q4 good status water quality required under the WFD. However, it is evident that the Q-value reduces to Q3 downstream of the proposed wind farm on the Owenmore (Manorhamilton)_010 and Owenmore (Manorhamilton)_020 in places.

Further information related to the Q-value assessment can be located in Chapter 5 (Biodiversity), Appendix 5-4 (Aquatic Baseline).





Legend

- Application Boundary
- Application Boundary: Study Area
- Grid Connection Route
- GCR: Study Area
- WFD - River Water Bodies

EPA surface water monitoring locations

- Q4 - Q5 Unpolluted
- Q3-4 Slightly Polluted
- Q2 - Q3 Moderately Polluted

0 2 4
Kilometers

Spatial Reference
Datum: IRENET95
EPSG: 2157

A	27/04/2026	First issue	K.K	S.R
Rev	Date	Description	By	Chkd.

Client:
FuturEnergy Ireland

Project:
Lissinagroagh Wind Farm

Title:
Figure 8-5:
EPA Biological Monitoring –
Proposed Wind Farm and GCR

Scale @ A3: 1:100,000

Prepared by: K.Kale
Checked by: S.Ryan
Date: April 2026

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Map Ref: 10955-020-EPA.SWML-GCR-TOB-A

Draft: A

8.3.1.4 Water Quality – Field Sampling

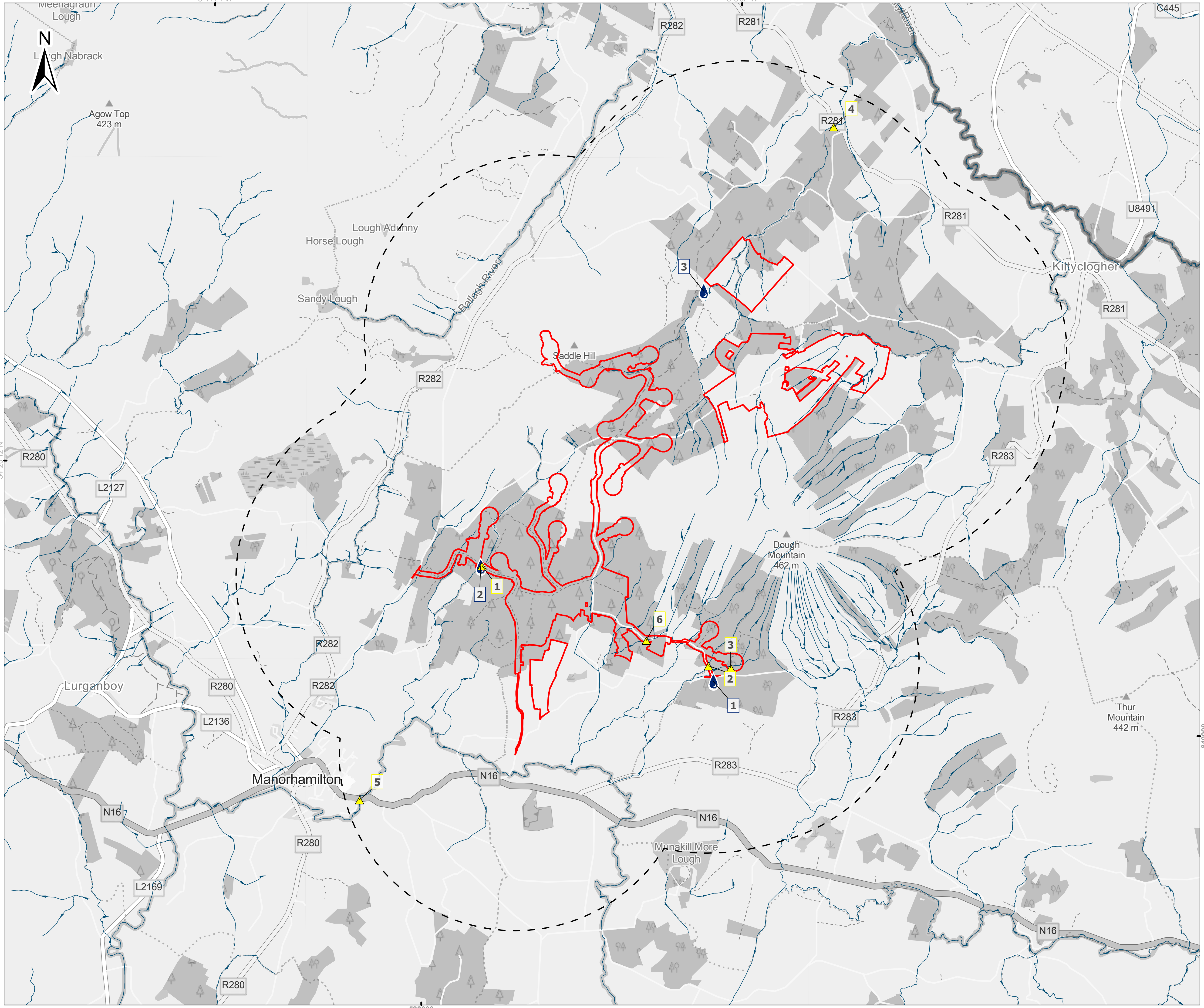
Surface water sampling of watercourses within the proposed wind farm study area was undertaken in October 2020, July 2021, January 2025 and October 2025. Samples were collected from five surface water sampling locations in July 2021 and three surface water sampling locations in October 2020 and January 2025. Sampling locations are shown in Figure 8-7.

Field measurements of pH, electrical conductivity (µS/cm), turbidity and dissolved oxygen (DO, mg/L) were taken on-site and samples were subsequently submitted to an accredited laboratory, Eurofins Chemtest Laboratories, for analysis of a range of parameters.

The results of the analysis are summarised in Table 8-12, 8-13, 8-14 and 8-15.

Field hydrochemistry measurements of pH, electrical conductivity (µS/cm), turbidity, and Dissolved Oxygen (DO, mg/L) were taken at the sampling locations during the sampling events. Electrical conductivity values for the samples taken range from 82 – 630 µS/cm. This is indicative of surface water, which is mainly derived from precipitation, with limited groundwater input. The pH values at the sample locations ranged from 8.3 – 8.6, with all pH values above 8, indicating alkaline conditions. Natural waters at pH 8.2–8.6 are commonly found in areas influenced by limestone or other carbonate geology. Turbidity values vary due to the flashy flow in the upland streams. Turbidity monitoring at three site locations has been ongoing since early 2025.

Measured water quality parameters across SW1 to SW5 sampling locations ranged as follows: pH was 8.3 to 8.6, electrical conductivity from 82 to 250 µS/cm, suspended solids were less than 5.0 to 17 mg/l, BOD ranged 10 to 11 mgO_2/l, COD was between 87 and 130 mgO_2/l, alkalinity ranged 27 to 100 mg/l, chloride was 11 to 20 mg/l, ammonia ranged from less than 0.050 up to 0.24 mg/l, nitrite consistently measured below 0.020 mg/l, nitrate was less than 0.50 up to 0.86 mg/l, total phosphorus varied 0.026 to 0.033 mg/l, orthophosphate as PO_4 was between 0.077 and 0.098 mg/l, total nitrogen was less than 5.0 mg/l, and total hardness as $CaCO_3$ ranged from 26 to 100 mg/l.



Legend

- Application Boundary
- Application Boundary: Study Area
- Turbidity Monitoring
- Water Sampling Locations
- WFD - River Water Bodies

0 1 2
Kilometers

Spatial Reference
Datum: IRENET95
EPSG: 2157

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FuturEnergy Ireland

Project:

Lissinagroagh Wind Farm

Title:

Figure 8-6:
Surface water: Sampling and Turbidity Monitoring Locations

Scale @ A3: 1:40,000

Prepared by: K.Kale
Checked by: S.Ryan
Date: March 2026

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Draft: A

Table 8-12: Surface Water Sampling Results (October 2020)

Parameter	Units	Surface Water Regs 2007 (as amended)	SW1 Skreeny [35S46] Stream	SW2 Dough Mt [35M62] Stream:	SW3 Moneenshinagh 35 [35M60] Stream	SW4 Lattone 35 [35L66] River	SW5 Manorhamilton [35O08] River
			01/10/2020	01/10/2020	01/10/2020	02/10/2020	01/10/2020
pH	pH	Soft (3) Water 4.5< pH < 9.0	8.6	8.5	8.4	8.3	8.4
Electrical Conductivity	µS/cm		250	120	130	82	200
Suspended Solids @105°C	mg/l		8	17	< 5.0	< 5.0	9
COD	mgO_2/l		130	120	87	130	110
Alkalinity (Total)	mg/l		71	27	44	32	100
Chloride	mg/l		15	11	13	17	20
Ammonia	mg/l		0.24	< 0.050	< 0.050	< 0.050	< 0.050
Nitrite	mg/l		< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Nitrate	mg/l	50mg/l (Ground Water Regulations)	< 0.50	< 0.50	< 0.50	0.86	< 0.50
Phosphorus (Total)	mg/l	≤0.025	0.033	0.029	0.03	0.033	0.026
Orthophosphate as PO_4	mg/l	Good status ≤ 0.065 (mean) and ≤ 0.140 (95%ile)	0.1	0.087	0.091	0.098	0.077
Nitrogen (Total)	mg/l		< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Total Hardness (CACO3)	mg/l		73	34	44	26	84

Table 8-13: Surface Water Sampling Results (July 2021)

Parameter	Units	Surface Water Regs 2007 (as amended)	L701	L702	L703
			21/07/2021	21/07/2021	21/07/2021
pH	pH	Soft (3) Water 4.5< pH < 9.0	8.2	8.4	8.5
Electrical Conductivity	µS/cm		630	530	260
Suspended Solids @105°C	mg/l		13	6.0	7.0

COD	**mgO_2/l**		<10	12	25
Chloride	**mg/l**	200	14	15	13
Ammonium	**mg/l**	Good status ≤ 0.065 (mean) ≤ 0.140 (95%ile)	0.18	0.079	0.14
Nitrate	**mg/l**	50mg/l (Ground Water regulations)	3.1	3.1	0.71
Phosphorus (Total)	**mg/l**	≤0.025	0.080	0.040	0.040
Orthophosphate as PO_4	**mg/l**	Good status ≤ 0.065 (mean) and ≤ 0.140 (95%ile)	0.24	0.12	0.12

Table 8-14: Surface Water Sampling Results (Jan 2025)

Parameter	Units	Surface Water Regs 2007 (as amended)	L701	L702	L703
			21/07/2021	21/07/2021	21/07/2021
pH	**pH**	Soft (3) Water 4.5< pH < 9.0	7.2	7.5	7.5
Electrical Conductivity	**µS/cm**		630	530	260
Suspended Solids @105°C	**mg/l**		13	6.0	7.0
COD	**mgO_2/l**		<10	12	25
Chloride	**mg/l**	200	14	15	13
Ammonium	**mg/l**	Good status ≤ 0.065 (mean) ≤ 0.140 (95%ile)	0.18	0.079	0.14
Nitrate	**mg/l**	50mg/l (Ground Water regulations)	3.1	3.1	0.71
Phosphorus (Total)	**mg/l**	≤0.025	0.080	0.040	0.040
Orthophosphate as PO_4	**mg/l**	Good status ≤ 0.065 (mean) and ≤ 0.140 (95%ile)	0.24	0.12	0.12

Table 8-15: Surface Water Sampling Results (Oct 2025)

Parameter	Units	Surface Water Regs 2007 (as amended)	L701	L702	L703
			22/10/2025	22/10/2025	22/10/2025
pH	**pH**	Soft (3) Water 4.5< pH < 9.0	7.4	7.4	7.5
Electrical Conductivity	**µS/cm**		520	512	195
Suspended Solids @105°C	**mg/l**		7	<5	11
Chloride	**mg/l**	200	14	15	13
Ammonium	**mg/l**	Good status ≤ 0.065 (mean) ≤ 0.140 (95%ile)	0.04	0.02	0.05

Nitrate	**mg/l**	50mg/l (Ground Water regulations)	1.5	1	0.55
Orthophosphate as PO_4	**mg/l**	Good status ≤ 0.065 (mean) and ≤ 0.140 (95%ile)	0.015	0.015	0.01

The surface water sampling programme included monitoring at three sites (L701, L702, and L703) with samples collected primarily on three dates: July 21, 2021, January 2025 and October 22, 2025. The parameters analysed comprised pH, electrical conductivity, suspended solids, chemical oxygen demand (COD), chloride, ammonium, nitrate, total phosphorus, and orthophosphate. Across these dates, the pH values ranged from about 7.2 to 8.5, electrical conductivity varied between 195 to 630 µS/cm, and suspended solids were recorded between 5 to 13 mg/L. Concentrations of nutrients such as ammonium ranged from 0.02 to 0.18 mg/L, nitrate from 0.55 to 3.1 mg/L, and phosphorus total was between 0.025 to 0.080 mg/L. These results were contextualized against relevant surface water regulations to assess water quality status. This time span captures representative seasonal and multiyear variations in surface water quality for the sites.

While this one-off sampling provides a useful snapshot, potential seasonal or episodic variations in water quality are acknowledged, and conservative assumptions have been applied in the assessment to account for these uncertainties. Turbidity monitoring was undertaken at three locations since Q1 2025. Turbidity monitoring on the proposed wind farm site indicated a large variation in turbidity levels typical of upland eroding site. During base flow periods (non-rainfall periods) values were less than <5 Nephelometric Turbidity Units (NTU). During heavy rainfall events values increased to between 20 and >200 NTU. Turbidity strongly correlated with discharge. As rain and flow increases, the energy to erode and transport sediment rises. Information in relation to the turbidity monitoring is included in Appendix 8-3.

8.3.1.5 Assessment of Hydrometric Data

Hydrometric data is information on levels and flows of surface water (hydrology) and groundwater (hydrogeology). Discharge refers to the volumetric flow rate of water that is transported through a given cross-sectional area. Hydrometric data is collected as part of the EPA's Hydrometric Programme.

It is noted that there were no active hydrometric stations located in the immediate environs of the proposed wind farm site. Although hydrometric stations do exist on watercourses down-gradient of the proposed wind farm site, they include flows coming from a number of different tributaries that are not connected to the proposed project. As such, they are not representative of the actual flows occurring at the proposed wind farm site.

Surface water runoff or overland flow is the flow of water occurring on the ground surface when excess rainwater, stormwater, meltwater, or other sources, can no longer sufficiently infiltrate the soil. HR Wallingford developed a number of UK Sustainable Drainage System tools (available at www.uksuds.com) including the Greenfield Runoff Rate Estimation Tool which was used to provide a calculation of runoff for the proposed wind farm site and represents best practice in Ireland. When accessing runoff characteristics of the proposed wind farm site, it can be best described as an area with moderate to high infiltration, and high rainfall. The

Manorhamilton rainfall monitoring station operated by Met Éireann collects daily rainfall levels and is located approximately 3 km to the southwest of the proposed wind farm site. Data from this station indicates that there is an average annual rainfall of approximately 1,527 mm/yr since 1982.

However, the groundwater recharge dataset from the GSI indicates recharge rates of 80 mm/yr to 1,012 mm/yr, due to the underlying soil and bedrock aquifer characteristics.

8.3.1.6 Surface Water Abstractions and Protection Areas

The EPA Map Viewer provides information on the locations of surface water protection areas. These are in the form of:

- Drinking Water – Rivers;
- Drinking Water – Lakes;
- Geological Survey Ireland (GSI) Public Supply Source Protection Areas; and
- National Federation Group Water Schemes (NFGWS) Group Scheme Source Protection Areas.

The proposed project does not fall within any surface water protection areas and there are no known surface water abstractions within the proposed study area.

8.3.1.7 Flood Risk Assessment

The OPW provides information on flood risk throughout Ireland. This includes historical events as well as modelled flood extents for:

- Low probability events i.e., 1-in-1000 chance of occurring or being exceeded in any given year, also known as an Annual Exceedance Probability (AEP) of 0.1%;
- Medium probability events i.e., 1-in-a-100 chance of occurring or being exceeded in any given year, or an AEP of 1%; and
- High probability events i.e., 1-in-a-10 chance of occurring or being exceeded in any given year, or an AEP of 10%.

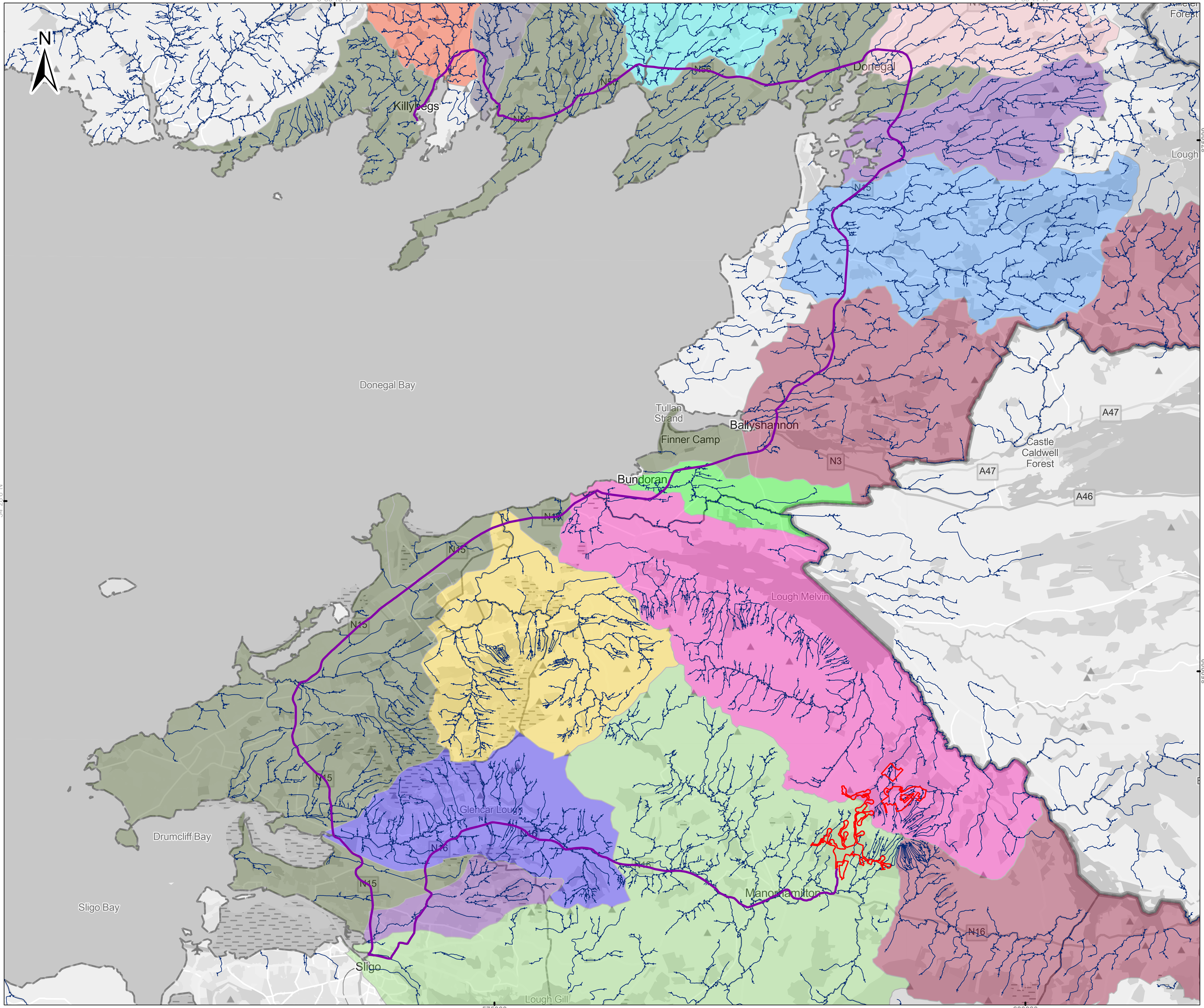
The OPW also produce 'Flood Maps' (surface water) to comply with the requirements of the European Communities (Assessment and Management of Flood Risks) Regulations 2010 to 2015 (implementing Directive 2007/60/EC) for the purposes of establishing a framework for the assessment and management of flood risks. These aim to reduce the adverse consequences for human health, the environment, cultural heritage and economic activity associated with floods.

The GSI has also developed Groundwater Flood Maps as part of the 2016-2019 Groundwater Flood Project in collaboration with Trinity College Dublin (TCD) and the Institute of Technology Carlow (IT Carlow). These maps aid in understanding the deficit of groundwater flood data in Ireland and help to assist stakeholders making informed decisions regarding groundwater risk.

A Stage 1 Flood Risk Assessment (FRA) was conducted by TOBIN and is included as part of this environmental impact assessment report (refer to Appendix 8-4).

One historic flood event (ID-13429), attributed to fluvial flooding from the Ballagh River, occurred approximately 3.5 km to the north of the proposed wind farm site at Rossinver on the 07/12/2015. A re-occurring flood (ID-5017) also occurs approximately 3 km downstream on the

Owenmore (Manorhamilton). Road flooding from a stream occurs on the Larkfield Road (R280), approximately 3.6 km south of Manorhamilton, following periods of heavy rain.



Legend

- Application Boundary
- Turbine Delivery Route
- WFD - River Water Bodies

WFD - River Basins

- Ballintra
- Bradoge
- Bungosteen
- Coastal
- Drowes
- Drumcliff
- Duff
- Eany Water
- Eask
- Erne
- Garvogue
- Oily
- Stream

0 5 10
Kilometers

Spatial Reference
Datum: IRENET95
EPSG: 2157

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A	11/03/2026	First issue	S.P	S.R

Client:

FuturEnergy Ireland

Project:

Lissinagroagh Wind Farm

Title:

Figure 8-7:
Surface water Features and River Basins along the TDR.

Scale @ A3: 1:165,694

Prepared by:	Checked by:	Date:
S.Pezzetta	S.Ryan	March 2026

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Map Ref: 10955-024-WFD-TDR-TOB-A

Draft: A

8.3.2 Groundwater

The purpose of this section is to describe the groundwater (hydrogeological) setting of the study area. It is provided to give context to the groundwater characteristics and flow patterns within and adjacent to the proposed wind farm site, proposed GCR works and proposed accommodation areas on the TDR.

Groundwater is water that has infiltrated into the ground to fill the pore spaces within sediment deposits and the pore space and fractures within the bedrock. An aquifer is an underground body of water bearing rock or unconsolidated materials (gravel or sand) that can yield a usable quantity of water.

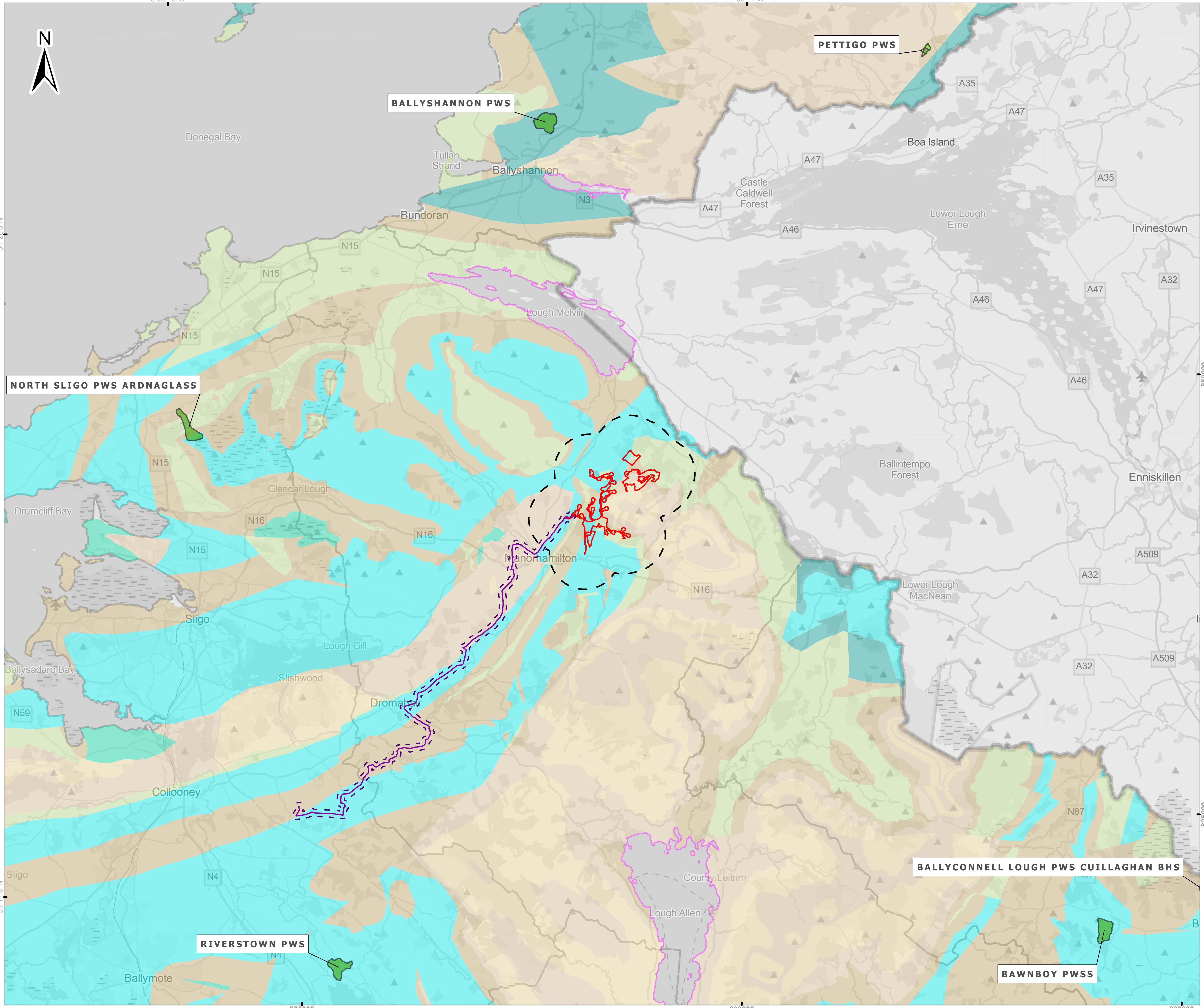
8.3.2.1 Aquifer Potential and Characteristics

The aquifer potential of a bedrock unit is determined by the groundwater productivity, which in turn is determined based on the hydraulic characteristics compiled from borehole data throughout the country. The GSI categorises the aquifer bodies into Regionally Important Aquifers, Locally Important Aquifers and Poor Aquifers. These are then subcategorised to create a total of seven bedrock aquifer categories and two sand and gravel aquifer categories.

Reference to the GSI National Aquifer Map as shown in Figure 8-8, indicates that the proposed project is underlain by a number of Regionally Important to Poor Aquifers, as detailed in Table 8-16. The Dartry Limestone Formation is classified as a Regionally Important Aquifer – Karstified Conduit, meaning that the bedrock aquifer has undergone karstification, a geological process where soluble carbonate rocks such as limestone are dissolved by natural acidic waters.

Table 8-16: Bedrock Aquifer Classification and Characteristics

Aquifer Classification	Productivity	Bedrock	Karst Features
Regionally Important (Rck)	Regionally Important Aquifer – Karstified Conduit	Dartry Limestone Formation	Yes
Locally Important Aquifer (Ll)	Bedrock which is moderately productive only in local zones	Bundoran Shale Formation Benbulben Shale Formation Glencar Limestone Formation Bellavally Shale Formation Meenymore Formation	No
Locally Important Aquifer (Lm)	Bedrock which is generally moderately productive	Mullaghmore Sandstone Formation Glenade Sandstone Formation	Yes
Poor Aquifer (Pl)	Bedrock which is generally unproductive except for local zones	Carraun Shale Formation Lacoon Flagstone Member	No
Poor Aquifer (Pu)	Bedrock which is generally unproductive	Dergvone Shale Formation	No



Legend

- Application Boundary
- Application Boundary: Study Area
- Grid Connection Route
- GCR: Study Area

Public Supply Source Protection Areas

- SI-Inner Protection Area
- SO-Outer Protection Area

Aquifer Bedrock

- Rkc - Regionally Important Aquifer - Karstified (conduit)
- RK - Regionally Important Aquifer - Karstified
- Lm - Locally Important Aquifer - Bedrock which is Generally Moderately Productive
- Lk - Locally Important Aquifer - Karstified
- LI - Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones
- PI - Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones
- Pu - Poor Aquifer - Bedrock which is Generally Unproductive
- Lake

0 5 10
Kilometers

Spatial Reference
Datum: IRENET95
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FuturEnergy Ireland

Project:

Lissinagroagh Wind Farm

Title:

Figure 8-8:
Aquifer Classification and
Source Protection Areas

Scale @ A3: 1:200,000

Prepared by:	Checked by:	Date:
K.Kale	S.Ryan	March 2026

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Map Ref: 10955-004-Aq.B-P.App.BO-TOB-A

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Groundwater bodies are the groundwater management units of the WFD. Groundwater bodies are subdivisions of large geographical areas of aquifers so that they can be effectively managed in order to protect the groundwater and linked surface waters. A groundwater body (GWB) is defined as distinct volume of groundwater, including recharge and discharge areas with little flow across the boundaries.

The proposed wind farm site and study area overlies seven WFD groundwater bodies namely the Glenaniff (IE_NW_G_043) in the northwest of the proposed wind farm site, the Kiltyclogher (IE_NW_G_074) to the north east of the proposed wind farm site, the Kilcoo (IEGBNI_NW_G_017), to the north of the proposed wind farm site, the Killarga South (IE_WE_G_0056), located throughout the central and eastern portion of the proposed wind farm site, the Killarga (IE_WE_G_0055), Dromahair (IE_WE_G_0054) and Glencar (IE_WE_G_0060), located to the south west of the proposed wind farm site.

The hydrogeological data of each GWB is detailed below:

- The Glenaniff GWB has no abstraction/discharge data available, however the GWB is described as being composed of a high karstified aquifer, which are often associated with extremely variable transmissivity values, borehole yields and spring yields. There is a high degree of interconnection between groundwater and surface water in the karstified limestone which is highlighted by the pattern of swallow holes and caves along the boundary with lower permeability rocks. The presence of dolines, caves, turloughs, springs, and 'losing' and 'gaining' streams also provide a direct route between surface water and groundwater systems. This rapid interchange between surface water and groundwater is often reflected in their similar water quality as contamination is also rapidly transported between the two systems.
- The Kiltyclogher GWB is composed primarily of low transmissivity rocks. Transmissivity values are expected to be <20 m^2 /d, and possibly <10 m^2 /d in the shale-dominated lithologies. Sandstones (Lm aquifer) generally have a higher fissure permeability and therefore, the potential to have relatively high transmissivity values – in the order of 10-50 m^2/d. Groundwater will discharge locally to streams and rivers crossing the aquifer and to small springs and seeps. Owing to the poor productivity of most of the aquifers in this body, it is unlikely that any major groundwater - surface water interactions occur. Baseflow to rivers and streams is likely to be relatively low, although might be higher across the Lm aquifers.
- The Kilcoo GWB, has no abstraction/discharge data available. The Kilcoo GWB is a karstified aquifer. Karstified aquifers are often associated with extremely variable transmissivity values, borehole yields and spring yields. Spring yields can also be very large. Recharge can be rapid and a large proportion of the flow can occur through conduits, sometimes at extremely high velocities (e.g. 100s m/hr). Accordingly, highly karstified rocks are often associated with low storativity. Recharge for Kilcoo GWB was averaged at c. 268 mm/annum.
- The Killarga GWB and Killarga south GWB is karstified and has expected transmissivity values of 2000 m^2/d, with low storativity. Groundwater flows through fissures, faults, joints and bedding planes. In pure bedded limestones these openings are enlarged by karstification which significantly enhances the permeability of the rock. Generally, there is a high degree of interconnection between groundwater and surface water in karstified limestone areas. The karst features represent the close interaction between surface water and groundwater. The stream density is relatively high, which is due to the

relatively low permeability subsoils. Any contamination of surface water is rapidly transported into the groundwater system, and vice versa.

- The Dromahair GWB is a poorly productive aquifer. Transmissivities are expected to be in the range of 0.1-10 m^2/d. In the vicinity of faults, transmissivity may be higher. Storativity is expected to be low (<0.5%). Groundwater will discharge locally to streams and rivers crossing the aquifer and also to small springs and seeps. Owing to the poor productivity of the aquifers in this body it is unlikely that any major groundwater - surface water interactions occur. Baseflow to rivers and streams is likely to be relatively low.
- The Glencar GWB has widespread karstification throughout, with transmissivities expected to be variable ranging from 1 to greater than 2000 m^2 /d. Storativity is likely to be low - approximately 0.01-0.02. Generally, there is a high degree of interconnection between groundwater and surface water in karstified limestone areas. The karst features represent the close interaction between surface water and groundwater. The stream density is relatively high, which is due to the relatively low permeability subsoils. Any contamination of surface water is rapidly transported into the groundwater system, and vice versa.

8.3.2.2 Karst Areas

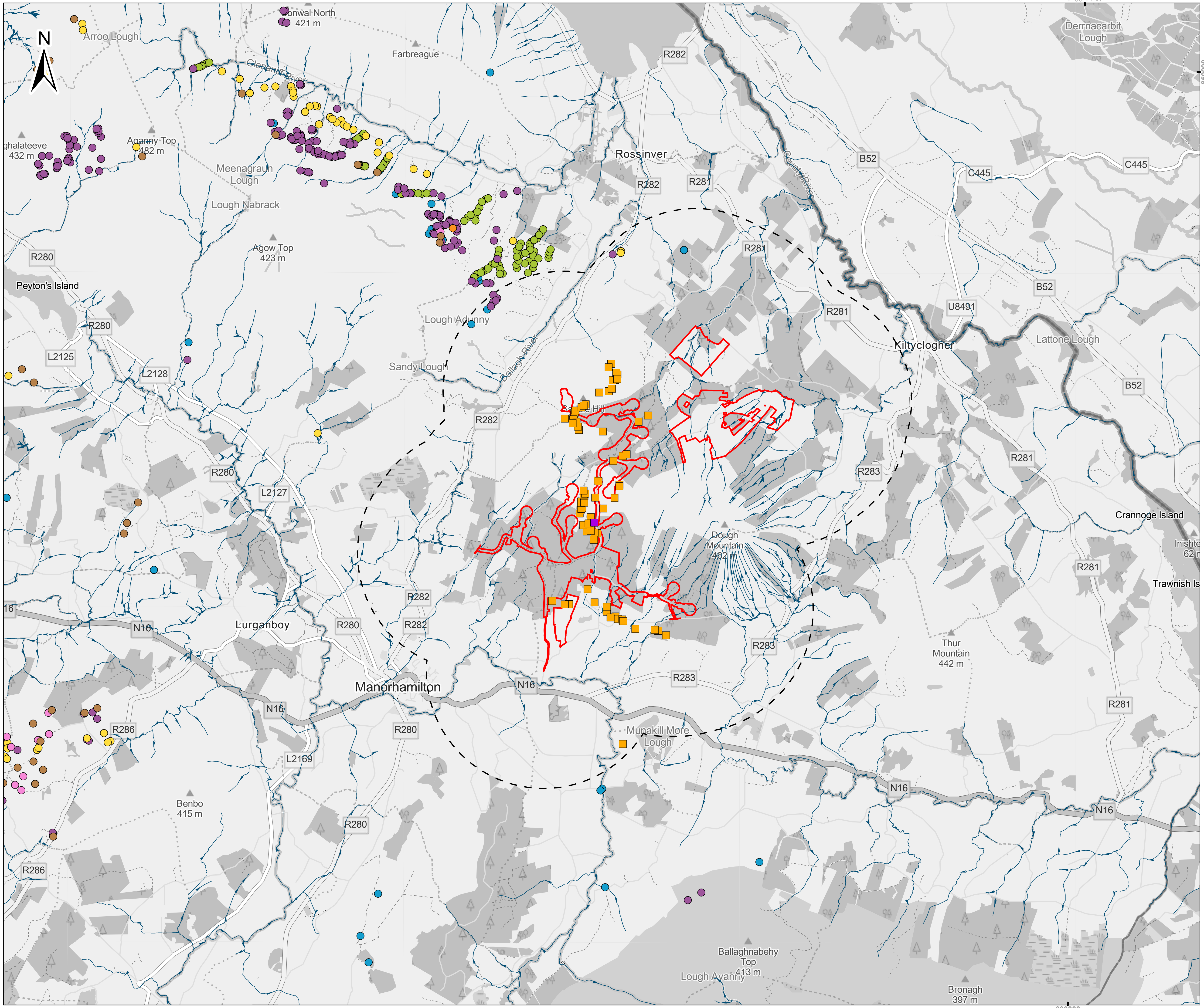
Details of the karst identified on the wind farm site are included in Chapter 7 - Land, Soils and Geology. According to the GSI online viewer, there are no mapped karst features present with the proposed wind farm site boundary or at work areas along the TDR and GCR. Consultation with the GSI on geological heritage contained information regarding two swallow holes on the proposed wind farm site. A combination of information from the aerial mapping and site walkovers were used to identify and describe the karst features present in the study area. Site surveys indicated there are 76 possible karst features present within the study area, including enclosed depressions (dolines) which have developed and are typically 3-5 m in diameter. Figure 8-9 illustrates the locations of the karst features identified onsite. The proposed wind farm infrastructure footprint will not intercept any identified karst features, thereby avoiding potential impacts on these karst landforms which often function as important conduits for surface water recharge to the underlying aquifer system.

The two aforementioned swallow holes were identified during the site surveys, within the proposed wind farm site, with Polldough swallow hole (Photo 3) being observed in the centre of the site approximately 170 m to the northeast of T7. Similar karst features were also located 215 m to the northeast of T7. No karst features were encountered on the proposed T7 infrastructure footprint based on site walkovers, site geotechnical investigations and geophysical surveys. A qualitative dye trace from Polldough indicated a groundwater pathway to the local stream – i.e. Mt Dough Stream 1km to the south. When dye is added into a karst system, it travels through the conduits and fractures, and its concentration is measured at various points downstream.

No evidence of karst features (such as voiding or piping within the superficial deposits) were recorded within the trial pits excavated or rotary core drilling works during site investigations for the proposed wind farm.

Photo 3: Polldough Cave/ Swallow Hole

Polldough is a vertical pothole shaft, at the base of which is a recently explored cave 50 m deep. This depression can be seen from Google Maps satellite view in the central portion of the proposed wind farm site, to the west of Dough Mountain. Karst features can act as a point recharge to groundwater. While areas of karst were identified on site, the presence of extensive surface water drainage on site indicates relatively short flowpaths to the onsite streams.



Legend

- Application Boundary
- Application Boundary: Study Area
- WFD - River Water Bodies

Karst Features

- Cave
- Dry Valley
- Enclosed Depression
- Estavelle
- Spring
- Superficial Solution Feature
- Swallow Hole

Observed Karst Features

- Shallow oval shaped depression
- Oval shaped depression

0 1.5 3
Kilometers

Spatial Reference
Datum: IRENET95
EPSG: 2157

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Project:

Lissinagroagh Wind Farm

Title:

Figure 8-9:
Karst Features

Scale @ A3: 1:60,000

Prepared by: K.Kale
Checked by: S.Ryan
Date: March 2026

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www.tobin.ie

Map Ref: 10955-007-KA-P.App.BO-TOB-A

Draft: A

8.3.2.3 Groundwater Quality

Proposed Wind Farm Site

The WFD groundwater quality status classifications are based on an assessment of the point and diffuse sources in the area that may affect groundwater quality. The WFD requires Member States to designate these waterbodies so that each one achieves good chemical and good quantitative status. The ground waterbody WFD Status 2019-2024 for the proposed wind farm site is detailed in Table 8-17.

The WFD also classifies each GWB in terms of its risk of failing to meet the WFD objectives by 2027. The risk of not meeting WFD objectives was determined by assessment of monitoring data, data on the pressures and data on the measures that have been implemented. Waterbodies that are 'At Risk' are prioritised for implementation of measures. This assessment was completed in 2020 by the EPA Catchments Unit in conjunction with other public bodies and was primarily based on monitoring data up the end of 2018. The WFD Risk 2019-2024, is detailed in Table 8-17.

Table 8-17: GWB Groundwater Quality Status within the Proposed Wind Farm

WFD Groundwater Body	WFD Status 2019-2024	WFD Risk 2019-2024
Glenaniff (IE_NW_G_043)	Good	Not at risk
Kilcoo (IEGBNI_NW_G_017	Good	Not at risk
Kiltyclogher (IE_NW_G_074)	Good	Not at risk
Killarga South (IE_G_0056)	Good	Not at risk
Killarga (IE_WE_G_0055)	Good	Not at risk
Glencar (IE_WE_G_0060)	Good	Not at risk
Dromahair (IE_WE_G_0054)	Good	Not at risk

Proposed GCR and work areas on the proposed TDR

Due to the nature of the Proposed Grid Connection along public roads, with the cable being placed within the road carriageway structure, no groundwater bodies are likely to be encountered. However, the Killarga GWB underlies the proposed HDD river crossing location on the GCR. The WFD Risk 2019-2024, is detailed in Table 8-17, above.

Work areas along the TDR have the potential to interact with the Killarga South GWB.

8.3.2.4 Groundwater Vulnerability

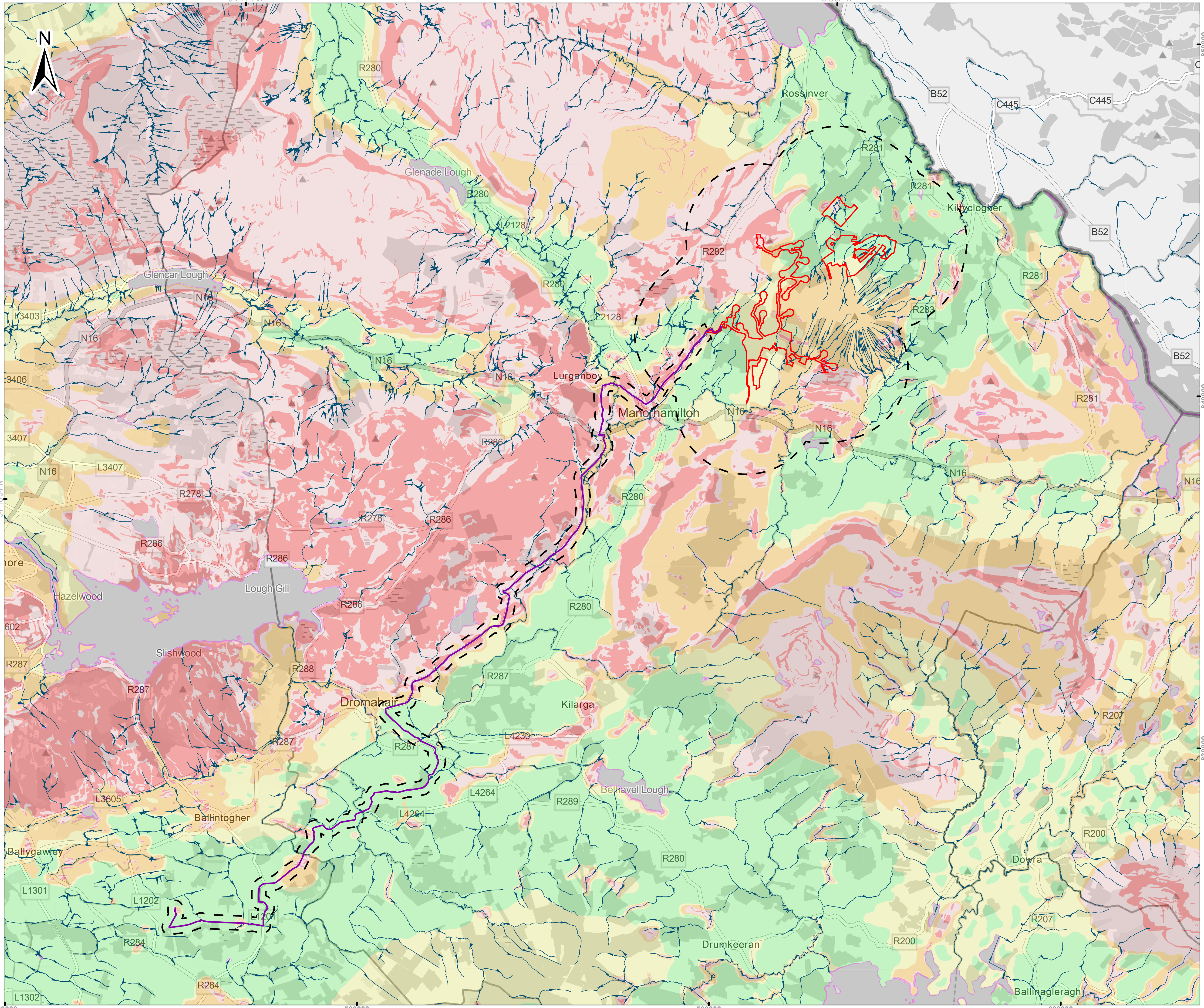
Groundwater vulnerability represents the intrinsic geological and hydrogeological characteristics that determine how easily groundwater may be contaminated by activities at the surface. Vulnerability depends on the quantity of contaminants that can reach the groundwater, the time taken by water to infiltrate to the water table and the attenuating capacity of the geological deposits through which the water travels. These factors are controlled by the type of subsoils that overlie the groundwater, the way in which the contaminants recharge the geological deposits (whether point or diffuse) and the unsaturated thickness of geological deposits from the point of contaminant discharge. Areas with thin or absent subsoils, or those underlain by karstic limestone, are the most vulnerable. Groundwater vulnerability on the site is variable as illustrated in Figure 8-10.

The Groundwater Vulnerability Map (Figure 8-10) classifies vulnerability based on subsoil type and thickness, including sands, gravels, glacial tills, peat, and alluvial silts and clays, as well as the presence of karst features. Groundwater that receives recharge quickly and directly from the surface is more vulnerable than that which receives slower, more attenuated recharge.

The vulnerability categories are:

X – Rock at or near surface or karst,
E – Extreme,
H – High,
M – Moderate,
L – Low.

A detailed description of the vulnerability categories can be found in the Groundwater Protection Schemes document (Department of the Environment and Local Government (DELG) / EPA/GSI, 1999) and in the draft GSI Guidelines for Assessment and Mapping of Groundwater Vulnerability to Contamination (GSI, 2003).



Legend

- Application Boundary
- Application Boundary: Study Area
- Grid Connection Route
- GCR: Study Area
- WFD - River Water Bodies

Groundwater vulnerability

- Rock at or near Surface or Karst
- Extreme
- High
- Moderate
- Low
- Water

0 2 4
Kilometers

Spatial Reference
Datum: IRENET95
EPSG: 2157

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Rev	Date	Description	By	Chkd.
A	11/03/2026	First issue	K.K	S.R

Client:

FuturEnergy Ireland

Project:

Lissinagroagh Wind Farm

Title:

Figure 8-10:
Groundwater Vulnerability

Scale @ A3: 1:100,000

Prepared by: K.Kale
Checked by: S.Ryan
Date: March 2026

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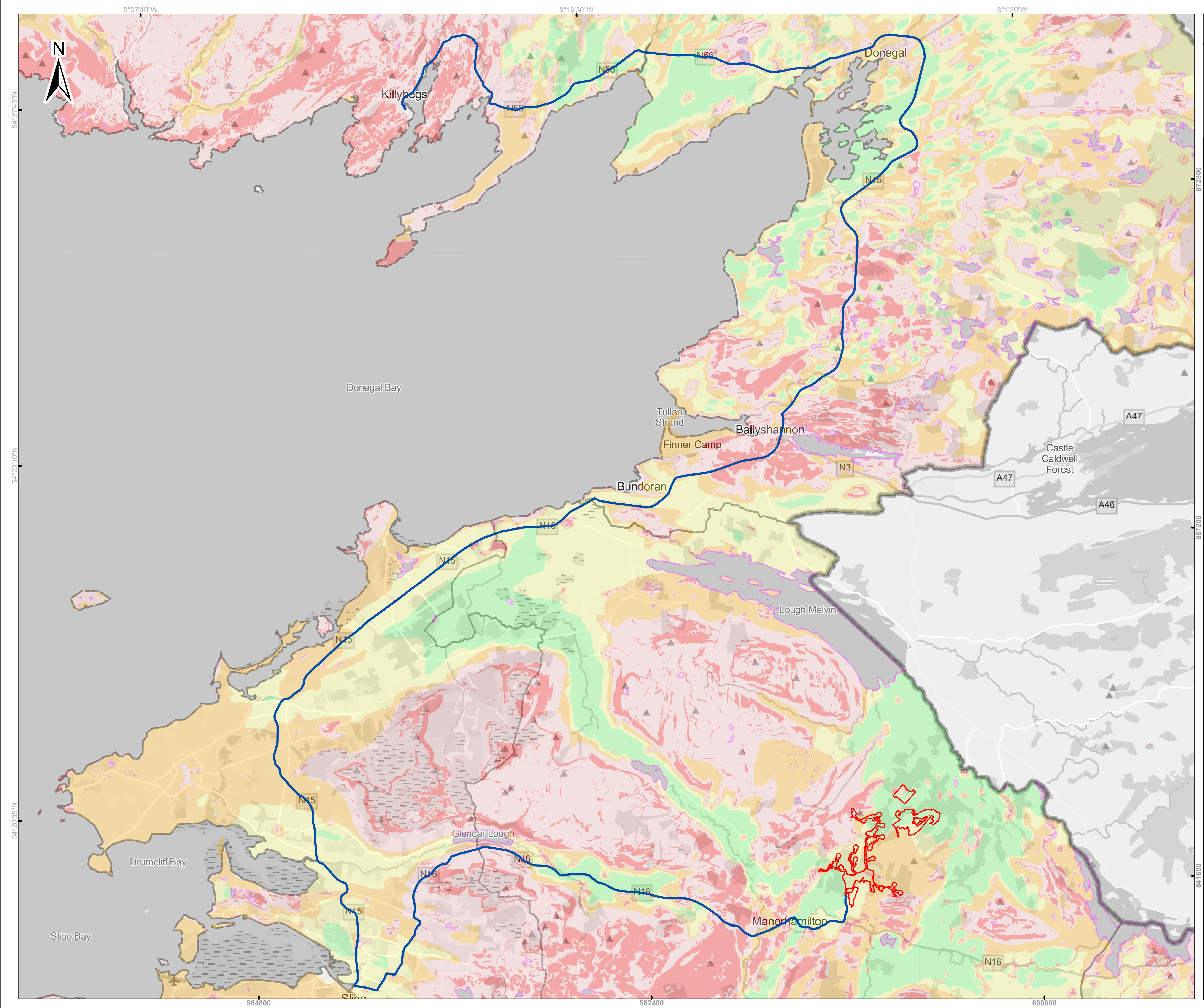
Map Ref: 10955-006-GRD.V-P.App.BO-TOB-A

Draft: A



Legend

- Application Boundary
- Turbine Delivery Route

Groundwater vulnerability

- Rock at or near Surface or Karst
- Extreme
- High
- Moderate
- Low
- Water

0 2.5 5
Kilometers

Spatial Reference
Datum: IRENET95
EPSG: 2157

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A	11/03/2026	First issue	K.K	S.R

Client:

FuturEnergy Ireland

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Lissinagroagh Wind Farm

Title:

Figure 8-11:
Groundwater Vulnerability TDR

Scale @ A3: 1:155,000

Prepared by: K.Kale
Checked by: S.Ryan
Date: March 2026

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Map Ref: 10955-023-GRD.V-TDR-TOB-A

Draft: A

The groundwater vulnerability throughout the proposed wind farm site ranges from L (Low) to X (Extreme), where bedrock is at or within 1m of surface as shown on Figure 8-10. The majority of the proposed wind farm site is classified as moderate to low with extreme vulnerability to the north and southeast. Along the GCR and TDR, vulnerability similarly spans low to extreme categories per GSI mapping, though TDR accommodations are primarily limited to non-intrusive public road accommodations minimising groundwater exposure risks.

8.3.2.5 Groundwater Recharge

The term 'recharge' refers to the amount of water that infiltrates into the ground and replenishes an aquifer. As such it is an important part of the water balance of a groundwater flow system. Groundwater recharge has been calculated by GSI nationally by multiplying the effective rainfall by a set of recharge coefficients which are displayed on the GSI's groundwater recharge map of Ireland and are based upon hydrogeological settings. Broadly, these hydrogeological settings are governed by subsoil permeability and thickness, the presence of saturated soils, and the ability of the underlying aquifer to accept percolating waters. In areas where the majority of effective rainfall runs off the land surface, surface water is dominant, and equally where the majority of the effective rainfall is recharging the aquifers, groundwater is dominant.

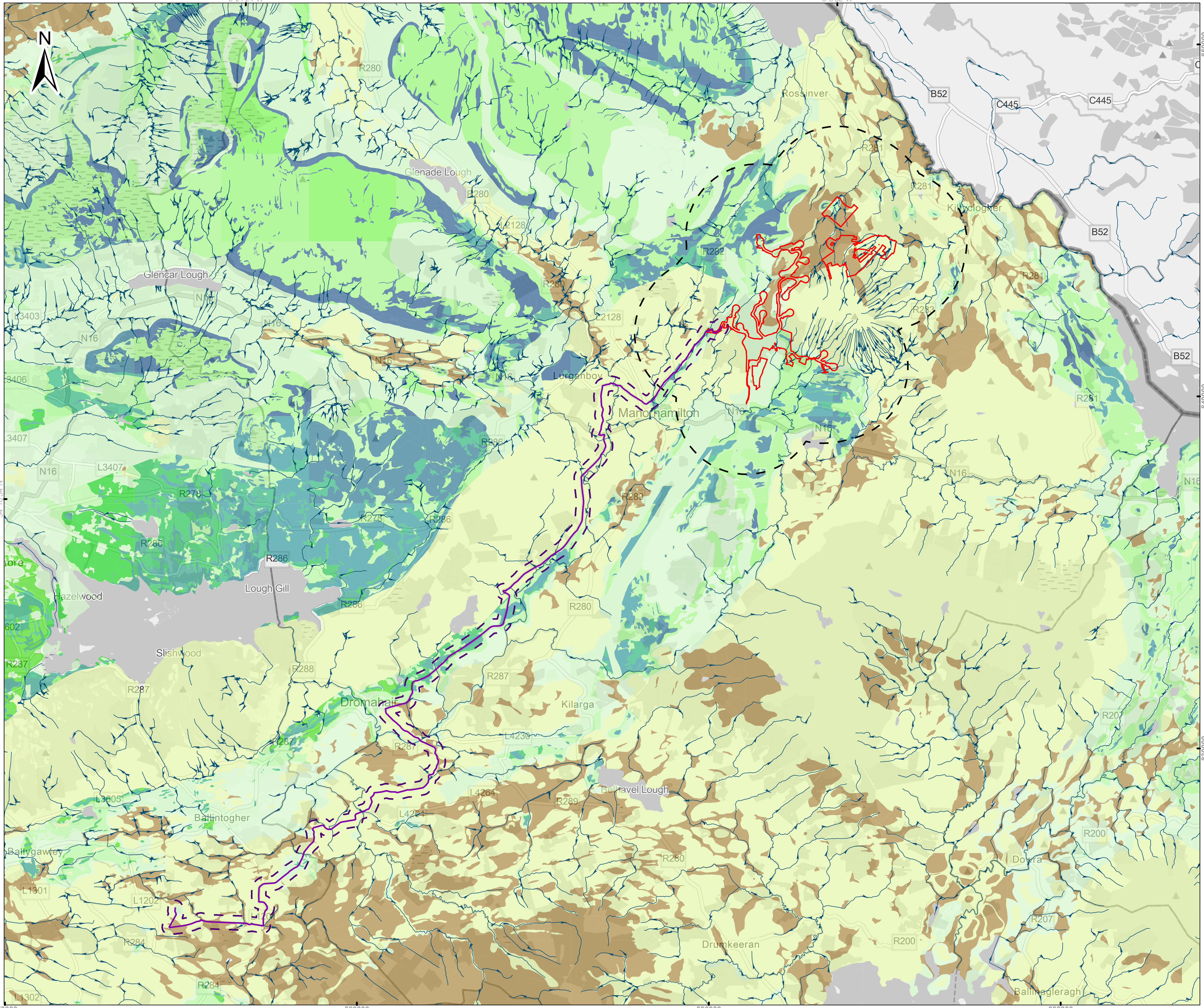
Recharge values vary across the extent of the proposed wind farm site, GCR and TDR. The highest recharge rates are found where bedrock is at or close to the surface and the lowest recharge rates are found where there is low permeability subsoil. Karst features allow point recharge to groundwater as detailed in Section 8.3.2.2. Diffuse recharge occurs over the majority of the proposed windfarm via rainfall percolating through the subsoil/bedrock.

A recharge cap i.e., the maximum amount which the underlying bedrock aquifer can accept, is applied to the full extent of the proposed wind farm site. The northeast of the site has the lowest recharge rates within the proposed wind farm site. The northern area is dominated by blanket peat soils that have very low permeability making it difficult for rainwater to infiltrate through the soil. Typical annual recharge rates are in the region of 48mm/yr.

In contrast, the northwest of the site has some of the highest recharge rates within the proposed wind farm boundary, ranging from 263 mm/yr – 1,012 mm/yr. Recharge rates are high due to the presence of limestone bedrock with the presence of karst features. Groundwater flow directions through karst areas can be very variable due to the heterogenous nature of karstification/weathering within a rock that is otherwise limited groundwater flow. However, based on the presence of a dense surface water network, groundwater flows over a short distance and provides baseflow to the onsite streams.

The southwest of the site also has high rates of recharge, ranging from 80 mm/yr- 907 mm/yr this is due to areas of shale and sandstone dominated till forming a subsoil with low permeability and the presence of bedrock outcropping. This hydrogeologic setting dominates the majority of the south and southwest of the site. The southeast of the site has high recharge rates ranging from 100 mm/yr to 911.76 mm/yr due to the presence of subsoils in these areas consisting of sandstone and shale till, along with presence of bedrock outcropping. Groundwater recharge across the proposed wind farm site is detailed in Figure 8-11.

The GCR and TDR, recharge rates vary per GSI mapping, though works are not anticipated to result in groundwater recharge related risks.



Legend

- Application Boundary
- Application Boundary: Study Area
- Grid Connection Route
- GCR: Study Area
- WFD - River Water Bodies

Groundwater Recharge: Annual Recharge (mm)

- 1001-1400 mm
- 901-1000 mm
- 801-900 mm
- 701-800 mm
- 601-700 mm
- 551-600 mm
- 501-550 mm
- 451-500 mm
- 401-450 mm
- 351-400 mm
- 301-350 mm
- 251-300 mm
- 201-250 mm
- 151-200 mm
- 101-150 mm
- 51-100 mm
- 1-50 mm

0 2 4
Kilometers

Spatial Reference
Datum: IRENET95
EPSG: 2157

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Client:

FuturEnergy Ireland

Project:

Lissinagroagh Wind Farm

Title:

Figure 8-12:
Groundwater Recharge

Scale @ A3: 1:100,000

Prepared by: K.Kale
Checked by: S.Ryan
Date: March 2026

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Map Ref: 10955-005-GRD.R-P.App.BO-TOB-A

Draft: A

8.3.2.6 Groundwater Levels and Flow

Groundwater levels on the site are highly variable with the presence of deeper peat across the northern part of the wind farm site and variable aquifer (poorly productive to karstified aquifer) characteristics. On a regional scale, the groundwater flow direction is generally a subdued reflection of surface water drainage. Groundwater flow mirrors topography, and local flows are likely to be varied reflecting the dense local drainage patterns.

Across the majority of the site, groundwater flow is towards local drains and streams, reflecting the general flow direction of the various catchments. Local groundwater flow discharges to the local streams and drainage ditches in the area as well as possibly through an open joint network in the underlying bedrock. Recharge is varied but is limited in the peat soils on the proposed wind farm.

Groundwater flow paths within the aquifers are expected to generally follow the local surface water catchments. Adjacent to the rivers, water levels will be closer to ground level. Much of the potential recharge to these strata is rejected and throughput is low (Tedd, K. *et al*., 2008).

Several karst features were observed in site surveys as indicated in section 8.3.2.2, within the vicinity of the proposed wind farm site. Therefore, there is a potential for a strong linkage between surface water and groundwater through the proposed wind farm to the centre of the site, i.e. to the east of T7 and between T10 and the local road. The nearest swallow hole is located 170 m to the east of T7. A number of dolines are present in the surrounding area as detailed in Section 8.3.2. These karst features allow point recharge to groundwater. No potential enclosed depressions are located within the proposed footprint of the substation, turbine bases or hardstand areas. However, potential enclosed depressions are located along proposed access road to T3 to the north of the site.

Rotary core drilling was undertaken at six locations by Causeway Geotech and GII between November 2021 and October 2025, supervised by TOBIN, which correspond to the locations of T7 and Borrow Pits 2 and 3. These boreholes were drilled to provide details on the depth of overburden and bedrock lithology/type and to provide groundwater monitoring points. Shallow groundwater monitoring was undertaken at a number of locations to monitor the water level in the peat soils. Groundwater monitoring locations are shown on Figure 8-12. Groundwater monitoring was undertaken at BH01, BH02, BH07 and BH08 and GW3 to GW6. Results are provided in Table 8-18.

Table 8-18: Groundwater Monitoring Results (Water level mbgl)– Proposed Wind Farm

ID	Purpose	Dec 2021	Jan 2022	Oct 2022	Dec 2024	Jan 2025	April 2025	May 2025
BH01	Initial Borrow pit assessment	2.25	2.1	4.5	3.2	2.0	NA[4]	NA
BH02	Borrow pit assessment	8.4	8.4	9	8.7	NA	NA	NA
BH07	Assessment of T7				Dry, >10			
BH08	Borrow pit assessment							5.75
GW3	Shallow Peatland monitoring/habitats	NI	0.61	0.48	0.25	0.33	NA	NA
GW4	Shallow Peatland monitoring/habitats	0.42	0.8	0.49	0.3	0.35	NA	NA
GW5	Shallow Peatland monitoring/habitats	NI[5]	NI	NI	NI	NI	0.53	0.37
GW6	Shallow Peatland monitoring/habitats	NI	NI	NI	NI	NI	0.38	0.37

Regional groundwater levels are >10 m below ground level however perched groundwater may be encountered in the peat and where lower permeability bedrock is encountered.

[4] NA - Not accessible
[5] NI - Not installed

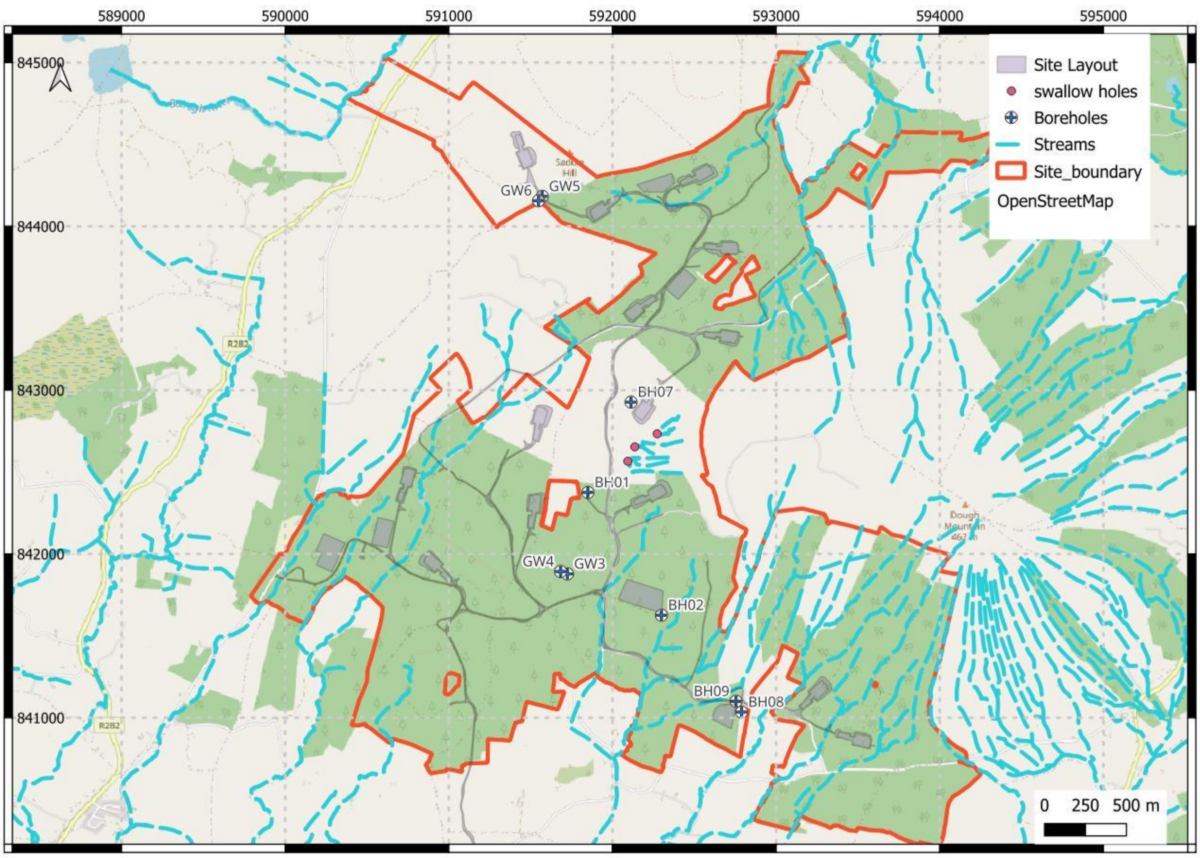


Figure 8-13: Groundwater Monitoring Locations

Local groundwater flow directions along the GCR works and TDR accommodation areas are determined by topography and by the local drainage patters. Flow path lengths are generally long (up to several kms). TDR accommodations are primarily limited to non-intrusive public road accommodations minimising groundwater exposure risks.

8.3.2.7 Groundwater Usage and Wells

There are a number of group water schemes (GWS) and public water supplies (PWS) in County Leitrim, however there are currently no Groundwater Protection Scheme Reports produced by the GSI for Leitrim. There are no GWS or PWS within 2 km of the proposed wind farm site. A 2 km radius was assigned as suggested in Hydrogeology Chapters of Environmental Impact Statements' (IGI 2013).

Based on the GSI data and a review of Census data, there are no known domestic wells located within 2 km of the proposed wind farm site however not all wells are identified on the GSI database. One EPA registered groundwater abstraction occurs at Kerrigan quarries, located 0.5 km to the south of the Owenmore (Manorhamilton) river.

8.3.3 Designated Conservation Sites

8.3.3.1 Proposed Wind Farm Site

Designated conservation sites that are hydrologically connected to the proposed wind farm site are listed in Table 8-19. Locations of the designated sites are further illustrated in Chapter 6 – Biodiversity.

Table 8-19: Designated Sites within the Proposed Wind Farm Study Area

Site ID	Site Classification	Site Code	Proximity to the proposed wind farm turbine footprint	Connection to the proposed wind farm site
Lough Gill SAC	SAC	IE001976	1.8 km	Hydrologically connected to the proposed wind farm site via the Owenmore (Manorhamilton)_020 and Brackary_010 rivers and associated tributaries. Indirect hydrogeological connection via groundwater discharge to the Owenmore river.
Lough Melvin	SAC	IE00428	2.2 km	Hydrologically connected via the Lattone_010 River and the Ballagh_010 and associated tributaries. Indirect hydrogeological connection via groundwater discharge to the Lattone river.
Lough Melvin (NI)	SAC	UK0030047	5.8 km	Hydrologically connected via the Lattone_010 River and the Ballagh_010 and associated tributaries. Indirect hydrogeological connection via groundwater discharge to the Lattone river.
Dough/Thur Mountains	NHA	IE002384	0.1 km	This site is designated for peatlands and overlaps with the proposed windfarm site boundary No works are proposed in the NHA however areas within the NHA are within the biodiversity enhancement area. The NHA is located upgradient of the proposed wind farm infrastructure. No potential for (negative) drainage effects on the NHA due to the topography and existing drainage on the peatlands. Potential for peatland enhancement within the Biodiversity enhance areas. Hydrologically connected via the Lattone_010, the Rosfriar_010, the Owenmore (Manorhamilton)_020.
Lough Melvin	pNHA	IE000428	2.2 km	Hydrologically connected via the Lattone_010 River and the Ballagh_010 and associated tributaries.
Arroo Mountain	SAC	IE001403	1.3 km	Not hydrologically or hydrogeological connected to the proposed project.

As detailed in the Natural Impact Assessment (NIS) for the proposed project, Lough Gill SAC is protected under the EU Habitats Directive (92/43/EEC) and is designated for four habitats and six species. Lough Melvin SAC is also protected under the EU Habitats Directive (92/43/EEC) and is designated for two habitats and two species. The Dough/Thur Mountains NHA is protected under the Wildlife Act (2000) and is designated for peatlands. The Arroo Mountain SAC is not hydrologically or hydrogeological connected to the proposed project. Lough Melvin SAC (NI) is designated for Annex I aquatic habitats as well as Annex II aquatic species. Further details related to designated sites can be found in section 5.4.1.1.1 of the Biodiversity Chapter (Chapter 5).

Lough Melvin is also categorised as a proposed Natural Heritage Area (pNHA), due to its high ecological and conservation value.

Several ASSIs are recorded to the north and northeast of the proposed wind farm site within Northern Ireland. These comprise Lough (Melvin ASSI140) (hydrologically connected to the site), Knocknashangan (ASSI297), Ross (ASSI299), Frevagh (ASSI400) and Rushy Hill (ASSI403), which collectively support diverse blanket bog, heathland, purple moor-grass and rush pasture and aquatic habitats of regional geological and ecological significance comparable to NHAs/pNHAs in the Republic of Ireland. The closest of these mapped sites is approximately 4 km to the northeast of the proposed windfarm site.

8.3.4 Conceptual Site Model

The Conceptual Site Model (CSM) for the proposed wind farm has been informed by the desk-based assessment, hydrological analysis, and intrusive ground investigations. The model is intended to identify the potential sources of contamination, plausible migration pathways, and sensitive environmental receptors relevant to the construction, operational and decommissioning phases of the project. The conceptual site model was not completed for the TDR and GCR due to the limited available working and accommodation areas, and because the extensive spatial scale and distance involved made the preparation of a meaningful conceptual model impracticable. On this basis, a separate CSM was not considered feasible for these elements.

Groundwater vulnerability on the site is variable with a number of potential point recharge (dolines or karst features) to ground on the proposed windfarm site. The underlying bedrock aquifer as classified by the Geological Survey Ireland (GSI) varies from poor aquifer to regionally important aquifer. A number of karst features were identified as part of the site walkovers. These zones are potentially more vulnerable due to the lack of overburden protection and the presence of weathered or fractured rock that could facilitate preferential flow paths.

The primary environmental receptors identified within the CSM are the surface water features that traverse or border the proposed wind farm. These streams exhibit moderate to steep gradients, active erosion, and hydrological connectivity with surrounding land. Their morphology and topographic setting enhance their capacity to mobilise surface-derived pollutants, particularly during rainfall events. These watercourses ultimately discharge into more sensitive downstream receiving waters, including the Bonet and Lattone Rivers.

The most credible contaminant migration pathway identified is surface water runoff. This pathway presents a risk of transporting pollutants off-site and into adjacent surface waters. Hazards associated with the construction, operational and decommissioning phases include:

- Accidental fuel and chemical spills;
- Mobilisation of suspended solids and silt-laden runoff;
- Uncontrolled discharge of concrete wash water or grout;
- Sanitary wastewater or firewater discharge incidents.

8.3.5 Sensitivity of Receptors

This section discusses the sensitivity of the receiving hydrological and hydrogeological environment in terms of the proposed project and identifies those receptors which will be carried forward into the assessment of effects section.

Key Receptor Sensitivities:

- Downgradient streams (Owenmore (Manorhamilton), Bonet River): High sensitivity due to ecological value; EPA Q4 (Good).
- Flood risk/flow sensitivity: Low sensitivity - no project elements in Flood Zones.
- Groundwater aquifer vulnerability: High to medium sensitivity per criteria - karstified aquifer, Low-Extreme vulnerability mapping.
- Hydrogeological abstraction: Medium sensitivity - limited abstractions, no project elements in source protection zones.
- Ecological receptors: Salmonids downstream; SAC qualifying interests (lakes, crayfish, lamprey, otter) are hydrologically connected.

Hydrological sensitivity of downgradient streams (Owenmore (Manorhamilton) and Bonet River) is high due to ecological value. EPA water quality monitoring indicates that the receiving waters within the study area are classified as good (Q4) however site-specific monitoring undertaken in 2023 indicates water quality is moderate. Further information on the sensitivity rating for aquatic macroinvertebrates species can be found in Section 5.2 and Appendix 5-4 of Chapter 5. In terms of hydrological flows, the study area is low sensitivity as no elements of the proposed project are located in a flood zone i.e. Flood Zone B or C.

The downgradient rivers are known to contain salmonids (refer to Chapter 5 - Biodiversity) however no salmonid or course (cyprinid) fish were identified on the proposed wind farm. A large number of natural barriers and man-made barrier prevent fish passage into the onsite streams. Other qualifying interests of hydrologically connected SAC's include natural eutrophic lakes with Magnopotamion or Hydrocharition, oligotrophic to mesotrophic standing waters with sensitive vegetation, crayfish, lamprey and otter species present.

Based on criteria set out in Section 8.3.2, groundwater at the site can be classed as high to medium sensitivity as the aquifer is mapped as a Locally Important to Regionally Important Karstified aquifer and groundwater vulnerability is mapped as Low to Extreme. A number of karst features were identified as part of the site walkovers. These zones are potentially more vulnerable due to the lack of overburden protection and the presence of weathered or fractured rock that could facilitate preferential flow paths. The proposed turbines, substation and construction compounds have been sited to ensure that karst features are avoided.

The hydrogeological quality is of medium sensitivity due to the limited groundwater abstraction on the proposed wind farm site, GCR and accommodation areas along the proposed TDR, and no elements of the proposed project are located in a groundwater source protection zone. There are no public water supplies within 0.7 km of the GCR or works areas along the proposed TDR. There are no groundwater abstractions within 0.5 km from the borrow pits or turbine locations.

8.4 LIKELY SIGNIFICANT EFFECTS

8.4.1 Introduction

This section addresses the likely significant effects of the proposed project. The description of the likely significant effects covers direct effects and any indirect, secondary, cumulative, transboundary, short-term, medium-term and long-term, permanent and temporary, positive and negative effects of the proposed project. The criteria (EPA, 2022) for the assessment of effects require that likely significant effects are described with respect to their magnitude, frequency, extent, complexity, probability, duration, reversibility, etc.

The construction, operational and decommissioning activities were reviewed to identify those likely to cause an effect on identified water bodies including water courses within the study area for the proposed project. Following the identification of sensitive waterbodies, the extent and severity of potential construction, operational and decommissioning effects were evaluated considering all proposed control measures included in the proposed project design.

Section 8.4.4 to Section 8.4.6 presents an assessment in the absence of any mitigation measures, with the exception of embedded mitigation that has been incorporated into the design (e.g. avoiding sensitive features through the siting of the proposed project during the scoping and initial assessment). Measures have been proposed in Section 8.5 to reduce or mitigate the effects, and the residual effects after the application of mitigation measures are assessed in Section 8.6.

8.4.2 Future Baseline Scenario

As outlined in EPA (2022), the description of the Future Baseline Scenario relates to the environment as it would be in the future should the proposed project not be constructed and in operation. If the proposed project is not constructed there would be no major changes in the hydrology and hydrogeology of the proposed wind farm site. Forestry, farming and related activities would continue on the site.

Commercial forestry operations (including the associated drainage and access track maintenance) would continue in operation at the proposed wind farm site. Overall, a slight increase in commercial forestry may occur in line with national policy (Ireland Forestry Strategy 2023-2030). Agricultural practices (including the associated drainage measures) would continue as they currently are. The localised increasing or decreasing pressures on the local water quality will continue without separate intervention.

According to publicly available EPA water quality monitoring, the receiving watercourses in the study area are currently classified as 'Good Status'. However, site-specific biological monitoring conducted for this project provides a more detailed understanding of current conditions. Streams surrounding the proposed wind farm site are Moderate to Good Status (Q3-4 to Q4), increasing to Good Status further downgradient on the Bonet and Owenmore (Manorhamilton) to the south of Manorhamilton. Recent data on the Ballagh_010 is limited for recent years, however it is anticipated that the rivers are at Good Status based on the Q values. Excess nitrogen remains a concern for water quality (EPA, 2022).

Considering the less intensive agricultural activities in the overall study area and the established afforestation, the WFD 'Good' status objective for hydrology and hydrogeology will likely be maintained.

8.4.3 Embedded Measures

The design team has integrated mitigation measures into the project's design (referred to as *embedded mitigation*), outlined in Chapter 2 – Description of the Proposed Project.

Embedded mitigation measures have been incorporated into the design of the proposed project and are therefore considered an inherent part of the project rather than additional, stand-alone mitigation. However, for transparency and to demonstrate how these measures will function in practice, the key embedded measures are also summarised in the mitigation section and table below, alongside any further mitigation that may be required to address likely significant effects. This approach is intended to clearly show how environmental considerations have informed the project design, while still illustrating the combined effect of embedded and additional mitigation on the likely effects. These embedded mitigation measures, outlined in Table 8-18 and below, are as follows:

Surplus peat will be placed in borrow pits: Spoil Management Plan (Appendix 2-5) to ensure proper handling, storage, and reuse of soils. Peat will be placed in the borrow pits to contain and control sediment.

A hydrocarbon interceptor will be installed at the construction compound and at the proposed substation site with regular inspection and maintenance, to ensure optimal performance.

Concrete is required for the construction of the turbine bases and foundations. Wash out of the main concrete mixing drum will not be permitted on site; wash out is restricted only to chute wash out.

Trenchless techniques (HDD) will be used at major watercourse and infrastructure crossings to minimise disturbance; and

Topsoil and subsoil will be stored separately (max. 3m height), protected from contamination, and handled in dry conditions.

The identification and avoidance of potential karst features was undertaken for project design. Turbines, borrow pits, construction compounds and the substation infrastructure is not located within 30 m of any known karst features (dolines, etc.) or 100 m of swallow holes, in line with best practice.

Near-stream construction work will be carried out in accordance with the IFI (2016)[6] guidance document *"Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites"*. No instream works will be carried out at proposed TDR or GCR stream/river crossings.

All associated tree felling will be undertaken using best practice working practices as outlined in the Forestry Report and the CEMP (Appendices 2-5 of this EIAR), the Forestry Harvesting and Environment Guidelines (Forestry Service, 2000) and the Forestry and Water Quality Guidelines (Forestry Service, 2000). Brash mats will be used to support harvesting and forwarding machinery. The brash mats reduce erosion of the surface and will be renewed as they become used and worn over time.

Sediment and silt traps will be regularly monitored and maintained throughout the construction stage. Sediment traps will be constructed and maintained in line with the requirements of the

[6] IFI (2016) *Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites*

Forest Road Manual and Forest Drainage Engineering – A Design Manual (Forestry Schemes Manual, 2011).

Table 8-20: Embedded Mitigation for the Proposed Wind Farm

Embedded Mitigation Measure	Purpose	Project Elements
Spoil / Peat Management	Peat management on site – peat to be placed in borrow pits	All construction activities.
Hydrocarbon interceptors at construction compound and substation	Treats run off from hardstanding and refueling areas to protect surface water quality.	Construction and operational phases at compounds and substation.
Off-site concrete wash-out (no on-site drum wash-out, chute-only wash-out where necessary)	Avoid highly alkaline concrete wash water entering soils, drains, or watercourses.	Turbine foundations, substation foundations, and other concrete works.
Use of trenchless techniques at major watercourse and infrastructure crossings	Minimise disturbance to river/stream beds and banks and maintain hydromorphology and fisheries habitat.	Cable and access track crossings at main watercourses.
Separate storage of topsoil and subsoil (≤3 m height, dry-weather handling)	Preserves soil structure and quality for reinstatement and prevents compaction and runoff.	All excavations for roads, hardstands, cables, compounds, and substation.
Placement of peat in borrow pits for reinstatement and sediment control	Provides controlled deposition of excavated peat, reducing erosion and uncontrolled peat runoff.	Borrow pits and peat management areas.
Set-back of turbines, borrow pits, compounds and substation from karst features and swallow holes (e.g., ≥30 m / 100 m)	Protects groundwater receptors from contamination and maintains integrity of features.	Overall site layout and design.
Good forestry practice during felling (Forestry Guidelines, CEMP; use of brash mats)	Minimise soil disturbance, rutting and sediment generation during tree felling and forwarding.	Tree felling for roads, hardstands, cable routes, and turbine locations.
Sediment traps, silt fences and regular maintenance in line with forestry manuals	Controls suspended solids in runoff before discharge to watercourses.	Roads, bridge/culvert works, compounds and borrow pits during construction.
SuDS measures surface water settlement ponds, attenuation to greenfield runoff rates)	Manage surface water quantity and quality to mimic greenfield conditions and protect downstream receptors.	Access roads, hardstands, substation and compounds – construction, operation and decommissioning.
Clear-span bridge and oversized bottomless culverts at watercourse crossings	Avoids in-channel works, maintains natural bed, and supports fish passage and sediment transport.	River and stream crossings on site access tracks.
Use of existing road network where possible and careful new road construction with drainage management	Minimise new ground disturbance and controls road runoff and sediment mobilisation.	Site roads and passing bays.

SuDs measures

Approaches to manage surface water that take account of water quantity, water quality, biodiversity and amenity are collectively referred to as SuDS. SuDS measures will be implemented across the construction stage but will remain in place for the operational and decommissioning phases.

The principal behind SuDS devices is to reduce the quantity of discharge from developments such as the proposed project to predevelopment flows and to improve the quality of run-off. The SuDS devices as part of the proposed wind farm design mimic existing greenfield runoff in terms of volume, rate of runoff and quality of runoff. For the proposed wind farm the quantity of run-off will be decreased to greenfield rates by providing SuDs methods such as surface water settlement ponds.

Interceptor drains will be installed up-gradient of all proposed infrastructure to collect clean surface runoff, in order to minimise the amount of runoff reaching areas where suspended sediment could become entrained.

Track edge drainage/swales will be implemented to control run-off from the running surface to lower water levels in the subgrade, to control surface water and to carry this flow to outlet points. Swales will be installed along access tracks in advance of the main construction phase.

Swales will provide additional storage of storm water, located along gradient. Given the steep longitudinal gradients on some sections of access track, regular check dams will be employed within the trackside swale on these sections to reduce the flow velocity and provide settlement opportunity. Additional information can be located on the drainage layout plans, Drawing No; 10955-2050 to 10955-2061.

Photo 4: Example of an Operational Phase Settlement Pond

A total of 25 settlement ponds will be located downstream of road swale sections and at hardstand locations, to manage/buffer volumes of runoff discharging from the drainage system during periods of high rainfall, thereby reducing the hydraulic loading to watercourses. Settlement ponds are designed in consideration of the greenfield runoff rates. The settlement pond design (See Appendix 2-8 SWMP and Drawing 10955-2036) is based on primary settling out of suspended solids from aqueous suspension. Only the proposed onsite access track will be used for project-related traffic.

Embedded mitigation measures for the operational phase include the following:

- Fuel stored in bunded areas (110% capacity);
- Oil interceptors at the substation; and
- Drainage management.

8.4.4 Likely Significant Effects – Construction

The construction phase of the proposed project will involve the following key activities that could have likely significant effects on hydrological and hydrogeological quality and flows.

8.4.4.1 Alteration of Surface Water Quality

<u>Proposed Wind Farm Site</u>

Construction activities with the potential to effect surface water quality within and downstream of the proposed wind farm site consist of tree felling and soil preparation works required for infrastructure development such as access roads, passing/turning bays, temporary compounds, bridge structures, turbine foundations, and substation foundation works.

These activities may disturb and expose soils, increasing the risk of erosion and sediment-laden runoff. The release of suspended solids is particularly associated with groundworks where soils are inadequately compacted. The felling required for the proposed wind farm site may result in nutrient mobilisation in the runoff.

Areas of soft, compressible organic/peaty soils that are generally not suitable as road formation material will be removed and replaced by suitable road bearing fill material and associated SuDS.

During construction, there is a potential risk of pollution from site traffic through the accidental release of hydrocarbons (oils, fuels) and other contaminants from vehicles. Concrete (specifically, the cement component) is alkaline and any spillage to a local watercourse would be detrimental to water quality as well as to flora and fauna.

Improper management of earthworks and excavations during the main construction phase could lead to mobilisation of sediment into nearby watercourses from runoff and erosion from soil stockpiles prior to reinstatement and inadequate surface water management at excavations.

All watercourse crossings will be by way of overcrossing existing culverts, existing culvert extensions, new clear span bridges or Horizontal Directional Drilling (HDD). HDD will be used to install the proposed GCR cable under each watercourse, where necessary. Further detail on the HDD methodology is found in Chapter 2 - Description of the Proposed Project). There is the possibility of sediment laden water being generated as part of the construction process within the proposed windfarm site. Where existing culverts are in poor condition or inadequately sized, instream works will be required to remove the culvert. Dam and flume methodology will be implemented as per the IFI (2016)[7] guidance. A bottomless culvert will replace the existing culvert. The use of HDD and clear span bridge crossings will minimise disturbance to aquatic environments, and with implementation of standard mitigation measures (e.g., silt fences, settlement ponds, and works timing restrictions), no likely significant effects on surface water quality are anticipated.

Pre-mitigation, the likely significant effects on surface water quality at the proposed wind farm site, as stated above, are considered slight to moderate (significant) negative, direct, and indirect, short-term. The direct effects on surface water quality are anticipated to arise from immediate impacts such as sediment runoff, chemical spills, and vegetation removal during construction, which can cause temporary water quality deterioration near the construction area. Indirect effects, downstream may include altered drainage patterns, increased erosion, and pollutant mobilization that can affect water quality beyond the immediate construction area and over an extended period. Direct effects are immediate and localised impacts from construction activities, while indirect effects arise later and farther downstream due to changes in hydrology and pollutant transport pathways.

Proposed GCR works and accommodation areas on the proposed TDR

Pre-mitigation, the potential effects on alteration of surface water quality at the GCR works and accommodation areas for the TDR arise from minor public road accommodations. These works could generate limited sediment run-off or accidental spills. These effects are negative, direct/indirect, temporary, slight (not significant), as per Table 8-5 criteria, and unlikely given small-scale works. No instream works are proposed on the GCR or TDR. The direct effects on surface water quality typically involve immediate impacts such as sediment runoff, chemical spills, and vegetation removal during construction, which can cause temporary water quality deterioration near the construction area. Indirect effects, downstream may include altered drainage patterns, increased erosion, and pollutant mobilisation that can affect water quality beyond the immediate construction area. Further details are included in the GCR Appendix 2-4 Construction Methodology Report.

8.4.4.2 Alteration of Surface Water Flow

Proposed Wind Farm Site

Construction activities at the proposed wind farm site could potentially reduce the infiltration capacity of the soils in areas where earthworks are undertaken thus increasing the rate and volume of direct surface runoff. The proposed permanent wind farm footprint comprises approximately 49 ha. As detailed in Section 8.3.2, the potential alteration to infiltration is minimal. Infiltration rates or recharge are variable based on an assessment of slope, bedrock properties, site observations of drainage.

The construction of infrastructure including the 110kV substation and turbines will require the removal of topsoil and subsoil to a competent founding layer. Concrete/structural fill will be used to upfill to the required finished floor level. Ground investigations at the substation location were undertaken and have been used to inform the depth of excavation and upfill required.

[7] IFI (2016) *Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites*

Construction of structures over water courses (Table 8-20) has the potential to alter water flows during the construction phase. All EPA marked streams will be crossed by clear span bridge, as illustrated in Figure 8-13. A total of eleven (11) watercourse crossings will be required within the proposed wind farm site, detailed as follows:

- Ten (10) new clear span bridge crossings;
- One (1) existing piped culvert upgrades.

Table 8-21: Proposed New /Modified Watercourse Crossings

Stream name	ID	River Subbasin	EPA Segment code	Turbines/ Infrastructure	Catchment area km2	Flow m3/s 1:100 yr	Gradient / water depth/ Dimensions (m)	Proposed crossing type
Lisdarush	1	Lattone _010	36_7062	New Bridge between T1 & T2	<0.1	<1	0.14, 1.5-2.3m wide, 0.05 to 0.3m deep, U shaped stream	New clear span bridge required
Lisdarush	2	Lattone _010	36_7062	Existing culvert extension between T1 & T2	0.12	<1	0.04, 1.5m wide, 0.3 to 1.2m deep, U shaped stream. 0.4 m x 2 concrete culvert	New clear span bridge required
Null	3	Owenmore_20	35_3973	Existing road to T7	0.35	1.2	0.14, 1.5-2.3m wide, 0.05 to 0.3m deep, U shaped stream	New clear span bridge required
Skreeny	4	Owenmore_20	35_2951	Existing culvert between substation and T12	0.1	<1	0.04, 1.5 wide, 0.01 to 0.4m deep, U shaped stream.	New clear span bridge required
Null	5	Owenmore_20	35_4030	Existing culvert between substation and T12	1.95	4.2	0.04, 2.5 wide, 0.01 to 0.4m deep, U shaped stream.	New clear span bridge required
Moneenshinagh 35	6	Owenmore_20	35_4070	Existing road to T13	0.35	2.6	0.04, 1.5m wide, 0.3 to 1.2m deep, U shaped stream. 1.0 m x 2 concrete culvert	New clear span bridge required

Stream name	ID	River Subbasin	EPA Segment code	Turbines/ Infrastructure	Catchment area km2	Flow m3/s 1:100 yr	Gradient / water depth/ Dimensions (m)	Proposed crossing type
Null	7	Owenmore_20	35_2909	Existing road to T13, near BP2	0.56	2.1	0.04, 1.5m wide, 0.3 to 1.2m deep, U shaped stream. 1.0 m x 2 concrete culvert	Existing culvert extension required
Curraghfore	8	Brackary_010	35_3221	Western site entrance	1.3	2.7	0.04, 1.5m wide, 0.3 to 1.2m deep, U shaped stream. 1.0 m concrete culvert.	New clear span bridge required
Mt_Dough	9	Owenmore_20	35_3841	Existing culvert extension on local road	0.1	<1	0.04, 1.5m wide, 0.3 to 1.2m deep, U shaped stream. 1.0 m concrete culvert	New clear span bridge required
Null	10	Owenmore_20	35_2999	Existing road to T13	0.59	2.2	0.04, 1.5m wide, 0.3 to 1.2m deep, U shaped stream. 1.0m culvert	New clear span bridge required
Null	11	Owenmore_20	35_4203	New Bridge between T14 & T13	<1	N/A	0.04, 1.5m wide, 0.3 to 1.2m deep, U shaped stream. 1.0 m concrete culvert	New clear span bridge required

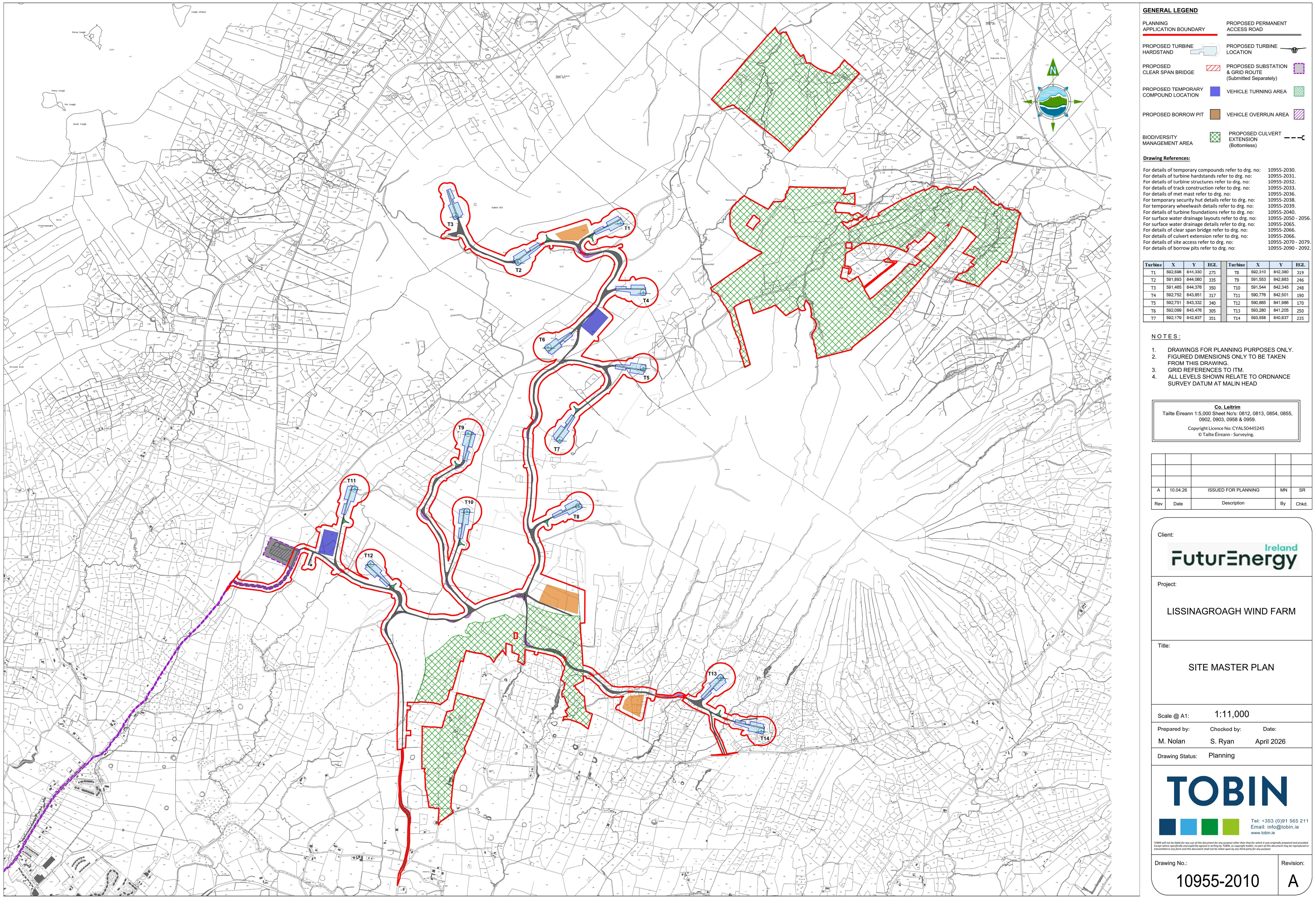


Figure 8-14: Site Master Plan – Proposed Clear Span Bridge Crossing Location

The proposed clear span bridges range from 10 m to 14 m and there are no works within 2.5 m from the banks of the rivers. Further details of the bridge crossings are provided on Drawing 10955-2050. The proposed bridge flow capacity will be greater than the 1:100-year flow +20% climate change.

The potential significant effects on the alteration of surface water flow at the proposed wind farm site are considered negative, direct, short term, unlikely and not significant /slight, as per Table 8-5 criteria (low magnitude due to oversized spans and no bank disturbance and temporary duration during construction).

Flood Risk

A flood risk assessment (FRA) was undertaken to determine whether the proposed project is at risk from extreme fluvial flooding events. The FRA report (Appendix 8-4) concluded that the key infrastructure, including the substation, are not at risk from flooding. The FRA also considered the potential for the proposed wind farm to increase flood risk on surrounding lands, in particular through changes in surface-water runoff associated with the proposed wind farm. The proposed drainage design is intended to manage runoff such that there is no significant increase in flood risk to downstream or adjacent areas,

Therefore, the likely significant effects of flooding on the proposed wind farm site are negative, direct, short term, unlikely, not significant/slight.

Proposed GCR Works and TDR Accommodation Areas

No instream works are proposed on the above-mentioned river crossings along the GCR. Limited excavations are required for the proposed TDR. TDR accommodations will generally consist of temporary vegetation trimming, removal of vegetation, local road strengthening and removal of street furniture. No new watercourse crossings or modification of existing culverts are required for the accommodation areas along the proposed TDR.

Eleven (11) existing bridge crossings are required, of which eight (10) will involve in-road HDD (Horizontal Directional Drill), two (2) will involve off-road HDD and one (1) will be a standard crossing within the bridge deck.

Execution of crossing will be via an undercrossing, overcrossing or a horizontal directional drill (HDD). Further detail on the HDD methodology is found in Chapter 2 - Description of the Proposed Project. There is the possibility of sediment laden water being generated as part of the construction process. Due to the location of the HDD launchpad which is set back from the surface water features and the design measures the magnitude of impact is low.

Therefore, the likely significant effects on alteration of surface water flow at the proposed GCR and at the proposed TDR works areas are negative, indirect, short term, unlikely, not significant/slight.

8.4.4.3 Alteration of Groundwater Quality

Proposed Wind Farm Site

The construction of the proposed wind farm has the potential to affect groundwater quality via road cuttings that could increase aquifer vulnerability by removing overburden or reducing subsoil depth. Pre-mitigation, these indirect, short-term effects are assessed as moderate (significant) magnitude as per Table 8-5 criteria, due to pathway creation to sensitive receptors. However, this risk reduces to slight/not significant as pollution pathways are intercepted with the implementation of SuDS, outlined in section 8.4.2 – refer also to Appendix 2-8 Surface Water Management Plan.

There are no groundwater abstraction wells within the proposed wind farm site. There is a private abstraction mapped c. 0.4 km to the south of the southern wind farm study area boundary. However, it is conservatively assumed that every private dwelling in the area utilises private groundwater wells. Pre-mitigation, direct/indirect, short-term effects on groundwater quality remain unlikely and slight/not significant per Table 8-5 (low probability, attenuated pathways via distance/topography).

Proposed GCR Works and TDR Accommodation Areas

Limited excavations are proposed for the GCR and the accommodation areas for the proposed TDR. Pre-mitigation, the likely significant effects on the alteration of groundwater quality are direct/indirect, short-term, unlikely, not significant/slight.

8.4.4.4 Alteration of Groundwater Flow

Proposed Wind Farm Site

Due to the presence of karstification in the study area there is important interaction between groundwater and surface water flows. Based on the borehole data, groundwater levels vary and are generally <1 m bgl (in the peat) to >10 m bgl in the bedrock. As a result of the karstification, regional groundwater levels in the Regionally Important aquifer are 10-20 m bgl across the karstic area. However perched groundwater levels occur where lower permeability zones occur.

The construction activities associated with the proposed wind farm site have the potential to impact groundwater, if a particular pathway, e.g. karst conduit, existed near the development. Permeability is likely to vary widely within the proposed wind farm site, where karst features exist. However, based on all the available site investigation data, no karst features or evidence of potential pathways have been identified at the proposed turbine locations. A number of karst features were identified within the project study area (within proximity to Turbine T7). These bedrock aquifers can rapidly transmit localised groundwater particularly through enlarged underground conduits and fissures.

Dewatering will likely be required during construction operations including turbine foundations and borrow pits. To minimise the potential effects associated with dewatering, there are no turbines or borrow pits proposed within 500 m of any well. This is sufficient distance to ensure no interaction with drawdown within the cone of depression. Borrow pits are proposed to be excavated up to 7m deep and this has potential to therefore locally affect groundwater levels, during construction. Turbine foundations will be excavated up to 4 mbgl. No groundwater was observed during the recent trial pit investigation works; however, perched groundwater may form at the upper contact of less permeable fine-grained soils following periods of sustained precipitation. Any such inflows will be managed through temporary local dewatering and collection, with subsequent discharge via onsite settlement and attenuation measures, in accordance with the Construction Environmental Management Plan. Dewatering will be short term and highly localized and, combined with the 500 m buffer to all wells and the low permeability of the subsoils/bedrock, is not expected to cause any significant or measurable drawdown of groundwater.

The proposed wind farm site is not located with a designated drinking WSZ. There are no registered drinking water supplies within the proposed wind farm site. There are no water abstraction wells within the proposed wind farm site. The likely significant effects on the alteration of groundwater flow affecting public water supplies (PWSs) at the proposed wind farm site are considered indirect, short-term, unlikely, not significant/slight due to the separation distances.

Localised groundwater flow patterns in the glacial and bedrock deposits which drain towards local streams that flow through the proposed wind farm site. Based on the distance between the infrastructure, the likely significant effects on private groundwater wells is considered indirect, short term, unlikely, slight.

Proposed GCR Works and TDR Accommodation Areas

A number of public water mains are located along the proposed GCR as detailed in Appendix 2-3 Grid Construction Methodology Report. Water mains will be crossed over or under depending on their location within the road corridor.

The underground cable for the proposed GCR will be located in the existing road network. Due to the shallow trenching nature of the works, there are no likely significant effects anticipated.

The proposed TDR accommodation areas are not located in a Groundwater SPZ (Source Protection Zone). The nearest water supply zone is North Leitrim Regional Water Supply (NLRWS), which is located approximately 0.4 km west of turbine T3 The NLRWS raw water abstraction is from Lough Gill, Co Sligo. Due to the minor accommodations required on the proposed TDR, no likely significant effects on groundwater flow are anticipated.

Pre-mitigation, the likely significant effects on the alteration of groundwater flow at the proposed GCR are considered unlikely, indirect, short-term, and not significant/slight for public water supplies and private wells, due to the limited excavations proposed for the GCR works areas.

8.4.5 Likely Significant Effects – Operation

8.4.5.1 Alteration of Surface Water Quality

Proposed Wind Farm Site

The proposed permanent wind farm footprint comprises 49 ha within the overall wind farm site area of 1,096 ha (4.4%). An on-site 110 kV substation will be constructed. The majority of the substation foundation will be gravel hardcore. The electrical plant at the substation site (primarily transformers) may contain oil for insulation purposes which may be a potential source of contamination.

The presence of hardstand areas may increase the risk of sediment-laden surface water runoff.

Surface water arising from roof drainage and surface water associated with the substation will be managed using SuDS, which mimic natural drainage processes to reduce the effect on the quality and quantity of runoff and can provide biodiversity benefits.

Due to the design measures and limited activity on the site, the proposed wind farm site is likely to have negative, direct, long-term, not significant to slight effect on the surface water quality.

Proposed GCR Works and TDR Accommodation Areas

No excavation works are anticipated on the proposed TDR or GCR during the operational phase, and therefore no significant effects on surface water quality are predicted. In the unlikely event that limited localised excavations are required for maintenance, these will be minor in nature, subject to the project's construction and environmental management controls, and are not expected to give rise to likely significant effects on surface water quality.

The potential significant effects are limited by the size of the fuel tanks of the vehicles used on the operation, which will be limited to light vehicles and vans with small fuel tanks. As a result, occasional/accidental emissions, in the form of oil, petrol or diesel leaks, could potentially cause slight/negligible temporary and highly localised contamination of surface water quality.

8.4.5.2 Alteration of Surface Water Flow

<u>Proposed wind farm site</u>

The installation of permanent infrastructure will not result in a significant increase in surface water runoff during the operational phase of the proposed wind farm site as detailed below. Surface water arising from roof drainage and surface water associated with the substation will be managed using sustainable urban drainage systems (SuDS). As detailed in Section 8.3, existing infiltration is anticipated to be low throughout the majority of work areas and will not result in a signification alteration in infiltration rates. The proposed permanent wind farm footprint comprises 49.0 ha within the overall proposed wind farm site area of 1,096 ha (4.4%). There is no potential significant effects of the stream crossing locations during the operational phase.

The proposed wind farm site is likely to have a negative, direct, long-term and not significant effect in the alteration of surface water flow.

<u>Proposed GCR Works and TDR Accommodation Areas</u>

No excavation works are anticipated on the proposed TDR or GCR during the operational phase, and therefore no significant effects on surface water flow are predicted. In the unlikely event that limited localised excavations are required for maintenance, these will be minor in nature, subject to the project's construction and environmental management controls, and are not expected to give rise to likely significant effects on surface water flow.

8.4.5.3 Alteration of Groundwater Quality

<u>Proposed Wind Farm Site</u>

With regard to water quality effects, there will be no direct discharges to groundwater during the operational phase. Runoff from the turbine hardstands etc, will be controlled and treated prior to discharge from the proposed wind farm. During wind farm operations, vehicle access to the site will be limited to light vehicles and vans with small fuel tanks (typically under 100 litres), minimising the potential volume of any accidental emissions. As a result, occasional leaks of oil, petrol, or diesel would be slight, temporary, and highly localised, posing no risk of likely significant effects on groundwater quality.

Karst features are present on site and can provide a direct connection between the surface water and the groundwater environment, where present. No turbine, construction compounds or substation infrastructure is proposed within 30 m of any karst features (dolines, etc.) or 100 m of swallow holes, as per Section 8.4.3. The proposed SuDS measures and surface water drainage network or management measures are included in the SWMP – Appendix 2-8.

The presence of occasional maintenance workers at the proposed substation will lead to the generation of foul sewage from toilets and washing facilities. This foul sewage will be collected and tankered off-site for disposal at a licensed wastewater treatment facility.

Therefore, likely significant effects of the proposed wind farm site on alteration of groundwater quality are negative, direct, long term, likely and not significant.

Proposed GCR Works and TDR Accommodation Areas

No excavation works are anticipated on the proposed TDR or GCR during the operational phase, and therefore no significant effects on groundwater quality are predicted. In the unlikely event that limited localised excavations are required for maintenance or minor road reinstatement (e.g., blade/component replacement), these will be minor in nature, subject to the project's construction and environmental management controls, and less extensive than construction activities - thus are not expected to give rise to likely significant effects on groundwater quality.

8.4.5.4 Alteration of Groundwater Flow

Proposed Wind Farm Site

The installation of permanent infrastructure could result in a decrease in groundwater infiltration during the operational phase of the proposed wind farm site, as a result of the proposed permanent wind farm infrastructure and impermeable areas. However, due to the small proportional land use change within the proposed wind farm site, the change to infiltration rates is low. SuDS design measures such as swales will encourage infiltration back to ground.

The proposed wind farm site is likely to have an imperceptible, direct, long-term and not significant effect on groundwater flow.

Proposed GCR Works and TDR Accommodation Areas

No excavation works are anticipated on the proposed TDR or GCR during the operational phase, and therefore no significant effects on groundwater flow are predicted. In the unlikely event that limited localised excavations are required for maintenance, these will be minor in nature, subject to the project's construction and environmental management controls, and are not expected to give rise to likely significant effects on groundwater flow.

8.4.6 Likely Significant Effects – Decommissioning

Decommissioning of the proposed project will result in the cessation of renewable energy generation and the removal of certain infrastructural elements, including all above ground turbine components. Below ground turbine foundations and hardstands will remain in-situ, as well as the site access roads, the substation and the GCR.

The effects of decommissioning the above-ground components have been assessed as less significant than the construction phase. Mitigation measures for the construction phase will also be implemented during decommissioning.

8.4.6.1 Alteration of Surface Water Quality

The removal of permanent infrastructure could result in a slight effect on surface water quality during the decommissioning phase of the proposed wind farm site, primarily from minor sediment mobilisation and earthworks disturbance akin to construction activities. The decommissioning phase of the wind farm site infrastructure will potentially have a negative, temporary/short-term, not significant to slight effect on the alteration of surface water quality.

8.4.6.2 Alteration of Surface Water Flow

The removal of permanent infrastructure could result in a slight increase in surface water runoff during the decommissioning phase of the proposed wind farm site. Primarily from minor sediment mobilisation and earthworks disturbance akin to construction activities. The proposed wind farm site is therefore likely to have a negative, temporary/short-term, slight effect on the alteration of surface water flow.

8.4.6.3 Alteration of Groundwater Quality

With regard to groundwater quality effects, there will be no direct discharges to the groundwater environment during the decommissioning phase. The surface water management infrastructure will remain in place during the decommissioning phase. Due to the nature of the decommissioning, there will be vehicles and machinery on the proposed wind farm site. The potential significant effects are limited by the size of the fuel tanks of the vehicles used on the decommissioning, which will be limited to light vehicles and vans with small fuel tanks. As a result, occasional/accidental emissions, in the form of oil, petrol or diesel leaks, could potentially cause slight/negligible temporary and highly localised contamination of groundwater.

Likely significant effects on the alteration of groundwater quality at the proposed wind farm site are therefore considered to be negative, direct, short term, likely and not significant.

8.4.6.4 Alteration of Groundwater Flow

The removal of permanent infrastructure could result in a slight increase in groundwater infiltration during the decommissioning phase of the proposed wind farm site, due to restored natural topography allowing greater rainfall percolation into exposed subsoils and bedrock interfaces. However, this localised change is anticipated to be not significant long-term for groundwater flow, as it represents a return toward pre-development recharge patterns already assessed under operational baseline conditions.

8.4.7 Summary of Likely Significant Effects

Tables 8-22 to 8-24 summarises the significance of effects (pre-mitigation) for the construction, operation and decommissioning phase of the proposed project.

Table 8-22: Significance of Hydrological and hydrogeological Effects - Construction Phase (Pre mitigation)

Criteria	Description	Sensitivity	Magnitude	Significance of Likely effects (pre mitigation)
Surface Water Quality	A potential, short term loss in water quality is expected. Potential for minor spills of fuels and concrete. Potential sediment laden runoff.	Medium to High	Moderate	Short term, to Slight (Not Significant) to moderate (**significant**) negative
Surface Water Flow	Potential increase in surface water runoff may be caused by impermeable areas on the wind farm site and give rise to a slight increase in surface water flow locally but is expected to have a negligible effect on the volumetric flow rate of downstream rivers.	Medium	Negligible Magnitude	Short term, to Slight (Not Significant) negative
Groundwater Quality	No significant reduction in groundwater quality is expected. Potential for minor spills of fuels and concrete.	Medium to High	Moderate	Short term, to Slight (Not Significant) to moderate (**significant**) negative
Groundwater Flow	Potential alteration of groundwater flow to one on site well. Limited excavations on GCR/TDR	Medium	Low Magnitude	Short term, unlikely, Not Significant to Slight (Not Significant) negative

Table 8-23: Significance of Hydrological and Hydrogeological Criteria - Operational Phase (Pre mitigation)

Criteria	Description	Sensitivity	Magnitude,	Significance of potential effect (pre mitigation)
Surface Water Quality	Potential sediment laden runoff. No significant loss in water quality is expected. Site infrastructure and SuDS will remain in place during the operational phase	Medium to High	Negligible	Long term and rarely, Slight (Not Significant) negative
Surface Water Flow	Increased surface runoff caused by impermeable areas on the wind farm site may give rise to a slight increase in surface water flow rate of downstream rivers.	Low to Medium	Negligible	Long term and rarely, Imperceptible to Slight (Not Significant) negative

Groundwater Quality	No significant effects on groundwater quality.	Medium to High	Negligible	Slight (Not Significant) negative
Groundwater Flow	No significant alteration in groundwater flow.	Low to Medium	Negligible	Imperceptible to Slight (Not Significant) negative

Table 8-24: Significance of Hydrological and Hydrogeological Criteria - Decommissioning Phase (Pre Mitigation)

Criteria	Description	Sensitivity	Magnitude	Significance of potential effect (pre mitigation)
Surface Water Quality	Potential sediment laden runoff. A slight, temporary to short terms increase in sediment locally but is expected to have a slight potential effect on the downstream rivers. Limited excavations proposed during the decommissioning phase	Medium to High	Low to Negligible	Temporary to short term and unlikely, Slight (Not Significant)
Surface Water Flow	Decommissioning on the wind farm site may give rise to a slight increase in surface water flow locally but is expected to have a slight potential effect on the volumetric flow rate of downstream rivers. Limited excavations proposed during the decommissioning phase	Medium	Low to Negligible effect	Temporary to Short term and unlikely, Slight (Not Significant)
Groundwater Quality	No significant effects on groundwater quality. Limited excavations proposed during the decommissioning phase	Medium to High	Low to Negligible	Long term and unlikely, Slight (Not Significant)
Groundwater Flow	No significant alteration in groundwater flow. Limited excavations proposed during the decommissioning phase	Medium	Negligible	Long term and unlikely, Slight (Not Significant)

8.5 Mitigation Measures

As outlined in Chapter 2 - Description of the Proposed Project, the design of the proposed project includes a range of best practice measures including the use of bunding and Sustainable Drainage Systems (SuDS), the implementation of a Construction Environmental Management Plan (CEMP) and a surface water management plan (SWMP) (Appendix 2-3 and 2-7) which details the design and control measures.

8.5.1 Mitigation Measures – Construction Phase

8.5.1.1 Alteration of Surface Water Quality

The SWMP will be implemented by the appointed contractor and will be regularly audited throughout the construction phase. The Environmental Manager will stop works on site if he/she is of the opinion that a mitigation measure or corrective action is not being appropriately or effectively implemented.

In addition, the proposed turbine locations will include an infiltration basin which will be used for control of any surface water runoff.

The infiltration basin will be lined with a permeable geotextile membrane/filter material in accordance with TII guidance DN-DNG-03065[8] formerly NRA HD 45/15. Where limited soils are present such as at proposed turbine locations T3, T7 and T14, a lined pond with a 1m composite base as set out in TII Guidance DN-DNG-03065. These ponds will allow for treatment of surface water runoff in infiltration to ground. Swales will re-vegetated following excavation. Vegetation will reduce the flow velocity, treat potential pollutants, increase filtration and silt retention.

Water within the excavation will be treated via a settlement pond. If the water has a heavy silt load, then an additional measure such as a Siltbuster™ or ATAC Lamella Units will be employed. Silt will be removed to ensure operational effectiveness.

For the 11 river crossings, three lines of silt fence will be erected to provide a physical separation, which will trap suspended sediment from the works area (see Drawings 10955-2050, 10955-2051 to 10955-2061). Silt fences will be inspected routinely, and inspections will be increased after runoff events. Once these measures are in place, topsoil will be carefully stripped from the foundation footprint on either side of the watercourse. Care will be taken to ensure that no disturbance occurs to the bed or banks of rivers or streams. Excavations within the river channel are strictly prohibited.

For the Bonet River GCR crossing, any water in excavations will be pumped to lands that are >10 metres from any watercourse and discharged via a silt bag and overland flow to a discharge point. Silt fencing will be erected at the location of stream crossings. Triple silt fences (woven, high tensile strength heavy porous filter fabric) will be used near stream crossings. The first silt fence will be installed by hand, with placement following site contours to avoid long runs, using heavy porous filter fabric (TerrastopTM), posts embedded to the specified depth and spacing, and soil tightly compacted on both sides of the fence.

[8] Tii Publications - https://www.tiipublications.ie/document/?id=2685

Site Construction Management

Hazardous substances (fuel, oils, chemicals) will be stored in bunded areas (110% capacity) with impermeable bases and leak detection equipment. Spill response protocol, consisting of secondary containment, drip trays, supervised refuelling, and impermeable refuelling zones, will be implemented in the event of a spill.

Excavated material will be reused on site. The stockpiling of materials will be carefully supervised as per the mitigation measures listed in Chapter 7 - Land, Soils and Geology. Surplus material will be placed in the borrow pits.

The nature of the spoil deposition areas is an important measure in mitigating against suspended solids in run-off. The spoil deposition areas have the following characteristics; >50m from rivers, relatively flat (<3 degrees), and topographically constrained. This mitigates against potential stability issues. The drainage scheme for the spoil deposition area will be controlled through a series of proposed settlement ponds with the provision of an overflow. Settlement ponds will be maintained over the course of the development and for a period until vegetation has stabilised.

The reinstated borrow pit will be allowed to naturalise and utilise the vegetative features to filter water on site. Revegetation of the spoil deposition areas will stabilise the spoil. Based on the existing plant species, the vegetation will initially comprise predominantly heath/peatland vegetation including grasses, sedges and bryophytes. These areas will reseed naturally utilising adjacent and local seed banks.

8.5.1.2 Alteration of Surface Water Flow

A total of 11 clear span bridges/bottomless culverts will be utilised as part of the project. There are no works within 2.5 m from the banks of the streams. All crossings occur on small first order streams with a small catchment area (<2.6 km^2). The proposed bridges will have a flow capacity is 4 to 10 m^3/s which is greater than the 1:100 year flow. Further details of the bridge crossing are provided on Drawing 10955-2050.

Further mitigation measures in relation to the proposed GCR route and road/junction accommodations on the proposed TDR are outlined in the CEMP (Appendix 2-3).

8.5.1.3 Alteration of Groundwater Quality

During the construction phase, all works associated with the construction of the wind farm will be undertaken in accordance with the guidance contained within CIRIA Document C741 'Environmental Good Practice on Site' (CIRIA, 2015). Regional groundwater levels are >10 m below ground level however perched groundwater tables may be encountered. Groundwater pumped from excavations will be treated to remove silt by the use of silt bags. Water will discharge from the silt bags into settlement ponds/infiltration basins and the SuDS network.

A karst protocol will be employed during construction and involves a series of steps and methodologies in karst areas. The karst feature inspection protocol is documented by Madden & O'Hara (2016)[9]. Ground stabilisation measures that will be employed include compaction, grouting/stabilisation, geotextile or utilising raft foundations where required. Where weathered limestone or karst is encountered at formation level, the feature will be mapped in detail. Each feature and associated mitigation measure will be documented and included in the

[9] Madden and Hara (2016) The treatment of karst features encountered during road construction in County Galway

safety file for the Proposed Project. The stabilisation measures will be approved by a geotechnical engineer. Where infilling or grouting is required, works will be supervised by a suitably qualified hydrogeologist to ensure there is no effect on groundwater.

Design measures in relation to the proposed GCR and road/junction accommodations on the proposed TDR are outlined in the CEMP in Appendix 2-3 of the EIAR. No additional measures are required for these works.

8.5.1.4 Alteration of Groundwater Flow

Limited groundwater may be encountered in the borrow pits. Groundwater is >8m bgl in Borrow pit 2 and Borrow Pit 3 however minor seepages may occur. Groundwater encountered will be managed and treated in accordance with CIRIA C750, 'Groundwater control: design and practice' (CIRIA, 2016). Groundwater from the borrow pits will be treated in the settlement ponds, see Drawing 10955-2090 to 10955-2094.

No additional measures are required for the proposed GCR works or TDR accommodations.

8.5.1.5 Monitoring

8.5.1.6 Surface Water Quality Monitoring

Local surface water features at the proposed wind farm site boundary will be monitored pre-construction and during construction to take account of any variations in the quality of the local surface water environment as a result of activities related to the proposed project. A surface water management plan (SWMP) will be implemented as set out in Appendix 2-8.

The main water parameters in terms of their potential to cause damage to aquatic life, ecosystems, human health, and water quality in the receiving waters are outlined in the proposed surface water monitoring schedule. Inspections of silt traps will be caried out following prolonged or intense rainfall while maintenance will ensure maximum effectiveness of the proposed measures. Silt traps will be maintained with regular removal of silt. Stockpiles will be evaluated and monitored and kept stable for safety and to minimise erosion.

Turbidity monitors/alarms will be strategically placed on the Lattone_010 River and Owenmore (Manorhamilton)_020 River to assess the effects, if any, of the main construction works including bridge crossings and turbine base construction. Elevated turbidity could result from a number of on-site construction activities or from off-site sources i.e. erosion, forestry or agricultural activities. Where elevated turbidity is noted both upstream and downstream, visual checks will be undertaken. All monitoring equipment will be calibrated regularly to ensure that results are accurately measured.

Corrective actions will include:

- Investigate whether channels used to convey water are protected with vegetation, erosion control blankets, or a similar erosion control measure. If not, implement appropriate erosion control measures.
- Check all outlets and locations of turbidity monitors.
- Stop dewatering if the downgradient area shows elevated turbidity or erosion.
- Check outlet protection or any velocity dissipation device to ensure that erosion does not take place.
- Ensure a stable, erosion-resistant surface (e.g., well-vegetated grassy areas, clean filter stone, geotextile underlay) is maintained at outlets.

- Check for leaking pumps, hoses, and pipe connections and fix same if identified.

A programme of inspection and maintenance will be designed, and dedicated construction personnel assigned to manage this programme. A checklist of the inspection and maintenance control measures will be developed, and records kept.

During the construction phase, field testing, sampling and laboratory analysis of a range of parameters will be undertaken at adjacent watercourses, specifically following heavy rainfall events (i.e., weekly, monthly and event-based as appropriate).

8.5.1.7 Groundwater Monitoring

The dewatering operations will be inspected once each day when dewatering is taking place to ensure that dewatering treatment controls are working correctly and to evaluate whether there are observable indicators of sediment discharges. Where any issues are encountered, action will be undertaken to correct any problems at the proposed project or with the dewatering controls that may have contributed to the discharges.

Regular monitoring of groundwater (levels and quality) will take place using existing monitoring boreholes (see Figure 8-12) during the construction phase. The existing groundwater monitoring wells on site will be monitored on site during construction and for a period following cessation of construction activities (to be agreed with the relevant authorities).

8.5.2 Mitigation Measures – Operational Phase

The following mitigation measures will be implemented during the operational stage.

8.5.2.1 Alteration of Surface Water Quality

Measures outlined in Section 8.5.1 design measures will be implemented during the operational phase and these will be protective of surface water quality.No additional measures are required.

8.5.2.2 Alteration of Surface Water Flow

Measures outlined in Section 8.5.1 design measures will be implemented during the operational phase and these will be protective of surface water flow. No additional measures are required.

8.5.2.3 Alteration of Groundwater Flow

Measures outlined in Section 8.5.1 design measures will be implemented during the operational phase and these will be protective of ground water flow. No additional measures are required.

8.5.2.4 Alteration of Groundwater Quality

Measures outlined in Section 8.5.1 design measures will be implemented during the operational phase and these will be protective of ground water quality. No additional measures are required.

8.5.3 Mitigation Measures - Decommissioning

Decommissioning of the proposed project will involve the disassembly and removal of the turbines off-site. The potential significant effects have been assessed as less than construction phase and, therefore, the mitigation measures for the construction phase will also be implemented during decommissioning. Turbine hardstands will be allowed to naturally vegetate.

8.5.3.1 Alteration of Surface Water Quality

Mitigation measures applied during decommissioning activities will be similar to those applied during construction where relevant. These mitigation measures are outlined above in Section 8.5.1.

The decommissioning phase will not require any significant works that will potentially affect the drainage network. A fuel management plan to avoid contamination by fuel leakage during decommissioning works will be implemented as per the construction phase mitigation measures.

Mitigation measures to avoid contamination by accidental fuel leakage and compaction of soil by on-site plant will be implemented as per the construction phase mitigation measures in Section 8.5.2.

8.5.3.2 Alteration of Surface Water Flow

Measures outlined in Section 8.5.1 design measures will be implemented during the decommissioning phase and these will be protective of surface water flow. No additional measures are required. SuDS measures will remain in place during the decommissioning period.

8.5.3.3 Alteration of Groundwater Quality

Measures outlined in Section 8.5.1 design measures will be implemented during the decommissioning phase and these protective of ground water quality. No additional measures are required.

8.5.3.4 Alteration of Groundwater Flow

Measures outlined in Section 8.5.1 design measures will be implemented during the decommissioning phase and these protective of ground water flow. No additional measures are required.

8.6 Residual Effects

8.6.1 Construction Phase

The greatest potential for likely significant hydrological or hydrogeological effects occurs during the construction phase. The assessment proposes a range of mitigation measures (Section 8.5) as part of the CEMP (Appendix 2-4) and the SWMP (Appendix 2-8). The latter states that the erosion and sediment control measures will be in place and functioning before works commence. The drainage system will remain in place and maintained during construction, operation and decommissioning of the proposed wind farm site. Site drainage will utilize a sustainable drainage plan that has been designed for this proposed wind farm site.

Due to the presence of peat and karst features on site, the potential for the release of suspended solids/nutrients to watercourse receptors is a risk to the surface water and groundwater quality downgradient. Proven and effective measures to mitigate the risk of sediment/nutrient releases have been proposed in Section 8.5 above. Pre-mitigation, there is potential for water pollution as a result of the excavations, with potential negative, short term, moderate effects.

The potential to increase surface water runoff is low. It is predicted that the (pre mitigation) effects are not significant on groundwater flow or quality. The effects on hydrogeology are limited to issues associated with the storage and use of potential contaminants at the proposed localised dewatering at infrastructure locations i.e. borrow pits and turbine footprints.

Chemicals and fuel will be stored in bunded areas and used in accordance with the manufacturer's instructions and EPA guidelines. Accordingly, it is concluded that residual effects on groundwater quality or flow will be short term and imperceptible (not significant).

Based on the proposed mitigation, hydrological or hydrogeological conditions will not be altered to a degree that would significantly affect the environment [i.e. not significant effect]. The residual impacts on the hydrology and hydrogeology at the proposed wind farm site, proposed GCR works and accommodation areas on the proposed TDR are considered to be imperceptible/not significant and short term in nature.

As detailed in Appendix 8-1 - WFD Compliance Assessment, the proposed project will not compromise progress towards achieving Good Ecological Status or cause a deterioration of the overall status of the water bodies during the construction phase.

The construction timescale of activities within the proposed wind farm site will be phased and short-term in duration. There are no significant long-term effects.

Summary of Construction Phase Residual Effects:

The greatest potential for hydrological or hydrogeological effects occurs during construction. Pre-mitigation risks include moderate sediment/nutrient and slight-moderate contaminant risks from dewatering/storage, but these are addressed through embedded mitigation measures, outlined in Section 8-5. A summary of construction phase residual effects is evident in Table 8-25.

Table 8-25: Summary of Construction Phase Residual Effects

Criteria	Description	Sensitivity	Magnitude	Significance of Likely effects (post mitigation / Residual)
Surface Water Quality	A potential, short term loss in water quality is expected. Potential for minor spills of fuels and concrete. Potential sediment laden runoff.	Medium to High	Moderate	Imperceptible (Not Significant)
Surface Water Flow	Potential increase in surface water runoff may be caused by impermeable areas on the wind farm site and give rise to a slight increase in surface water flow locally but is expected to have a negligible effect on the volumetric flow rate of downstream rivers.	Medium	Negligible Magnitude	Imperceptible (Not Significant)
Groundwater Quality	No significant reduction in groundwater quality is expected. Potential for minor spills of fuels and concrete.	Medium to High	Moderate	Imperceptible (Not Significant)
Groundwater Flow	Potential alteration of groundwater flow to one on site well. Limited excavations on GCR/TDR	Medium	Low Magnitude	Imperceptible (Not Significant)

- Surface water quality: Pre-mitigation moderate (significant) effects from sediment/nutrients reduced to imperceptible/not significant via CEMP (Appendix 2-3), SWMP (Appendix 2-7) with SuDS, silt fences, and settlement ponds installed pre-works.
- Groundwater quality: Slight-moderate contaminant/dewatering risks mitigated to imperceptible/not significant through bunded storage, EPA guidelines, and 500 m turbine/borrow pit separation from any groundwater wells.
- Surface water runoff/flow: Slight effects controlled to imperceptible/not significant by sustainable drainage design maintained across the construction phase.
- Groundwater flow: Slight dewatering effects minimised to imperceptible/not significant via cone of depression separation distances and limited extraction requirements.

Following implementation of the embedded and additional mitigation measures outlined in this chapter, no significant effects on surface water or groundwater quality or flows will occur during the construction stage of the proposed wind farm, TDR accommodation areas, or GCR.

8.6.2 Operational Phase

During the operational phase, the only activities within the proposed wind farm site, will be ongoing maintenance and monitoring. The drainage system will remain in place and managed during the operation phase of the proposed wind farm site. Drainage will use a sustainable drainage plan that has been designed for this proposed wind farm site.

Based on the assessment of the proposed project and the implementation of mitigation measures mentioned in the above sections, there will be no likely significant residual effects on surface water or groundwater quality or flows during the operation phase of the proposed project.

As detailed in Appendix 2-8, the proposed project will not compromise progress towards achieving Good Ecological Status or cause a deterioration of the overall status of the water bodies during the operational phase, as per the WFD objectives.

8.6.3 Decommissioning Phase

The drainage system will remain in place and during the decommissioning phase of the proposed wind farm site.

Following implementation of the embedded and additional mitigation measures outlined in this chapter, there are no likely significant residual hydrological or hydrogeological effects associated with the proposed project during the decommissioning phase.

The proposed project will not compromise progress towards achieving Good Ecological Status or cause a deterioration of the overall status of the water bodies during the decommissioning phase, as per the WFD objectives.

8.7 CUMULATIVE EFFECTS

Cumulative effects of the proposed project with other developments within the study area are presented here in relation to likely significant effects on hydrology and hydrogeology. The developments assessed are listed in Table 8-21 below and also include other existing or planned developments with the potential for cumulative or in-combination environmental effects within the hydrology and hydrogeology study area. The main likelihood of cumulative effects is assessed to be hydrological (surface water quality) rather than hydrogeological (groundwater). Due to the hydrogeological setting of the proposed wind farm and the near surface nature of construction activities, cumulative effects with regard groundwater quality or quantity arising from the proposed wind farm are assessed as not likely.

The location of any offsite replanting (alternative afforestation) associated with the project will be greater than 10 km from the proposed wind farm site and outside any potential hydrological pathways of connectivity (i.e. outside the catchment within which the proposed project is located). This was also assessed here but was found to have no significant cumulative effects due to the separation distance.

Table 8-21 outlines the existing and proposed wind energy developments, described in Chapter 1 and illustrated in Figure 8-15. Projects located within a 5 km radius of the wind farm site were reviewed in line with best practice. These were reviewed as part of this cumulative assessment:

The primary potential for cumulative effects will occur during the construction phase of the proposed project, as this is when earthworks and excavations will be completed. The potential for cumulative effects during the operational phase of the proposed project will be significantly reduced as there will be no exposed excavations, there will be no sources of sediment to reach watercourses, no use of cementitious materials and fuels/oil will be kept to a minimum and bunded at the site. During the decommissioning phase, the potential cumulative effects are similar to the construction phase, but to a lesser degree with less ground disturbance.

Table 8-26: Local Authority and ACP Planning Applications for Existing / Proposed Wind Energy Developments

Planning Ref.	Development Description	Address	Grant Date /Status
04815	Construction of windfarm comprising of 9 No. wind turbines of 49 metre hub height	Carrickeeny Manorhamilton Co. Leitrim	28/07/2005 / Operational
1667	Faughary Wind farm.	Faughary, Manorhamilton, Co. Leitrim	12/12/2014 / Operational
1593	Additional Turbine (x2) Erection	Tullynamoyle Rd., Killaraga, Co Leitrim	31/08/2015 / Operational
15164	Additional Turbine (x3) Erection	Lackagh & Tullynamoyle, Killarga, Co Leitrim	01/02/2016 / Operational
1881	Construction and Operation of a Meteorological Mast	Tullynamoyle, Killarga, Co. Leitrim	07/08/2018 / Operational
1926	Additional Turbine (x4) Erection	Tullynamoyle, Killarga, Co. Leitrim	28/05/2020 / Operational
2360082	Continued Operation of a Meteorological Mast	Fenagh, Manorhamilton, Co. Leitrim	14/11/2023 / Operational
2157 (ACP Ref. 312895)	Additional Turbine (x4) Erection	Townlands of Tullinloughan, Lackagh, Tullynamoyle and Gowlaun, Co. Leitrim	29/08/2023 / Proposed

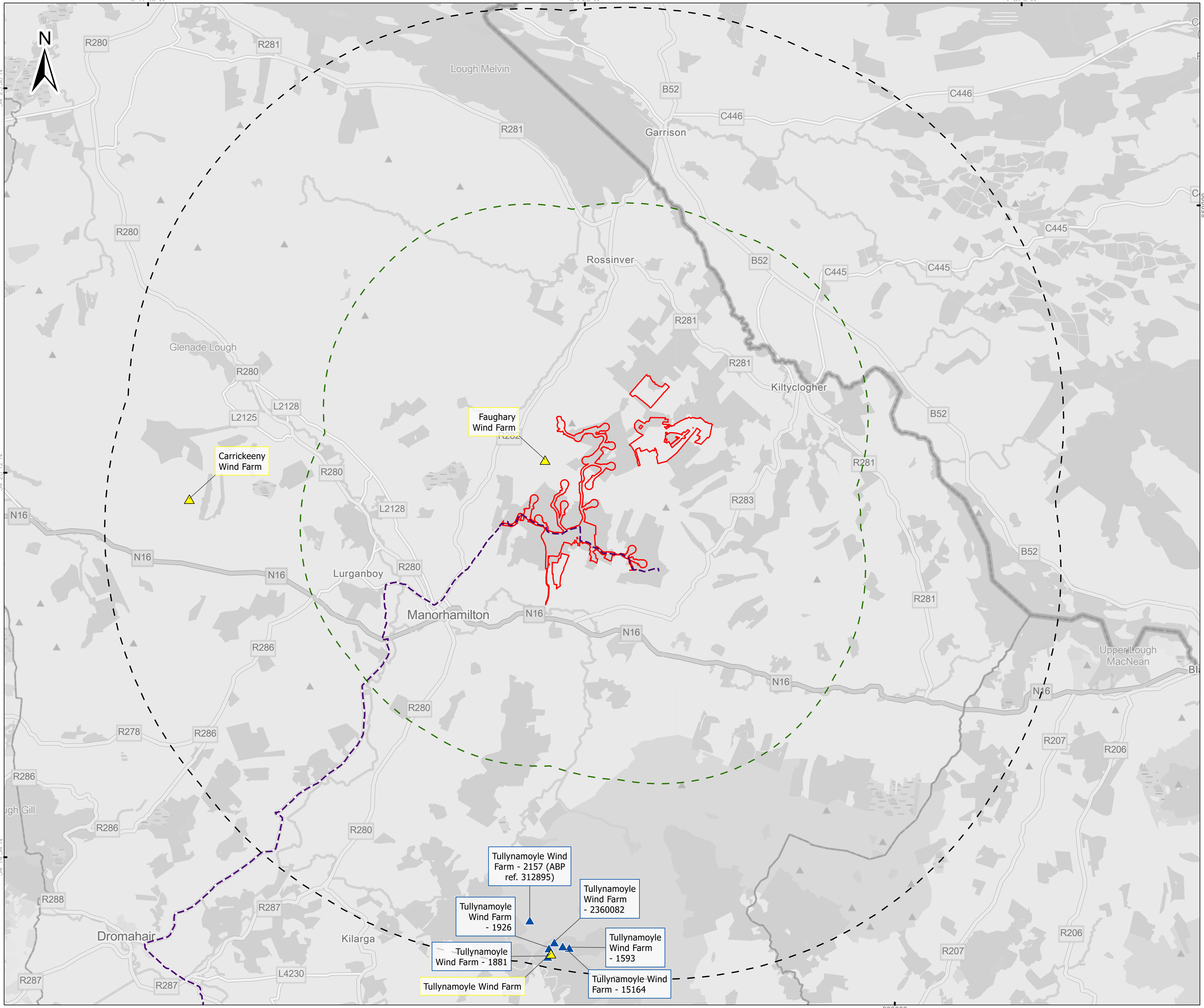
2460223	Modifications to a plan that was originally approved under An Bord Pleanála Reference PL12.312895	Tullynamoyle Rd., Killaraga, Co Leitrim	29/08/2023 / Proposed

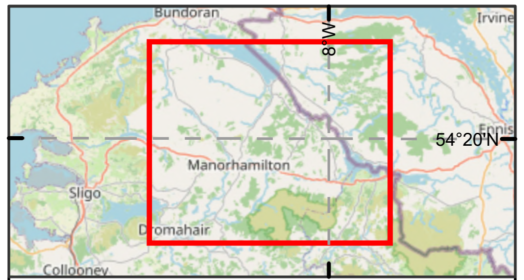
Mitigation measures detailed above in Section 8.5 for the construction, operation and decommissioning phases of the proposed project will ensure the protection of downstream surface water quality. It is concluded that there will not be a significant cumulative effect associated with proposed or existing activities. While an absence of likely significant effects from the proposed development alone is an important consideration, cumulative impacts can also arise from individually minor effects occurring in combination with other activities in the wider catchment. In this instance, most other developments within the study area are either fully operational with established drainage systems or are subject to similar environmental management plans and construction-phase controls. Consequently, the potential for additive or synergistic sediment, nutrient, or contaminant effects is very low.

The main likelihood of cumulative effects is assessed to be hydrological rather than hydrogeological. Due to the hydrogeological setting of the proposed wind farm site (i.e. low permeability soils overlying bedrock) and the near nature of construction activities, cumulative effects with regard groundwater quality or quantity arising from the proposed project are assessed as not likely.

The primary potential for cumulative effects will occur during the construction phase of the proposed development as this is when earthworks and excavations will be undertaken. The potential for cumulative effects during the operational phase will be significantly reduced as there will be no exposed excavations, there will be no sources of sediment to reach watercourses, there will be no use of cementitious materials and fuels/oil will be kept to a minimum at the site. During the decommissioning phase, the potential cumulative effects are similar to the construction phase, but to a lesser degree with less ground disturbance.

There will be no potential for cumulative effects beyond the cumulative study area due to increases in flow volumes (as the catchment area increases) and increasing distance from the proposed wind farm. Furthermore, the EIAR for cumulative projects including the Tullynamoyle wind farm development, assess the potential hydrological and hydrogeological issues during construction, operation and decommissioning phases, proposing best practice mitigation measures that ensure no negative effects on downstream surface water quality or quantity. These mitigations are comparable to those detailed in Section 8.5 of this EIAR chapter, confirming equivalent protection against cumulative pressures. Therefore, with projects implementing such embedded controls, no likely significant cumulative effects on the hydrological or hydrogeological environment are anticipated.





Legend

- Application Boundary
- Application Boundary: 5km buffer
- Application Boundary: 10km buffer
- Grid Connection Route

Wind Developments

- Proposed
- Existing

0 2 4
Kilometers

Spatial Reference
Datum: IRENET95
EPSG: 2157

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Rev	Date	Description	By	Chkd.
A	27/04/2026	First issue	S.P	S.R

Client:
FuturEnergy Ireland

Project:
Lissinagroagh Wind Farm

Title:
Figure 8-15
Existing and Proposed
Wind Energy Developments

Scale @ A3: 1:90,000

Prepared by: S.Pezzetta
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Map Ref: 10955-031-HYDRO..StA-CUMUL-TOB-A
Draft: A

No additional GCR works are anticipated for the above stated existing Wind Energy Developments and as such no overlap of associated grid connection works with the proposed project is expected. The proposed Tullynamoyle Wind Farm EIAR was reviewed and no overlap of associated grid connection works with the proposed project is expected.

Pre-mitigation, the GCR construction has potential for minor cumulative impacts on downstream surface water quality/quantity (e.g., additive sediment loading) when combined with nearby projects like Tullynamoyle Wind Farm, due to minor road works and cable trenching in shared hydrological catchments. Similarly, the mitigation and best practice measures proposed in Section 8-5, will ensure that the construction of the proposed Grid Connection does not have the potential to result in significant effects on the hydrological/hydrogeological environment. Therefore, with the implementation of the proposed mitigation measures (both for the proposed project and for existing/ planned energy developments) there will be no cumulative effects associated with the construction, operational or decommissioning phases of the proposed project.

The remaining planning applications reviewed relate principally to residential, commercial and agricultural use types. Remaining applications present no likely cumulative hydrology and hydrogeology impacts as they involve shallow, stable excavations distant from the wind farm, with no interaction pathways. It should be noted that details of these applications have been sourced from planning authority datasets available from the Department of Housing, Planning (MyPlan.ie) and Local Government and An Coimisiún Pleanála, assessed January 2026.

With mitigation implemented consistently across the project, as outlined above, no likely significant cumulative effects on surface water quality/quantity or groundwater are predicted for construction, operational, or decommissioning phases.

8.8 TRANSBOUNDARY EFFECTS

Due to the localised nature of the proposed construction works which will be kept within the proposed project site boundary, there is no potential for transboundary effects within Northern Ireland. There will be no significant effect arising from the wind farm, TDR, or grid connection route, construction, operation, or decommissioning on any transboundary surface water or groundwater body quality or flows within Northern Ireland.

8.9 CONCLUSION

The assessment of hydrology and hydrogeology has established a baseline for the receiving environment for the impact assessment. Potential impacts were considered for the construction, operational and decommissioning phases of the proposed project as well as potential residual and cumulative impacts.

The construction phase of the proposed project will have a not significant negative short-term effect on the hydrology and hydrogeology environment through the application of identified mitigation measures outlined above.

The operational phase of the proposed project will have a not significant negative long-term effect on the hydrology and hydrogeology environment through the application of identified mitigation measures and appropriate management throughout the operational phase of the wind farm.

The decommissioning phase of the proposed project will have a not significant negative long-term effect on the hydrology and hydrogeology environment through the application of identified mitigation measures and appropriate management throughout the decommissioning phase of the wind farm. Retention of the access roads as amenity tracks will have a not significant long-term positive effect.

The development will not give rise to cumulative or transboundary effects and will remain compliant with the objectives of the Water Framework Directive, ensuring no deterioration in the status of any relevant water body and that the project will not prevent or impede the achievement of WFD objectives for those water bodies.

8.10 References

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