FEHILY TIMONEY

CONSULTANTS IN ENGINEERING, ENVIRONMENTAL SCIENCE & PLANNING

ENVIRONMENTAL IMPACT ASSESSMENT REPORT (EIAR) FOR THE PROPOSED FAHY BEG WIND FARM, CO. CLARE

VOLUME 2 – MAIN EIAR

CHAPTER 10 – HYDROLOGY AND WATER QUALITY

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10. HYDROLOGY AND WATER QUALITY

10.1 Introduction

10.1.1 Project Description

This chapter has been prepared to describe the existing hydrology and water quality baseline of the local environment in the study area of the Fahy Beg Wind Farm and to assess potential effects on the hydrology and water quality of the local environment resulting from the activities associated with the proposed development.

The proposed development assessed in this chapter is comprised of the following key elements:

- The wind farm (hereinafter referred to as the **'site'**);
- Turbine delivery route (hereinafter referred to as the **'turbine delivery route'** or **'TDR'**);
- Grid connection route (hereinafter referred to as the or **'GCR'**).

A detailed description of the project is contained in Chapter 3. The site includes the wind turbines, internal access tracks, hard standings, the permanent meteorological mast, onsite substation, internal electrical and communications cabling, temporary construction compound, drainage infrastructure and all associated works related to the construction of the wind farm. The GCR will consist entirely of underground 38kV cable and will connect the on-site substation to the existing 110kV substation at Ardnacrusha. The turbine delivery route includes all aspects of the route from the M7/R494 junction to the site entrance including proposed temporary accommodation works to facilitate the delivery of wind turbine components.

10.1.2 Structure of this EIAR chapter.

Section 10.2 presents the methodology of assessment used in this chapter. Existing hydrology and water quality in the receiving environment including receiving waterbodies and catchments is outlined in Section 10.3. This includes information on historical flooding within the site, internal site drainage and GCR watercourse crossings.

The potential impacts of the development during construction, operation and decommissioning phases on surface water bodies within the receiving environment are identified with consideration of each of the project components and discussed in Sections 10.4. The flood risk assessment is presented in Section 10.5 and the proposed drainage layout is presented in the following Section 10.6.

Section 10.7 outlines proposed mitigation measures in consideration of the potential impacts identified in Section 10.4 and 10.5. Residual impacts, which take into account the mitigation measures, are presented in Section 10.8 and key points from the chapter are summarized in the concluding Section 10.9.

10.1.3 Study Area

The Study area regarding hydrology and water quality is comprised of catchments, sub-catchments, sub-basins and associated hydrological features within the vicinity and hydrologically connected to the proposed development. The delineation of the water bodies encompassing the drainage networks is defined by the latest available Water Framework Directive (WFD) 2000/60/EC, as amended, "Cycle 3".

For each project component, catchment characteristics and associated hydrological features are addressed within this Chapter.

The study area for this assessment comprises the relevant hydrological catchments within which elements of the above project are located or hydrologically connected to. A detailed description of the existing environment of the study area is contained in Section 10.3.

10.1.4 Aims

The aims of this EIAR chapter are to:

- Establish the baseline condition of the receiving surface water environment;
- Identify sensitive surface water receptors;
- Identify potential impacts as a result of the proposed development and assess the likelihood of such effects occurring;
- Assess the potential flood risk associated with the development;
- Outline mitigation and industry best practice that will be implemented during the construction and operation of the proposed development;
- Determine the scale of any potential effects, taking into account the prescribed mitigation and implementation of best industry practice, by assessing the degree of sensitivity of the water environment receptors and the potential magnitude of change from the baseline condition;
- Establish if the scale of the effect is considered to be significant;
- If required, provide specific mitigation measures; and,
- Identify any cumulative and residual effects.

10.2 Methodology

A qualitative assessment has been undertaken using professional judgement and in compliance with national and European Union legislation and other statutory policy and guidance. The assessment focuses on potential effects resulting from the proposed wind farm, GCR and TDR, which may include changes to the surface water regime or pollution and degradation in water quality.

A desk-based assessment and field assessment on 03 August 2022 and 11 August 2022 were undertaken during September 2022 to inform the assessment. The desk-based study assessed the surface water hydrology and water quality in the catchments relevant to the proposed project, including an assessment of the watercourses that will be intercepted by- and those that will receive surface water runoff from the layout of the wind farm site, GCR and turbine delivery route. The field assessment of the existing hydrological environment, was undertaken to both verify desk-based assessment, record all significant hydrological features and assess the proposed crossing points along water features.

Relevant legislation and guidance are described in Section 10.2.1. Other key sources of information for the assessment are the local authority, Clare County's Development Plan 2017 - 2023 (As Varied)[1] and the design layout of the wind farm site, GCR and turbine delivery route (Figure 3-1).

In summary, the overall methodology follows the process of: reviewing relevant legislation and guidance; baseline characterization of the existing site environment; review of proposed project construction, operation and decommissioning phases; assessment of potential effects and their likelihood, outline of proposed mitigation measures; assessment of residual impacts during the construction, operational and decommission phases of the project; and any need for additional mitigation.

10.2.1 Relevant Legislation and Guidance

10.2.1.1 Relevant EU Directives and Legislation

The Water Framework Directive (2000/60/EC)[2]

Directive 2000/60/EC of the European Parliament and Council established a framework for community action in the field of water policy. This Directive is also known as the WFD and came into force on the 22 December 2000. The WFD requires EU member states to aim to reach good chemical and ecological status in inland and coastal waters. The WFD is designed to enhance the status and prevent further deterioration of aquatic ecosystems and associated wetlands, to promote sustainable water use, to reduce pollution of water and to ensure progressive reduction of groundwater pollution. The WFD established a strategic framework for managing the water environment and requires a River Basin Management Plan (RBMP) to be developed every six years. In cases where good status/potential could not be achieved by 2015, a provision was given under Article 4.4 of the WFD extending the deadline to 2021 or 2027. The date has been extended to 2027 in respect of a large number of waterbodies.

The WFD has been implemented in Ireland by dividing the island of Ireland into eight river basin districts. These districts are natural geographical areas that occur in the landscape. River Basin Management Plan 2018-2021[3] has been prepared by Department of Housing, Planning and Local Government, presenting a RBMP for catchments throughout Ireland. This RBMP sets out the actions that Ireland will take to improve water quality and achieve 'good' ecological status in water bodies (rivers, lakes, estuaries and coastal waters) by 2027.

[1] Clare County Council, Clare County Development Plan 2017 - 2023 (As Varied), 2017. Available online here: Clare County Development Plan 2017 - 2023 (As Varied) | Planning, heritage and conservation | Services | Clare County Council (clarecoco.ie). Accessed August 2022.

[2] European Union, Water Framework Directive (2000/60/EC), 2000. Available online here:resource.html (europa.eu). Accessed August 2022.

[3] Department of Housing, Local Government and Heritage, River Basin Management Plan for Ireland, 2017. Available online here: gov.ie - River Basin Management Plan 2018 - 2021 (www.gov.ie) Accessed August 2022.

The WFD has been transposed into Irish law following:

- European Communities (Water Policy) Regulations, 2003 (S.I. No. 722 of 2003)[4].
- European Union (Water Policy) Regulations 2014 (S.I. No. 350 of 2014)5.
- European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009)6.
- European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010)7.
- European Communities (Good Agricultural Practice for Protection of Waters) Regulations 2010 (S.I. No. 610 of 2010)8.
- European Communities (Technical Specifications for the Chemical Analysis and Monitoring of Water Status) Regulations, 2011 (S.I. No. 489 of 2011).

Water Framework Directive Waterbody Status

The European Communities Environmental Objectives (Surface Water) Regulations 2009 (S.I. No. 272 of 2009)[9] (the Surface Water Regulations), implement the criteria and standards used for classifying surface waters in accordance with the WFD. There are five categories of surface water status: 'High', 'Good', 'Moderate', 'Poor' and 'Bad'.

A surface waterbody must achieve both good ecological status and good chemical status before it can be considered to be of good status. The chemical status of a waterbody is assessed based on certain chemical pollutants. The ecological status is assessed based on Biotic Indices or Quality (Q) Values. The EPA Biological Quality Rating System for Rivers (Q Rating System) and its relationship with the WFD Status is shown in Table 10-1:

[4] Department of Environment, Heritage and Local Government , 2003. S.I. No. 722/2003 - European Communities (Water Policy) Regulations 2003. Amended in 2005 (S.I. No 413/2005), 2008 (S.I. No. 219/2008) and 2010 (S.I. No. 93/2010). Available online here: S.I. No. 722/2003 - European Communities (Water Policy) Regulations 2003 (irishstatutebook.ie). Accessed August 2022.

[5] Department of Environment, Community and Local Government, 2014. European Union (Water Policy) Regulations 2014 (S.I. No. 350 of 2014). Available online here: S.I. No. 350/2014 - European Union (Water Policy) Regulations 2014. (irishstatutebook.ie) Accessed August 2022.

[6] Department of Environment, Heritage and Local Government, 2009. European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009) Amended in 2012 (S.I. No. 327/2012) and 2015 (S.I. No. 386/2015), 2019 (S.I. No. 77/2019), 2022 (S.I. No. 288/2022). Available online here: S.I. No. 272/2009 - European Communities Environmental Objectives (Surface Waters) Regulations 2009 (irishstatutebook.ie). Accessed August 2022.

[7] Department of Environment, Heritage and Local Government, 2010. European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010). Amended in 2011 (S.I. No 389/2011), 2012 (S.I. No 149/2012) and 2016 (S.I. No 366/2016). Available online here: https://www.irishstatutebook.ie/eli/2010/si/9/made/en/print. Accessed August 2022.

[8] Department of Environment, Heritage and Local Government, 2010. European Communities (Good Agricultural Practice for Protection of Waters) Regulations 2010 (S.I. No. 610 of 2010). Amended in 2014 (S.I. 31/2014), 2017 (.S.I. No. 605/2017), 2020 (S.I. No. 40/2020), 2022 (S.I. No. 113 of 2022). Available online here https://www.irishstatutebook.ie/eli/2010/si/610/made/en/print. Accessed August 2022.

[9] Department of Environment, Community and Local Government, 2011. European Communities (Technical Specifications for the Chemical Analysis and Monitoring of Water Status) Regulations, 2011 (S.I. No. 489 of 2011).
Amended in 2012 (S.I. No. 327 of 2012) and 2015 (S.I. No. 386 of 2015). Available online here: https://www.irishstatutebook.ie/eli/2011/si/489/made/en/print. Accessed August 2022.

Table 10-1: EPA Q Rating System and WFD Status[10]

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

* These Q Values are based on the relative proportions of pollution-tolerant to pollution-sensitive macroinvertebrates (the young stages of insects primarily but also snails, worms, shrimps etc.) resident at a river site.

** "Condition" refers to the likelihood of interference with beneficial or potential beneficial uses.

In accordance with the Surface Water Regulations, water classified as having 'High' or 'Good' status must not be allowed to deteriorate. Water classified as less than good must be restored. The Surface Water Regulations also state that, for the purpose of classification, a status of less than Good is assigned in the case of a waterbody where the environmental objectives are not met.

10.2.1.2 The Priority Substances Directive (2008/105/EC)

Directive 2008/105/EC[vii] of the European Parliament and Council of 16 December 2008 refers to the requirement to set environmental quality standards in the field of water policy, amended and subsequently repealed Council Directives 82/176/EEC, 83/513/EEC, 84/156/EEC, 84/491/EEC, 86/280/EEC and amended Directive 2000/60/EC of the European Parliament and Council. It is also known as the Priority Substances Directive (2008/105/EC) and was developed in response to the requirements of Article 16 of the WFD (2000/60/EC). The Priority Substances Directive requires the identification of priority substances to set Environmental Quality Standards (EQSs) for the concentrations of the priority substances in surface waterbodies and to review periodically the list of priority substances.

10.2.1.3 Relevant Guidance

The following guidelines were applied in the development of this chapter to identify relevant objectives relating to hydrology and surface water quality:

- Guidelines on the information to be contained in Environmental Impact Assessment Reports, Environmental Protection Agency (EPA), May 2022[11];

[10] Environmental Protection Agency, 2022. Available online here: Environmental Protection Agency (epa.ie) Accessed August 2022.
[11] Environmental Protection Agency, 2022. Available online here: Monitoring & Assessment: Assessment Publications | Environmental Protection Agency (epa.ie) Accessed August 2022.

- Draft Revised Wind Energy Development Guidelines- Department of the Environment, Heritage and Local Government, December 2019[12];
- Best Practice Guidelines for the Irish Wind Energy Industry - Irish Wind Energy Association, 2012[13];
- Good Practice Note on Strategic Environmental Assessment for the Energy Sector, Environmental Protection Agency (EPA), March 2021[14].

In addition to considering the documents above, the methodology for the impact assessment has been devised with due consideration of the following guidelines:

- The Planning System and Flood Risk Management - Guidelines for Planning Authorities - Department of Environment, Heritage and Local Government (DoEHLG) and the Office of Public Works (OPW), November 2009[15]
- Environmental good practice on site guide (fourth edition) (C741) - Construction Industry Research and Information Association (CIRIA), January 2015
- River Basin Management Plan 2018-2021 (Department of Housing, Planning and Local Government)[16]
- Best Practice Guide BPGCS005 Oil Storage Guidelines (Enterprise Ireland)
- Guidelines for the Crossing of Watercourses During the Construction of National Road Schemes (National Roads Authority, 2005)
- Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters (Inland Fisheries Ireland, 2016)[17]
- Good Practice During Wind Farm Construction (Scottish Natural Heritage 2019)[18]
- The SuDS Manual (C753) - Construction Industry Research and Information Association (CIRIA), 2015[19]
- Control of water pollution from linear construction projects (C648) – Construction Industry Research and Information Association (CIRIA), 2006;
- Control of water pollution from construction sites. Guidance for Consultants and Contractors (C532) - Construction Industry Research and Information Association (CIRIA), December 2001

[12] Department of Housing, Planning and Local Government, 2020. Draft Revised Wind Energy Development Guidelines. Available online here: gov.ie - Draft Revised Wind Energy Development Guidelines December 2019 (www.gov.ie). Accessed August 2022

[13]Irish Wind Energy Association, 2012. Best Practice Guidelines for the Irish Wind Energy Industry. Available online here: IWEA Best Practice Guidelines (gsi.ie) Accessed August 2022.

[14] Environmental Protection Agency, 2021. Good Practice Note on Strategic Environmental Assessment for the Energy Sector, Available online here: https://www.epa.ie/publications/monitoring--assessment/assessment/strategic-environmental-assessment/EPA_GoodPractice_SEA_EnergySector.pdf Accessed August 2022.

[15] Department of Environment, Heritage and Local Government , 2009. The Planning System and Flood Risk Management - Guidelines for Planning Authorities. gov.ie - The Planning System and Flood Risk Management - Guidelines for Planning Authorities - Technical Appendices (Nov 09) (www.gov.ie)

[16] Department of Housing, Planning and Local Government, 2018. River Basin Management Plan 2018-2021. Available online here: gov.ie - River Basin Management Plan 2018 - 2021 (www.gov.ie)

[17] Inland Fisheries Ireland, 2016. Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters Available online here: Guidelines Report 2016.pdf (fisheriesireland.ie)

[18] Scotland's Nature Heritage, 2019. Guidance - Good practice during Wind Farm construction. Available online here: Guidance - Good practice during Wind Farm construction | NatureScot

[19] CIRIA, 2015. The SuDs Manual. Available online here: SuDS Manual C753 Chapter List (ciria.org).

- UK Guidance for Pollution Prevention (GPP[20]):
    - GPP2: Above ground oil storage tanks (Natural Resources Wales (NRW), Northern Ireland Environment Agency (NIEA), the Scottish Environment Protection Agency (SEPA), Energy Institute, Oil Care Campaign, June 2021)[21]
    - GPP4: Treatment and disposal of wastewater where there is no connection to the public foul sewer (NRW, NIEA, SEPA, November 2017)
    - GPP5: Works and maintenance in or near water (NRW, NIEA, SEPA, January 2017)
    - GPP8: Safe storage and disposal of used oil (NRW, NIEA, SEPA, July 2017)
    - GPP21: Pollution Incident Response Plans (NRW, NIEA, SEPA, July 2017)
    - GPP22: Dealing with Spills (NRW, NIEA, SEPA, October 2018)
    - GPP26: Safe storage of Drums and intermediate Bulk Containers (IBCs), (NRW, NIEA, SEPA, February 2019)
- GE-INT-01003- Introduction to the NRA Design Manual for Roads and Bridges (Transport Infrastructure Ireland, December 2013)[22]
- Coillte (2013): Forest Operations & Water Protection Guidelines.

10.2.2 Desk Study

The desk study involved an examination of the hydrological aspects and water quality aspects using the following sources of information:

- Ordnance Survey Ireland mapping.
- Science and Stories about Integrated Catchment Management (https://www.catchments.ie/).
- OPW Indicative Flood Maps (https://www.floodinfo.ie/map/floodplans/).
- Geological Survey of Ireland (www.gsi.ie).
- Review of the WFD online mapping and data (available at http://www.wfdireland.ie/maps.html).
- Review of the EPA online mapping (https://gis.epa.ie/EPAMaps/).
- History of flooding and status of drainage in the vicinity of the proposed development (available at http://www.floodinfo.ie/map/floodmaps/).
- Environmental Protection Agency (http://www.epa.ie/hydronet).
- Met Eireann Meteorological Database (available at https://www.met.ie).

[20] NWR, et al. UK Guidance for Pollution Prevention (GPP) Available online here: UK Guidance for Pollution Prevention
[21] Natural Resources Wales (NRW) et al., June 2021. GPP2: Above ground oil storage tanks. Available online here: guidance-for-pollution-prevention-2-2022-update.pdf (netregs.org.uk)
[22] Transport Infrastructure Ireland , 2013. GE-INT-01003- Introduction to the NRA Design Manual for Roads and Bridges Available online here: IBD24/00 (tiipublications.ie)

10.2.3 Field Assessment

Site walkover surveys were carried out on 03 August 2022 and 11 August 2022. Key tasks undertaken included;

- Identification of existing hydrological features and recording of locations for same;
- Measurements of on-site hydrological features, such as channel width, bank height and depth of water;
- Review of existing surface drainage network on and off site; and
- A photographic record of the hydrological features observed.

The site walkover involved an initial review of available information gathered in the desk study followed by a site visit. The key observations of surface water features are presented in Appendix 10-1.

10.2.4 Evaluation Criteria

The sensitivity of receptors, the quality of impacts the magnitude of impacts, the probability and duration of the impacts are assessed for the proposed development to determine significance of the impacts.

Categories for assessing the sensitivity of receptors are outlined and defined in Table 10.2.

The EPA's guideline on information to be contained in an EIAR (2022) was used to define the evaluation criteria. Quality of effect of an impact is either 'Positive, 'Neutral' or 'Negative' and may have influence in the 'Momentary', 'Short', 'Medium' or 'Long-term'. Impacts may also be either 'Temporary' or 'Permanent'.

The probability of impact can be either 'Likely' or 'Unlikely'.

Thresholds for assessing the significance of an effect based on the sensitivity of the receptor and magnitude of impacts are outlined in Figure 10-1.

10.2.4.1 Sensitivity of Receptors

The sensitivity of a hydrological receptor is based on its vulnerability to be impacted/altered by the development, i.e.. the ability of the receptor to absorb development without perceptible change. Table 10.2 below outlines the criteria for determining receptor sensitivity.

Table 10-2: Criteria for Determining Receptor Sensitivity

Sensitivity	Criteria	Typical Examples	
		Surface Water	Hydro-ecological receptors
Very High	Receptor has a high quality and rarity on a national or regional scale and limited potential for substitution. Receptor is highly vulnerable to impacts that may arise from the project and recoverability is long-term or not possible.		

Sensitivity	Criteria	Typical Examples	
		Surface Water	Hydro-ecological receptors
High	Receptor has a high quality and rarity on a local scale and limited potential for substitution. Receptor is generally vulnerable to impacts that may arise from the project and recoverability is slow and/or costly.	Protected under EU or Irish habitat legislation (e.g., Special Area of Conservation (SAC) or Natural Heritage Area (NHA)). Designated Salmonid / Cyprinid Waters and/or fishery present. Surface water providing a regionally important resource or supporting a site protected under EU and Irish habitat legislation (e.g. water dependent ecological receptors).	Nationally and internationally designated sites where hydrology/hydrogeology is a key factor in designation (e.g. SAC / NHA/ Special Protection Areas (SPA) sites).
Medium	Receptor has a medium quality and rarity, local scale and limited potential for substitution/replacement or receptor with a low quality and rarity, regional or national scale and limited potential for substitution. Receptor is somewhat vulnerable to impacts that may arise from the project and/or has moderate to high recoverability.	Watercourse with designated features. Large lakes and non-potable reservoirs.	Statutory designated sites where hydrology/hydrogeology is a key factor in designation (e.g.
Low	Receptor with a low quality and rarity, local scale and limited potential for substitution. Receptor is not generally vulnerable to impacts that may arise from the project and/or has high recoverability.	Watercourse with no designated features. Non-sensitive water resources (non WFD classified e.g. small lakes, ponds). Man-made feature not in hydraulic continuity (e.g. canal).	Non-statutory designated sites where hydrology / hydrogeology is a key factor in designation
Negligible	Attribute has a very low environmental importance and/or rarity on local scale. Receptor is of negligible value, not vulnerable to impacts that may arise from the project and/or has high recoverability.	Man-made feature with no ecological importance (e.g. land drains).	
Note	Professional judgement based on the baseline condition of the receptor should be used to determine a receptor's sensitivity.		

The surface hydrological environment of the site and its slopes downstream are considered to be of **medium sensitivity.** The streams draining from the wind farm site area to the south drain to the Bridgetown River which in turn drains into the Lower Shannon River which is part of the Lower River Shannon Special Area of Conservation (SAC). The stream draining to the north from the wind farm site area contributes to flow within the Doon Lough Natural Heritage Area (NHA). Both the Lower River Shannon SAC and Doon Lough NHA are rated as **high sensitivity** due to their hydro-ecological designated status.

10.2.4.2 Assessment of Significance of Hydrological Impact

The assessment of the magnitude of an impact incorporates the timing, scale, size, duration and probability of the impact in accordance with the EPA Guidelines. The significance criteria for hydrological impacts are defined in Table 10.3:

Table 10-3: Assessment of Magnitude of Hydrological Impact[23]

Impact Significance	Criteria
Imperceptible	An impact capable of measurement but without noticeable consequences
Not significant	An impact which causes noticeable changes in the character of environment but without significant consequences
Slight impacts	An impact which causes noticeable changes in the character of the environment without affecting its sensitivities
Moderate impacts	An impact that alters the character of the environment in a manner that is consistent with existing and emerging trends
Significant impacts	An impact which, by its character, magnitude, duration or intensity significantly alters a sensitive aspect of the environment
Very Significant	An impact which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment
Profound impacts	An impact which obliterates sensitive characteristics

The scale of effect is determined in relation to the sensitivity of the receptor and the potential magnitude of change from baseline conditions, Figure 10-1, presents how comparison of the magnitude of the predicted impact to the sensitivity of the receiving environment can determine the significance of the impact. Sensitivity of the receiving environment can be 'high', 'medium', 'low' or 'negligible'. Description of impact is defined by its character, magnitude, duration, probability and consequences. The magnitude of impact can be 'high', 'medium', 'low' or 'negligible'.

The conventional source-pathway-target model is applied to assess potential impacts on downstream environmental receptors resulting from the development. The source being the activity that results in the potential impact or the potential source of pollution is described. The pathway being the route by which a potential source of impact can transfer or migrate to. The receptor being a part of the natural environment that could potentially be impacted.

[23] Guidelines on the information to be contained in environmental impact assessment report, Draft August 2017.

The pre-mitigation impact is the impact descriptors which describe the magnitude, likelihood, duration and direct or indirect nature of the potential impact before mitigation is put in place.

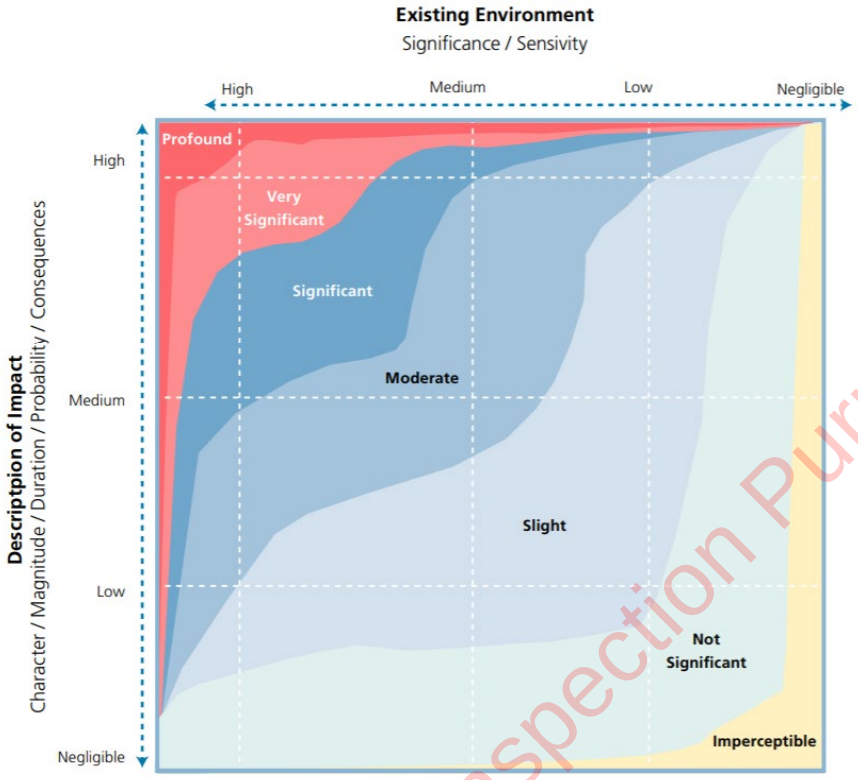


Figure 10-1: Classifications of the Significance of Impacts[24]

10.2.4.3 Assessment of Cumulative Impacts

The assessment of cumulative effects on the water environment considers the combined potential effects of other developments, with the potential to affect the water environment, within the same catchment(s) as the proposed development. This included consideration of other developments currently in the planning process and within the same catchment(s) as the proposed development, as discussed further in Section 10.4.6.

10.2.5 Consultation

Numerous statutory and non-statutory bodies have been consulted which is further discussed in Section 5.2.1 lists the relevant responses relating to surface water hydrology received from stakeholders including; Inland Fisheries Ireland; the Department of Tourism, Culture, Arts, Gaeltacht, Sports and Media; and Irish Water.

[24] Environmental Protection Agency - Guidelines on the information to be contained in environmental impact assessment report Draft August 2017

Table 10-4: Summary of relevant consultation scoping comments

Organisation	Form of Consultation	Relevant comments in Outcome
Inland Fisheries Ireland (IFI)	Letter sent to the Southwest RBD of IFI at Macroom office on 2nd of March 2021.	Letter response received 16/03/2021. - "Any instream works or other works which may impact directly on a watercourse should only be carried out during the open season for instream works; the 1st July to 30th of September in any year (so as to avoid impacting on the aquatic habitat during the spawning season.)"
		- "The area drained by the proposed windfarm flows into to the Bridgetown River, currently characterised as 'not at risk' and most recently (2017) achieving Q4 status. This must not be allowed to deteriorate as a result of the proposed development."
		- "Settlement ponds: It is particularly important during the construction phase that sufficient retention time in the settlement ponds is available to ensure no deleterious matter is discharged to drainage or surface waters. IFI recommend that settlement ponds are maintained, where appropriate, during the operational phase to allow for the adequate settlement of suspended solids and sediments and to prevent any deleterious matter from discharging."
		- "In constructing and designing silt traps particular attention should be paid to rainfall levels and intensity…Turbidity monitoring should take place at the trap inlets to allow the maximum time for control and mitigation measures to be put in place when silt-laden waters are entering the traps."
		- "The existing flow patterns must be investigated to ensure that normal flows are maintained both during and after construction."
Irish Water (IW)	Letter sent to Irish Water on 2nd of March 2021.	Letter response received on 13/04/2021. Non site-specific, generic recommendations made. - "IW currently does not have the capacity to advise on scoping of individual projects. "IW currently does not have the capacity to advise on scoping of individual projects."
		-"If a development will require a connection to either a public water supply or sewage collection system the developer is advised to submit a Pre Connection Enquiry (PCE) enquiry to IW"

Organisation	Form of Consultation	Relevant comments in Outcome
		-"Where the development proposal has the potential to impact an IW Drinking Water Source the applicant shall provide details of measures to be taken to ensure that there will be no negative impact to IWs Drinking Water Source."
		-"Any up-grading of water services infrastructure that would be required to accommodate the development" should be considered.
		-"In relation to the management of surface water; the potential impact of surface water discharges to combined sewer networks & potential measures to minimise/stop surface waters from combined sewers."
		-"Any physical impact on IW assets reservoir, drinking water source, treatment works, pipes, pumping stations, discharges outfalls etc. including any relocation of assets"
		-"Any physical impact on IW assets reservoir, drinking water source, treatment works, pipes, pumping stations, discharges outfalls etc. including any relocation of assets."
		-"Any potential impacts on the assimilative capacity of receiving waters in relation to IW discharge outfalls including changes in dispersion /circulation characterises."
		-"Any potential impact on the contributing catchment of water sources either in terms of water abstraction for the development (and resultant potential impact on the capacity of the source) or the potential of the development to influence/ present a risk to the quality of the water abstracted by IW for public supply."
		-"Where a development proposes to connect to an IW network and that network either abstracts water from or discharge waste water to a "protected"/sensitive area, consideration conservation objectives of the site would be compromised."

Organisation	Form of Consultation	Relevant comments in Outcome
Department of Tourism, Culture Arts, Gaeltacht, Sport and Media	Letter sent on 2nd of March 2021.	Letter response received on 19/04/2021 including comments; "The proposed windfarm has the potential for significant changes in patterns of surface water flow and may desiccate underlying soils allowing pathways to open up resulting in subsurface water losses. It should be noted that in 2020 a number of major upland peatland (blanket bog) landslides occurred across Ireland, most notably on Shass Mountain near Drumkeeran in County Leitrim2 and Meenbog, near Ballybofey in County Donegal."
		-"If a Peat Stability Risk Assessment is required it must be considered in light of these occurrences with consideration of climate change predictions (e.g. rainfall level) in the hazard rating and should thoroughly assess risk with regard to change in weather patterns due to climate change."
		-"Detailed consideration should be given to the amount of peat / soil to be excavated, stored, and disposed/recovered. A detailed plan for the safe storage, disposal and rehabilitation of excavated or disturbed peat /soil should form part of the EIAR."
		-"Excavated or exposed peat / soil should not pose any threat to surface waters and water quality."
		-"A detailed site drainage map will be required and should show all existing watercourses, drainage ditches, flushes, lakes or ponds; new drainage ditches; all outfall points to watercourses or lakes; and all settlement ponds. The EIAR must demonstrate that the proposed development will not pose any threat to surface waters and associated species. Any impact on water table levels or groundwater flows may impact on wetland sites some distance away."
		-"The likely impacts of grid connection, particularly for birds, sensitive habitats and surface waters, should be given due consideration at the EIA stage. It is noted that all of the proposed grid connection routes pass through Glenomra Wood SAC (SAC Code 001013)."
		-"The EIAR should cover the whole project, including construction, operation and, if applicable, restoration or decommissioning phases."

Organisation	Form of Consultation	Relevant comments in Outcome
		-"The River Shannon east of the proposed development from Killaloe Bridge to Parteen Weir is an important site for wintering wildfowl. IWebs data is available for this section."
		-"Water courses and wetlands: Wetlands are important areas for biodiversity and ground and surface water quality should be protected during construction and operation of the proposed development. The EIAR should include a detailed assessment of the hydrological impacts on wetlands from the proposed development. Any watercourse or wetland which may be impacted on should be surveyed for the presence of protected species and species listed on Annexes II and IV of the Habitats Directive."
		-Regarding potential otter habitat destruction, "A 10m riparian buffer on both banks of a waterway is considered to comprise part of the otter habitat. Therefore any proposed development should be located at least 10m away from a waterway and should consider movements between waterways and waterbodies by otters."
		-"Flood plains, if present, should be identified in the EIAR and left undeveloped to allow for the protection of these valuable habitats and provide areas for flood water retention (green infrastructure).
		-If applicable, the EIAR should take account of the guidelines for Planning Authorities entitled "The Planning System and Flood Risk Management" published by the Department of the Environment, Heritage and Local Government In November 2009.
		-"Construction work should not be allowed to impact on water quality and measures should be detailed in the EIAR to prevent sediment and/or fuel runoff from getting into watercourses which could adversely impact on aquatic species."
		-"A rule of thumb often used is to include all European sites within a distance of 15km. It should be noted however that this will not always be appropriate. In some instances where there are hydrological connections a whole river catchment or a groundwater aquifer may need to be included. Similarly where bird flight paths are involved the impact may be on an SPA more than 15 kilometres away."

10.3 Existing Environment

10.3.1 General Description of the Catchments

This section addresses catchment characteristics of the Site and the GCR. The receiving environment of the TDR and the Biodiversity Enhancement and Management Plan (BEMP) is addressed in Appendix 3.4 of the EIAR.

Within the region, the surface water drainage and hydrology are delineated into three levels of hierarchy under the WFD: catchment, sub-catchment and sub-basin. Table 10-5 summarises the delineated water drainage and hydrology within the wind farm site and GCR.

Table 10-5: WFD delineated waterbodies within the wind farm site ad GCR

Catchment	Sub-catchment	Sub-Basin
Lower Shannon catchment (ID 25D).	Shannon (Lower)_SC_080	Bridgetown (Clare_010).
		Glenomra Wood Stream (010).
		Blackwater (Clare_020).
		Blackwater (Clare_010).
		North Ballycannan (010).
Shannon Estuary North catchment (ID 27).	Owenogarney_SC_010	Broadford_010.

The wind farm site is located within two catchments of the Irish River Network System. These are the Lower Shannon catchment (ID 25D) and Shannon Estuary North catchment (ID 27).

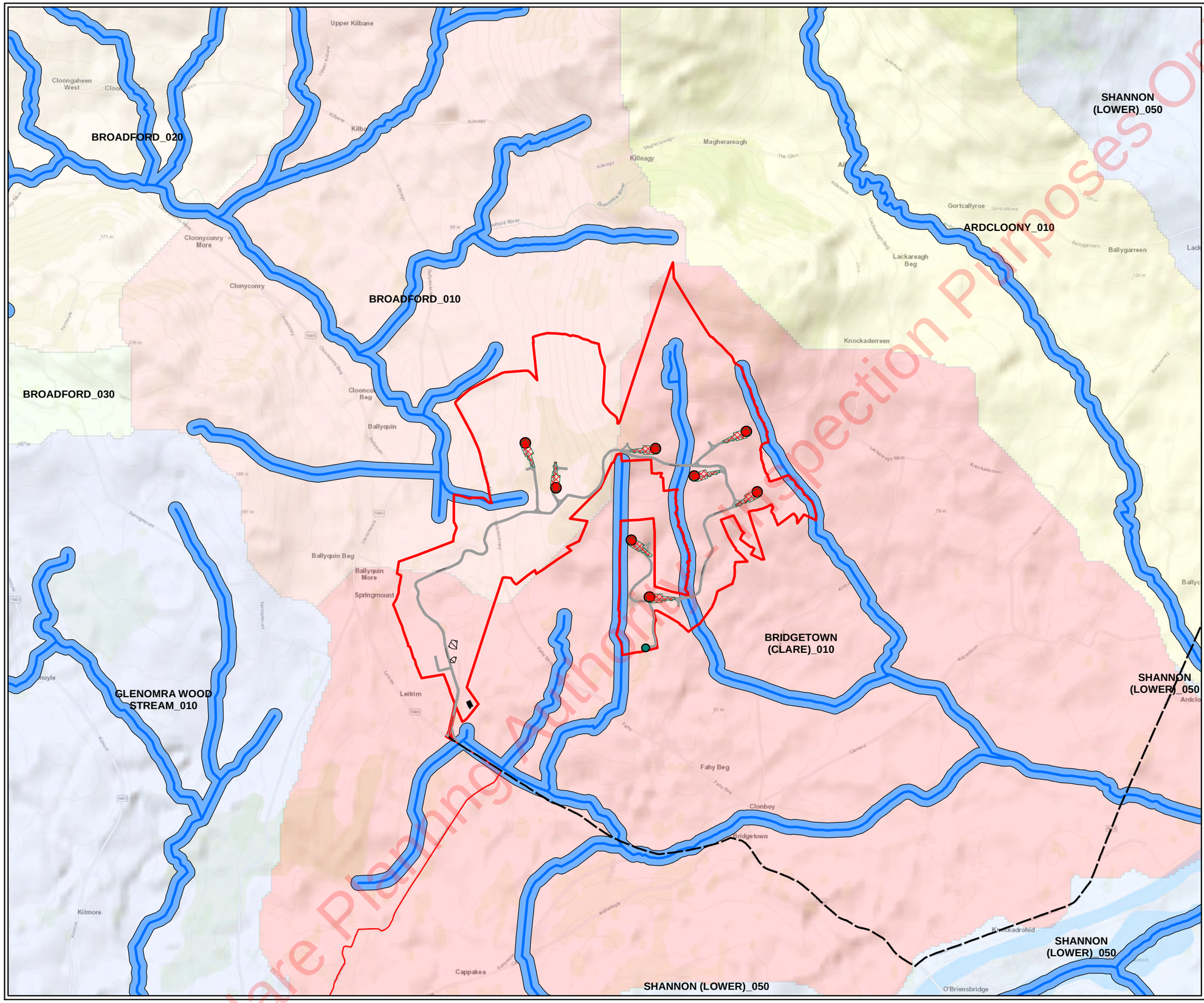
The wind farm site is situated within two sub-catchments delineated under the WFD. These sub-catchments are known as:

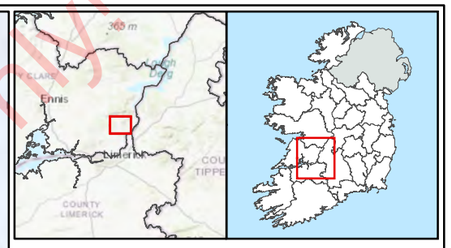
- Shannon (Lower)_SC_080.
- Owenogarney_SC_010.

The wind farm site is situated within two sub-basins, as shown on Figure 10-2, which constitute waterbodies (classified with status outcomes under the WFD) known as:

- Bridgetown (Clare)_010.
- Broadford_010.

Path: N:\ST\ST19447 - County Clare Windfarm\03 - Design\ArcGIS\P20-003_GIS_Fig1_Surface Water Sub-catchments_A3_Rev1.mxd





Legend

- P20-003_StudyArea
- P20003_turbineshardstandings
- 20220816_Fahybeg_PMM_Position
- P20003_turbines
- P20003_substation
- P20003_passingbays
- P20003_TDR
- P20003_roadsandturningbays
- P20003_GCR_fahybeg
- P20003_compounds
- WFD_RiverWaterbodiesActive_Cycle3_clipped
- Surfacewater_50m buffer
- ARDCLOONY_010
- BRIDGETOWN (CLARE)_010
- BROADFORD_010
- BROADFORD_020
- BROADFORD_030
- GLENOMRA WOOD STREAM_010
- SHANNON (LOWER)_050

TITLE: Surface Water Sub-catchments			
PROJECT: Fahy Beg Wind Farm, Co. Clare			
FIGURE NO:	10-2		
CLIENT:	RWE Renewables Ireland Ltd.		
SCALE:	1:25000	**REVISION:**	1
DATE:	30/11/2022	**PAGE SIZE:**	A3

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The majority of the site (1.94 km^2 out of 3.28 km^2) is within the Lower Shannon catchment, which has an overall area of 1,041 km^2. The site occupies less than 0.2% of the area of the Lower Shannon waterbody and approximately 9% of the Bridgetown sub-catchment, which has a total area of 21.65 km^2.

The Broadford (010) sub-basin has a total area of 14.03 km^2 and is located within the Owengarney sub-catchment within Shannon Estuary North catchment, The Shannon Estuary North has an overall area of 1651 km^2. Approximately 1.34 km^2 of 3.28 km^2 of the site area is located within the Broadford sub-catchment, accounting for approximately 10% of its area and less than 0.1% of the overall Shannon Estuary North catchment .

Turbines T1 and T2 will be located within the Broadford_010 sub-basin. Turbines T3, T4, T5, T6, T7 and T8 will be located within the Bridgetown (Clare)_010 sub-basin.

The GCR between the proposed on-site substation and existing substation at Ardnacrusha is within five waterbodies (river sub-basins) as defined by the WFD. The sub-basins are all within the Shannon (Lower)_SC_080 sub-catchment of the Lower Shannon catchment (ID 25D). These are;

- Bridgetown (Clare_010).
- Glenomra Wood Stream (010).
- Blackwater (Clare_020).
- Blackwater (Clare_010).
- North Ballycannan (010).

The elevation range of the overall wind farm site varies between approximately 345 meters above ordnance datum (mOD) and 50 mOD, and it has a mountainous topography. Turbines will be installed at an elevation range between approximately 230 mOD and 120 mOD. T5 and T7 will be at the highest elevations and T1 at the lowest elevations.

Within the Bridgetown sub-basin, two tributaries drain from within the wind farm site to the south-east. These streams are the Black (O'Briensbridge) stream and the Fahy (Clare) stream. Two other streams, the Kilroughil and an unnamed stream flow in close proximity, downgradient of the wind farm site. These all drain into the Bridgetown River (Clare). The Bridgetown River in turn drains into the Lower River Shannon (sub catchment Shannon Lower_050), downstream of Lough Derg, north of O'Briensbridge within the Broadford sub-basin, the Broadford stream which passes through the wind farm site is located to the west of the site, draining towards the north-west generally.

To summarize, the following are all receiving receptors of the wind farm site, TDR and GCR:

- Within the Lower Shannon catchment:
    - Kilroughil stream, flowing south-easternly, along the northern site boundary, c. 120 m east of T7.
    - Black stream, flowing southernly through the site between T5 and T6.
    - Fahy stream, flowing southernly, c.75 m west of T3.
    - Unnamed stream, flowing southernly, c.590 m west of T4.
    - The downstream receiving river, the Bridgetown River.

- The downstream receiving river, the Lower Shannon, within the Lower River Shannon SAC – Site Code: 002165).

- Within the Shannon Estuary North catchment:
  - Broadford stream, originating c.210 m west of T2.
  - Downstream receiving river, hydrologically connected to the Doon Lough Natural Heritage Area.

10.3.2 Rainfall

The average annual rainfall in period 1981-2010, recorded at Shannon Airport is 978 mm. This long-term meteorological station is c.17 km south-south-east of the wind farm site. The long-term average rainfall at the wind farm site may be higher than this due to relief rainfall as it is located at a higher elevation than Shannon Airport.

The M5-60 predicted rainfall value (a sixty minute storm that will occur with a frequency of once every five years) at the development location is 15.8 mm according to the Met Éireann rainfall data.

10.3.3 Site Hydrology

There are no naturally occurring lakes or reservoirs within the wind farm site. There is a man-made surface water body in the eastern part of the site, located c.350 m along the access track from the entrance that is understood to be the lagoon from quarry workings.

All wind turbines have been located at least 75m from any surface water receptor. Fahy stream, located c.75 m west of T3, is the closest to a turbine. On Figure 10-2, a 50 m buffer of all surface water receptors is presented to illustrate this.

10.3.4 Historical Flooding

Online OPW mapping does not show any recorded historical flooding events within the site or along the proposed cable route, with the closest being an area with recurring flooding to the south of R466 adjacent to the Bridgetown stream. As this is at a significantly lower elevation than the site area, it is not considered that the site area was affected by this flooding event.

The area of recurring flooding would, however, be adjacent to the final section of the turbine delivery route. This may cause disruption when turbines are being delivered during the construction phase and this should be managed accordingly. There are no other recorded historical flood events along other sections of the route.

'Benefiting lands' are defined as a dataset prepared by the Office for Public Works (OPW) identifying land that might benefit from the implementation of Arterial Drainage Schemes (under the Arterial Drainage act 1945) and areas of land subject to flooding or poor drainage. There are no areas defined as 'benefiting lands' within the wind farm site, GCR or turbine delivery route.

10.3.5 Surface Water Quality

WFD water quality status and river waterbody risk associated with the wind farm site and GCR are provided in Table 10.6.

Within the Lower Shannon catchment, the Bridgetown River is reported as having Good biological water quality status in 2010-2015. This was an improvement from Moderate biological water quality status reported for the period 2007-09 and 2010-12. The river downstream of Shannon Lower_050 sub-catchment, downstream of Lough Derg is reported as having Moderate biological water quality for the period 2010-2015, which it has maintained since 2007. It is observed that the Bridgetown River is reported as Not at Risk[25] and not under significant pressure. The river downstream Shannon Lower_050 sub-catchment, downstream of Lough Derg is, however, reported as At Risk and under 'significant pressure'[17].

Within the Shannon Estuary North catchment, the Broadford stream is reported as having Poor biological water quality status in 2010-2015. This was a deterioration from Moderate reported for the period 2007-09 and 2010-12.

For water bodies along the GCR, the waterbody ecological status is Good for all except the North Ballycannan, which has moderate status. Regardng WFD risk assigned, the Bridgetown (Clare_010) and Glenomra Wood Stream (010) are reported as "Not at Risk" and the Blackwater (Clare_010) and North Ballycannan (010) are reported as 'At Risk"[26]. The Blackwater (Clare_020) is under review due to a decline in ecological status from High to Good in 2015.

Table 10-6: WFD River Status and River Waterbody Risk

Watercourses (as shown on Figure 10-2)	Waterbody	River Status	Waterbody Risk
Wind Farm			
Kilroughil stream	Bridgetown(Clare)_010	Good	Not at Risk
Black stream	Bridgetown(Clare)_010	Good	Not at Risk
Fahy stream	Bridgetown(Clare)_010	Good	Not at Risk
Unnamed stream, flowing southernly, c.590 m west of T4	Bridgetown(Clare)_010	Good	Not at Risk
Bridgetown River (downstream receiving)	Bridgetown(Clare)_010	Good	Not at Risk
Lower Shannon	Shannon (Lower)_050	Moderate	At Risk
Broadford stream	Broadford_010	Poor	At Risk
Grid Connection Route (GCR)			
Unnamed Stream	Bridgetown (Clare_010)	Good	Not at Risk

[25] Environment Protection Agency, 2019. Water Framework Directive Cycle 2, Catchment Lower Shannon, Sub-catchment Shannon (Lower)_SC_080, Code 25D_6. Available online here: Subcatchment Assessment (catchments.ie)
[26] Environment Protection Agency, 2019. Water Framework Directive Cycle 2, Catchment Lower Shannon, Subcatchment Shannon[Lower]_SC_100, Code 25D_3. Available online here: Data - Catchments.ie - Catchments.ie

Watercourses (as shown on Figure 10-2)	Waterbody	River Status	Waterbody Risk
Unnamed Stream	Glenomra Wood Stream (010)	High	Not at Risk
Unnamed Stream	Blackwater (Clare_020)	Good	Under Review
Unnamed Stream	Blackwater (Clare_010)	Good	At Risk
Unnamed Stream	North Ballycannan (010).	Moderate	At Risk

Regarding surface water features local to the wind farm site, the River Black, draining southwards from the site, was given a Biological Quality Rating of Q4 in 2017, Good status and Not at Risk. The Kilroughil Stream, also draining south and surrounded dominantly by agricultural land, has Good status for the period of 2013-18 and Not at Risk.

The Broadford River drains generally westerly and northwards from the site. Regarding water quality, the EPA state, "*In the Broadford River, Station 0500 improved from poor to moderate ecological condition. Station 0600 continued to be of good ecological quality. Station 0700 was assessed for the first time since 1991 and was found to be in good ecological condition, this is a deterioration from high ecological condition at the last assessment. The lowermost station 0800 has declined from high to moderate ecological condition since the previous assessment*."

Despite the current quality, surface waters will be treated the same in terms of the level of protection and mitigation measures employed (there will be no negative change in status). Strict mitigation measures in relation to maintaining a high quality of surface water runoff from the development will ensure that the status of surface waterbodies in the vicinity of the site will be maintained, regardless of their existing status.

The EPA scheme of Biotic Indices or Quality (Q) Values was developed to determine the status of organic pollution in Irish rivers by assessing the occurrence of macro-invertebrate taxa with varying sensitivity to pollution. Biological Water Quality data was examined as part of this assessment.

As presented in Table 10.7, biological water quality ratings Q5, Q5-4 and Q4 relate to 'Unpolluted' status, Q3-4 relates to 'Slightly polluted', Q3 and Q2-3 relate to 'Moderately polluted' and Q2, Q1-2, Q1 relate to 'Seriously polluted' watercourse.

The most recent Biological Water Quality Ratings at stations downstream of the wind farm site and GCR are outlined in Table 10.7. For the Broadford sub-basin, Q ratings range between Q2 (2005, Scott's Bridge) to Q5 from 1988 to 2019 measurements. The most recent (2019) Biological Water Quality Ratings for the Broadford has been Q3-4.

Table 10-7: EPA Biological Water Quality Ratings

Sub-Basin	Station ID	Station Name	1988	1991	1996	1998	2001	2005	2007	2011	2013	2016	2019
Broadford	RS27B020500	Scott's Bridge	4	5	2-3	3	1-2	2	3-4	3	2-3	3	3-4
Broadford	RS27B020600	Near Graffa Bridge	4-5	4	4	4	3-4	4-5	4-5	4	4-5	4	4
Broadford	RS27B020700	BROADFORD -Bridge in Broadford	4-5	5									4
Broadford	RS27B020800	Bridge u/s Doon Lough	5	4	4	4	4	4-5	4-5	4-5	4-5	4-5	3-4
Sub-Basin	**Station ID**	**Station Name**	**2009**	**2012**	**2014**	**2017**	**2021**						
Bridgetown (Clare)	RS25B230100	Fahy Bridge	3-4	3-4	4	4	4						

10.3.6 Protected Ecological Environment

None of the wind farm site or the GCR is within a designated protected ecological environment. However, within the vicinity of the wind farm site, there are multiple protected ecological environments including:

- The Lower Shannon SAC is c. 3.9km downstream within the Lower River Shannon catchment. This is hydraulically connected to the windfarm site as the tributaries within and adjacent to the site drain from the Lackareagh Mountainside into the river of the SAC. This is protected as it is a site of high ecological interest because it contains a high number of habitats and species listed on Annexes I and II of the E.U. Regarding protected aquatic species present in this surface water body, the ecological survey (Ecopost, 2022) reports "in the River Fergus include Atlantic Salmon (*Salmo salar*) and Otter (*Lutra lutra*), Sea Lamprey (*Petromyzon marinus*), Brook Lamprey (*Lampetra planeri*) and River Lamprey (*Lampetra fluviatilis*). Other notable fish species designated in the SAC include Twaite Shad (*Allosa fallax fallax*)". The Bridgetown River in turn drains into the Lower River Shannon (sub catchment Shannon Lower_050), downstream of Lough Derg, north of O'Briensbridge. This is designated as a Special Area of Conservation (Lower River Shannon SAC – Site Code: 002165).
- The Doon Lough Natural Heritage Area, c. 6 km downstream within the Shannon Estuary North is designated as it is a raised bog, a rare habitat in the E.U. The raised bog at Doon Lough includes both areas of high bog and cutover bog, woodlands, lakes, marsh, fen and wet meadows. Within the Broadford sub-basin, the Broadford stream which passes through the wind farm site is located to the west of the site and is hydrologically connected to the Doon Lough Natural Heritage Area.
- Slieve Bernagh Bog, c.1.5km north from the wind farm site at its closest point, is a designated SAC as it comprises a range of peatland types, including active blanket bog, a habitat listed with priority status under the E.U. Habitats Directive. This is not hydrologically connected to the site as it us upstream in a different sub-basin.

- The Glenomra Wood SAC is a deciduous semi-natural woodland listed on Annex I of the E.U Habitats Directive., located c.600m from the GCR at its closest point. The main tree is Downy Birch (Betula pubescens), which is mixed with Sessile Oak (Quercus petraea), Ash (Fraxinus excelsior) and Beech (Fagus sylvatica). There are streams within the woodland and small area with raised bog vegetation. In the raised bog, mosses (Sphagnum spp.) and Heather (Calluna vulgaris) as well as other raised bog vegetation are found. This up hydraulic gradient of the GCR within the Glenomra Wood Stream (010) sub-basin.

Further information is provided on protected sites in the Biodiversity Chapter 8.

10.3.7 Land use

As stated in Chapter 3, the footprint of the proposed wind farm site supports extensive areas of conifer woodland (WD4) and improved agricultural grassland (GA1). Access to the site will be via an existing quarry site on the western side of the site. The quarry is currently not extracted from but there is planning permission granted for this quarry. The footprint of the quarry hosts scrub (WS1), young broadleaved woodland (WD1), other artificial lakes and ponds (FL8) and areas of recolonising bare ground and spoil and bare ground (ED2).

10.3.8 Internal Main Wind Farm Site Drainage

Due to the rural nature of the site, it is assumed that there is minimal formal drainage within the site area with runoff dispersing naturally via a combination of infiltration, evapotranspiration and overland flow. It is also considered that there is no formal drainage within the quarry site, with all surface water runoff also dispersing naturally.

10.3.9 Drains and existing road drainage

Surface water runoff from the existing access tracks within the site generally discharge to adjacent drainage channels. Flows then disperse naturally by infiltration and evapotranspiration within the channel, with excess flows directed to areas of open ground.

10.3.10 Drain Crossing Infrastructure

Where existing on-site access roads cross streams and drains, flows are generally conveyed within 450mm diameter culverts.

A total of 14 crossing points over streams, drains and watercourses were identified within the wind farm site area during field survey works. The location and general description of these crossings are included in the survey report contained in Appendix 10.1.

10.3.11 GCR

The proposed grid connection route will generally run within, or adjacent to, existing public highways which are considered to be served by formal drainage systems or shed surface water to adjacent verges.

Any agricultural land crossed by the cable trench will presently drain naturally via infiltration, evaporation and overland runoff.

The grid connection route crosses 8 watercourses, with four bridge crossings and four culvert crossings. Further detail is contained in the construction methodology report by TLI Group, included in Appendix 3.3.

10.3.12 Turbine Delivery Route

The turbine delivery route will utilise existing public highways which cross a number of watercourses. Further detail is included in section 3.3.6 of Chapter 3.

10.4 Potential Impacts

In this section scenarios of potential impacts of the proposed development detailed in Chapter 3, Section 3.3.1. are outlined.

10.4.1 Do Nothing Impact

If the proposed project does not proceed, the wind farm site will remain as the current land use for the foreseeable future. The hydrology of the site would remain as it is described in the baseline characterisation. Surface water drainage and infiltration to ground will continue as it is occurring currently with no impact on either surface or groundwater. Re-forestation may occur on the areas of deforestation. There is currently no information available on the timeline of decommissioning and restoration plan for the existing quarry area.

10.4.2 Potential Impacts During Construction

10.4.2.1 Unmitigated Increase in Surface Runoff

Activities which change the land use to less permeable surfaces all have the potential to contribute to the increase in runoff due to changes in the finished surfaces. Planned project components comprising, the construction of new access tracks, such as between quarry lands and the upgrade of existing tracks, turbine hardstanding areas, the on-site substation and associated compound will increase surface runoff if unmitigated.

Pathway / Mechanism: Site drainage network, tributaries on site, access tracks.

Receptor: Waterbodies within and down gradient from the wind farm site, Lower River Shannon SAC, Doon Lough NHA. All the relevant waterbodies are named in Section 10.3.

Pre-mitigation Impact: Direct, Negative, Reversible, Likely.

The significance of the effect of the increase in runoff at the wind farm site is **Moderate -Significant** on receiving waters because due to the relatively small infrastructure footprint, predicted increases in the peak runoff is relatively low compared to the flows of receiving waters. This is without taking account of mitigation measures that will be put in place to slow runoff down to mimic pre-development conditions within the proposed wind farm drainage system.

The increase in runoff due to GCR is not anticipated because the finished surfaces are not changed. The impact of the TDR is anticipated to be **Not Significant** to the hydrological environment as existing roads will be used and only temporary, minor vegetation trimming is anticipated to be required.

10.4.2.2 Suspended Solids

The activities associated with construction of the wind farm site will require earthworks. Potential sources of sediment laden water include:

- Standing water in excavations could contain an increased concentration of suspended solids as a result of the disturbance of the underlying soils.
- Haul roads passing close to watercourses could allow the migration of silt laden runoff into watercourses.
- Silt carried on the wheels of vehicles leaving the main wind farm site could be carried onto the public road and enter associated highways drainage.
- A blockage in the proposed roadside drains could allow a breakout of silt laden runoff to reach adjacent watercourses or streams.
- Overland flow entering excavations could increase the quantity of surface water to be treated for sediment removal.
- Inappropriate management of excavations could lead to loss of suspended solids to surface waters.
- Inappropriate storage and management of the excavated material could lead to loss of suspended solids to surface waters.
- Surface water inflows and minor groundwater seepages may occur in turbine base excavations. Surface water inflows can occur following a rainfall event. Pumped water from the pits will most likely contain suspended solids.

Pathway / Mechanism: Drainage and surface water discharge routes.

Receptor: Waterbodies within and down gradient from the wind farm site, Lower Shannon SAC, Doon Lough NHA.

Pre-mitigation Impact: Direct, Negative, Short Term, Likely.

These activities can result in the release of suspended solids to surface watercourses and could result in an increase in the suspended sediment load. This could result in increased turbidity that in turn could affect the water quality, aquatic ecology and fish stocks of downstream water bodies. Suspended solids, in small amounts, can have potentially serious effect on the spawning sites of salmonids. However, the aquatic survey undertaken by EcoFact (2022)[27] found that spawning habitat on the windfarm site is not common and does not occur on the Broadford River or the upper reaches of the River Black (O'Briensbridge) and River Bridgetown (Clare) at the sites which were dry.

The significance of the effect of the release of suspended solids into the receiving waters is "**Significant**" considering the sensitivity of the surface water body and the likelihood of occurrence.

[27] EcoFact Environmental Consultants, April 2022. Fahy Beg Wind Farm Aquatic Ecological Assessment (DRAFT V2.1)

10.4.2.3 Release of Cement-Based Products

Cement based product will be used in turbine foundation construction. Precast concrete structures (box culverts) will be used for nine new watercourse crossings.

- Cement-based products could lead to contamination of receiving waters in close proximately to the activity.

Pathway / Mechanism: Site drainage network, surface water bodies within the site/ downstream of the construction activity involving cement.

Receptor: Surface water bodies

Pre-mitigation Impact: Indirect, Negative, Brief, Unlikely.

Cement-based products are highly alkaline and corrosive, therefore leachate from these can have significant negative impacts on water quality. These generate very fine, highly alkaline silt (pH 11.5) and leachate that can physically damage fish by burning their skin and blocking their gills.

Entry of cement-based products into the site drainage system, into surface water runoff, and hence to surface watercourses or directly into watercourses represents a risk to the aquatic environment. Wet concrete and wash out of transport and placement machinery are the activities most likely to generate a risk of cement-based pollution.

The significance of the effect of the release of the cement-based products into the receiving waters is **Moderate** because following best practice pollution prevention measures, it is unlikely that a huge amount of cement-based products could be released into the environment.

10.4.2.4 Release of Hydrocarbons

Vehicles or generators could be a source of hydrocarbons during the following activities;

- Refuelling activities that could result in fuel spillages, which could pollute groundwater and surface water, especially during the construction of new culverts/bridges.
- There is the potential for fuel spill/leaks from storage tanks which will be stored in the wind farm site compound. Fuel spill/leaks could infiltrate underground and pollute underground water. Fuel spills/ leaks could pollute downstream watercourses.
- Two new watercourse crossings will be constructed adjacent to the existing fords. This will reduce the potential release of the oil and grease from vehicles entering the fords. This has a positive effect on water quality.
- Tree felling processes require trafficking of heavy machinery that can lead to pollution of watercourses due to spillage of fuels and hydrocarbons.

Pathway / Mechanism: Site drainage network and groundwater flow paths.

Receptor: Surface water and groundwater.

Pre-mitigation Impact: Direct, Negative, Temporary, Unlikely.

Hydrocarbons have a high toxicity to aquatic ecology, including fish, and is persistent in the environment. It is also a nutrient supply for adapted micro-organisms, which can rapidly deplete dissolved oxygen in waters, resulting in death of aquatic organisms.

The significance of the effect of the release of the hydrocarbons into the receiving waters is **Moderate** due to the low likelihood and low quantities involved.

10.4.2.5 Contamination from Wastewater

Biological contamination from sanitary waste by leaking welfare units could lead to contamination of receiving waters.

Pathway / Mechanism: Leakage from a storage tank or tanker, site drainage network

Receptor: Surface water bodies within and down gradient of the site, in the vicinity of the compound area and welfare units

Pre-mitigation Impact: Indirect, Negative, Temporary, Unlikely.

Release of effluent from domestic wastewater has the potential to impact surface water quality.

The significance of the effect of the release of sanitary waste into the receiving waters is **Not Significant** because it is highly unlikely that sanitary waste could be released into the environment due to proposed location and management of welfare facilities during the construction stage. Welfare facilities during the construction stage will be located at the temporary construction compound which is shown on Figure 3-2 In the unlikely event of an incident, it would likely be very localized in the vicinity of the source and only occur in low volumes.

10.4.2.6 GCR Cable Installation and Horizontal Directional Drilling (HDD)

The following potential impacts could result from the construction activities related to grid route installation and associated watercourse crossings:

- Suspended solids drained to watercourse could potentially lead to siltation and physical effect on flora and fauna.
- Excavated soil could be mobilised in the surface water runoff during an extreme rainfall event.
- The excavation of trenches for cable laying, and the launch and reception areas for directional drilling, could lead to silt-laden surface water run-off.
- Inadequate storage of fuels and oils could lead to contamination of surface water.
- Refuelling activities could result in fuel spillage.
- Works leading to erosion of the riverbanks/bed could negatively impact on the fisheries habitat.
- Drilling fluids (e.g. bentonite) associated with HDD works at the four locations could pollute watercourses either from poor management of bentonite or breakout into the channel during drilling.
- Sediment-laden runoff during the launch pit and reception pit excavation works.

The key potential impacts are related to suspended solids and spillage of hydrocarbons;

Suspended Solids

Grid connection and HDD activities can result in the release of suspended solids to surface watercourses and could result in an increase in the suspended sediment load, resulting in increased turbidity which in turn could affect the water quality, aquatic ecology and fish stocks of downstream water bodies.

Pathway / Mechanism: Surface water discharge routes or HDD breakout.

Receptor: Waterbodies down gradient from the grid connection and HDD.

Pre-mitigation Impact: Direct, Negative, Temporary, Low Probability.

The significance of the effect of the release of suspended solids into the receiving waters is **Slight** because the excavation area for the grid connection, open at any one moment, are short (c.50m). With increasing proximity to a surface water body, the significance increases. Therefore, the quantities that can get into the receiving water are small as well.

Hydrocarbons

Similar to construction on site at the wind farm during construction, hydrocarbon pollution from spills or leakage of fuel and oil from use of machinery has the potential to occur from sources such as from machinery leakage.

Pathway / Mechanism: Site drainage network and groundwater flow paths.

Receptor: Waterbodies downstream from the grid connection and waterbodies at Horizontal Directional Drilling locations.

Pre-mitigation Impact: Direct, Negative, Temporary, Low Probability.

The significance of the effect of the release of the hydrocarbons into the receiving waters is **Not Significant** due to the low likelihood and low quantities involved and there is no direct hydrological connectivity between the grid connection and Glenomra Wood SAC.

10.4.2.7 Potential Impacts Associated with Turbine Delivery Route Works

There is potential risk of the spillage of hydrocarbon pollutants, during the turbine delivery along the TDR (Figure 3-3). The TDR will follow existing roads and cross the Lower Shannon River SAC just south of Killaloe. the significance of the effect of the release of the hydrocarbons into the receiving waters is **Not significant** due to the low likelihood and low quantities involved. At the point of crossing the SAC this is increased in this small area to **Moderate** due to the high sensitivity of the receptor, however the area is small with short travel time over the SAC anticipated so likelihood of spillage here is low.

10.4.2.8 Potential Impacts During Tree Felling

As described in Chapter 3, permanent felling of approximately 14.2 ha of forestry is required within the main wind farm site to accommodate the construction of turbine hardstands, access tracks and biodiversity enhancements. Felling operations are anticipated to take 8 weeks.

The proposed tree felling around proposed 'infrastructure' will be limited to:

- Outer footprint of turbine hardstandings including an additional 10m offset from same;
- 20m wide corridors for new and upgraded access tracks;
- Felling Corridors around higher value woodland has been reduced to 10 m to protect as much woodland as possible.
- Up to 87m radius around each turbine tower located in forestry for bat impact mitigation;
- Felling of existing commercial coniferous forestry to make way for broadleaf woodland planting.

There is potential for release of suspended sediment and nutrients to surface water bodies, particularly if the felled trees remain in situ after felling.

Pathway / Mechanism: Site drainage network and surface water bodies.

Receptor: Surface water bodies.

Pre-mitigation Impact: Indirect, Negative, Short-Term, Likely.

The significance of the effect of the unmitigated release of the nutrients into the receiving waters is **Moderate** because of high likelihood and short-term period effect. Tree felling activities will potentially have a negative impact on water quality of the down gradient receiving watercourses, and further downstream to the east, the Doon Lough NHA and to the west, the Lower Shannon River SAC.

10.4.3 Potential Impacts During Operation and Maintenance

Site access by vehicle/foot are the main likely sources of potential impact during the operational phase by pollution from spills and leaks of fuel, oil and chemicals from vehicles and maintenance works. Additionally, transformer oil will be used in cooling the transformers associated with the facility which creates potential for oil spills during any oil replacement activity or leaks during the operational phase, although the likelihood of this is low. There is no significant risk of sediment release to cause increase suspended solids in surface waters during the operational phase as vegetation will not be disturbed during this phase. It is highly unlikely there will be replacement of any large wind turbine components during the operational phase therefore the TDR will not be affected during this time.

Pathway / Mechanism: Site drainage network and surface water bodies.

Receptor: Surface water bodies.

Pre-mitigation Impact: Indirect, Negative, Short-Term, Unlikely.

The significance of the effect of the release of the hydrocarbons into the receiving waters is **Not Significant** due to the low likelihood and low quantities involved.

10.4.4 Potential Impacts During Decommissioning

As described in Chapter 3, wind turbines will be deconstructed by unbolting the components by accessing using cranes.

The hardstandings and foundation pedestals of the turbines will be covered over (with soil that was stripped during construction) and allowed to re-vegetate. This is understood to be less disruptive to the environment than removing the hardstandings and foundations.

Infrastructure that will be left in-situ following decommissioning includes; internal site access tracks, GCR infrastructure, including the on-site substation and ancillary electrical equipment.

Potential hydrocarbon and sediment release.

Pathway / Mechanism: Site drainage network and surface water bodies.

Receptor: Surface water bodies.

Pre-mitigation Impact: Indirect, Negative, Short-Term, Unlikely.

As the hard standing infrastructure will remain in place the sediment disturbance is not significant during the disassembly. Potential impacts are similar to the construction phase but less significant as there is no invasive works breaking ground and it is mainly associated with the dis-assembly of the above ground components of the turbines. The potential receptors are the same as the construction phase. The significance of the effect of the release of the hydrocarbons into the receiving waters is **Slight** due to the low likelihood and low quantities involved.

10.4.5 Potential Impacts from Flooding

Flooding has the potential to impact a development and areas downstream of a development are also at risk of experiencing an increased probability and consequence of flooding as a result of the development. Potential impacts to the development from any existing flood risk from rivers, surface water runoff, groundwater and artificial sources include:

- Damage to the substation structure and its equipment, affecting the operation of the wind farm development;
- The safety of operatives on site; and
- Access tracks become impassable.

Potential impacts of flooding to downstream areas as a result of the development include:

- Increased rate and volume of surface water runoff as a result of increased impermeable area flowing off site;
- Loss of flood storage within a river catchment when new buildings, infrastructure and areas of raised ground are present within the flood plain;
- Diversion of natural river and overland flow flood flow routes, caused by new structures and modified ground levels, increasing flood risk to downstream areas previously unaffected; and
- Mobilisation of sediments and pollutants within surface water runoff from the development.

10.4.6 Potential Cumulative Impact

It is generally understood and accepted that developments within the same catchment and at the construction stage need to be taken into consideration when assessing the potential for cumulative effects.

According to Entec's 2008 report "*it is conceivable that two or more wind farms (or indeed other developments) in the catchment of a water receptor could result in combined runoff impacts to water quality, which then exceed Environmental Quality Standard thresholds. It is generally the case that in such circumstances any such effect is only likely to have the potential to be significant during the construction period. Once operational, any effects are likely to be restricted to high rainfall events when the level of dilution of impact is proportionately increased by higher flow levels that can be anticipated under these circumstances. Despite this theoretical potential impact, it is possible to control construction effects by good management techniques and therefore in practice significant effects, either individually or cumulatively, will rarely occur. Where such impacts occur other regulation provides additional controls. Due to the existing regulation over water environment there are absolute controls on the manner in which developments are constructed and operated in respect of the water environment which result in any potential effect being designed out. In this way it is unlikely that any cumulative effect would be significant.*"[28]

Therefore, only other developments that lie in the same catchment(s) as the Proposed Development that have the potential to have their construction stage overlap with the Proposed Development's construction stage are considered in this section.

Proposed developments that could potentially generate a cumulative impact with Fahy Beg Wind Farm include the development of Carrownagowan Wind Farm (Ref. ABP-303105-18) and associated GCR from Applicant - FuturEnergy Ireland Development DAC (FEID)) Ref. ABP – 314127. The Carrownagowan Wind Farm is significantly larger than Fahy Beg Wind Farm, consisting of 19 wind turbines. This development is proposed to be located near Slieve Bernagh, Co. Clare, "approximately 4km north-east of the village of Broadford, 7km north-west of Killaloe and 2.5km south of the village of Bodyke. The site, on the northern slopes of Slieve Bernagh (between 130 and 450m OD) is within Coillte forestry with additional private lands." This is within the Owenogarney subcatchment of the Shannon Estuary North catchment. Although this is within a different sub-catchment, this is part of the same catchment as part of the Fahy Beg Wind Farm site. The Killuran and Owenogarney rivers which drain the Carrownagowan Wind Farm also drain into Doon Lough (NHA), located 7.64km along the shortest connected watercourse from the Carrownagowan Wind Farm.[29]

The GCR for Carrownagowan will also connect to the Ardnacrusha power station.[30] The cable from the Carrownagowan Wind Farm follow a different route however there are portions of both GCR which overlap, such as along the R417 road. The GCR for Carrowngowan crosses watercourses in different sections than the Fahy Beg GCR. Any cumulative impact on water environment is likely to be during construction of the GCR and associated water crossings. The assumption is that best practices will be followed, and roads and verges will be re-laid to previous condition. Mitigation measures to reduce the cumulative impact of the Carrownagown and Fahy Beg GCR would be to lay the cable at the same time along overlapping sections. Additionally, projects could potentially collaborate to have greater portions of the GCR overlapping in order that associated potential impacts of GCR to the water environment are minimized.

[28] Entec UK Limited (2008) Review of Guidance on the Assessment of Cumulative Impacts of Onshore Windfarms: Phase 1 Report

[29] Malachy Walsh and Partners, Carrownagowan Wind Farm Main EIAR Volume 2, Chapter 8 Water. Available online here: https://carrownagowanplanning.ie/wp-content/uploads/2020/12/Chapter%208%20Water.pdf . Accessed October 2022.

[30] Malachy Walsh and Partners, Carrownagowan Wind Farm Main EIAR Volume 2, Chapter 2 Project Description. Available online here: https://carrownagowanplanning.ie/wp-content/uploads/2020/12/Chapter%202%20Project%20Description.pdf. Accessed October 2022.

The Carrownagowan Wind Farm and any other future developments within the same sub-catchments as the Proposed Development would have to comply with strict planning guidance and regulation in regard to the water environment. This means that the design of other major developments would most likely incorporate appropriate mitigation (such as pollution prevention measures) and discharges from these sites would be restricted to their greenfield runoff rates, as is the case for the Proposed Development. Additionally, any development requiring permitted activities, e.g., water discharges, would be subject to control and regulation by the relevant issuing authority.

The conclusion from the EIAR of Carrownagowan Wind Farm and GCR is that there will be no significant of cumulative effects of this development on the water environment. Overall, the combined cumulative effect of both projects is understood to be insignificant.

10.4.7 Summary of Unmitigated Hydrological Impacts on Sensitive Receptors

Considering the scale of change, relatively short timescales of construction and decommissioning activities, localized nature of change and footprint of the turbines and infrastructure on site, the unmitigated impacts on downstream sensitive receptors such as Lower Shannon River SAC and Doon Lough NHA, the unmitigated hydrological impacts range from **Not Significant** to **Significant.**

10.5 Flood Risk Identification and Assessment

As part of the flood risk identification the following elements of the project have been assessed:

10.5.1 Wind Farm Site

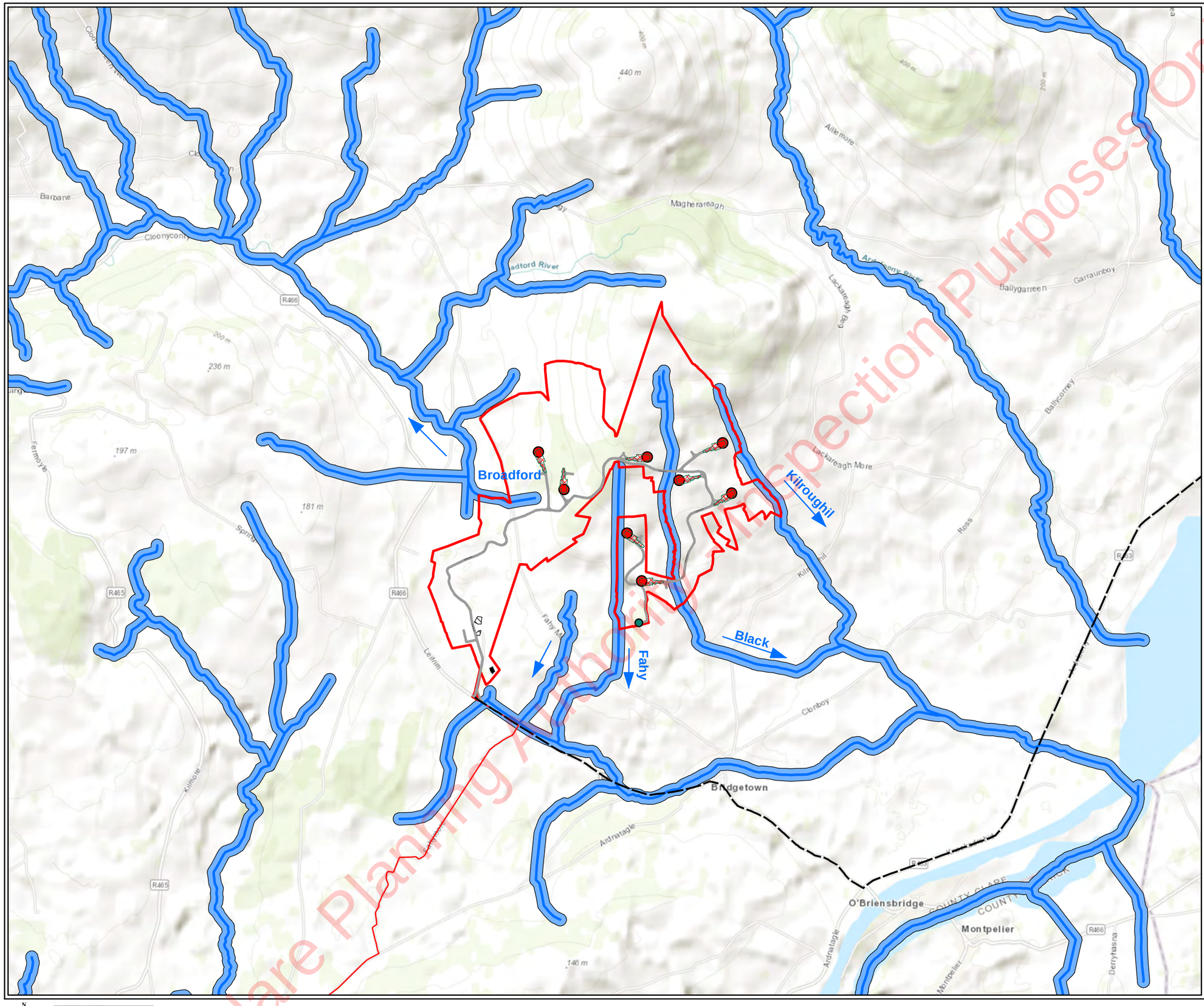
The wind farm site ('the site') area extends from the southern faces of Lackareagh Mountain in the north, to the settlement of Kilroughil to the east and the settlement of Fahy Beg in the south. The site boundary extends westwards across the Ballyquin Quarry to the settlement of Ballyquin More. The site will be accessed from the R466 in the south-western corner of the site.

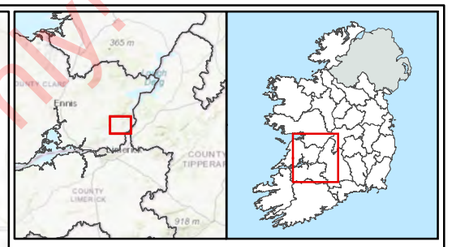
Ground levels within the site fall from a maximum of elevation of approximately 350m close to the peak of Lackareagh Mountain to a minimum elevation of approximately 63m the site entrance off the R466 in the south-western corner of the site. Ground levels fall most steeply along the south-western face of the Lackareagh Mountain in the north of the site, with the shallowest gradients around the quarry in the south-west of the site.

The site is located within two river catchments. The eastern and south-eastern areas of the site are located within the Lower Shannon catchment, and western and north-western areas are located within the Shannon Estuary North. These areas also form part of the Shannon (Lower) and Owengarney sub-catchments, respectively. Sections of four watercourses extend through the site, as shown on Figure 10.3 below:

- Black (O'Breinsbridge) stream extends through the centre of the site from its source on the Lackareagh Mountain to discharge to the River Shannon approximately 3.5km to the south-east of the site;
- Kilroughil stream extends along the eastern boundary from its source on the Lackareagh Mountain to join the Black (O'Breinsbridge) stream approximately 1km to the south-east of the site;
- Fahy (Clare) stream flows southwards from an area of woodland in the centre of the site, along the boundaries of the site to discharge to the Bridgetown (Clare) stream adjacent to the R466; and
- Broadford Stream extends westwards along the northern boundary of the quarry and discharges to the Owenogarney River approximately 9km to the north-west of the site

Path: N:\ST\ST19447 - County Clare Windfarm\03 - Design\ArcGIS\P20-003_GIS_Fig3_Surface Water in vicinity of Wind Farm Site_A3_Rev1.mxd





Legend

- P20-003_StudyArea
- P20003_turbineshardstandings
- P20003_turbines
- 20220816_Fahybeg_PMM_Position
- P20003_substation
- P20003_passingbays
- P20003_TDR
- P20003_roadsandturningbays
- P20003_GCR_fahybeg
- P20003_compounds
- WFD_RiverWaterbodiesActive_Cycle3_clipped
- Surfacewater_50m buffer

N W E S

0 200 400 800 Meters

TITLE: Surface Water in Vicinity of Wind Farm Site			
PROJECT: Fahy Beg Wind Farm, Co. Clare			
FIGURE NO:	10-3		
CLIENT:	RWE Renewables Ireland Ltd.		
SCALE:	1:30000	**REVISION:**	1
DATE:	30/11/2022	**PAGE SIZE:**	A3

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*Note on Figure 10-3: 50m buffer on surface water features to indicate proximity to planned and existing infrastructure/ access paths.

The proposed development will comprise eight wind turbines in northern and eastern areas, constructed on 25m diameter circular concrete foundations with adjacent areas of hardstanding to allow for the construction and assembly of the turbines. A substation area and construction compound will be located in the south-west of the site within the former quarry.

Internal access tracks will be used to provide access for vehicles during the construction, operation and decommissioning phases. Approximately 1.4km of existing internal agricultural and forestry access tracks within the site area will be retained and upgraded. Approximately 7.2km of new internal access tracks will also be constructed, which will generally be constructed from uncrushable stone with minimum fines. Access tracks will be 5m wide along straight sections, with wider sections on bends and turning areas. There will be approximately 2.75km of floating road construction in the north of the site where peat depth is highest, with these incorporating geogrid within the compacted stone at specified depths.

Temporary aluminium access trackway will be used to provide short term access to areas of the site not served by the proposed aggregate tracks during the construction and commissioning phase. These are primarily used for ground protection and to prevent the creation of excess mud from site vehicles.

10.5.2 GCR

The proposed GCR will have a total length of approximately 10.6km and will be constructed within the public road corridor. The route follows unnamed highways from the site entrance to the R471 close to the settlement of Coolderra. The cable route then follows the R471 and R465 through Ardnacrusha to the Ardnacrusha power station. The proposed cable route is shown on Drawing No. P20-003 GIS Fig3-4 *'GCR'.*

The cable route crosses the Glenomra Wood Stream along the route of the R471 and the Blackwater (Clare) stream along the route of the R465.

The cable will be installed in trenches within or adjacent to the public highways, with some sections crossing agricultural land. Trenches will be approximately 600mm wide and 1.2m deep and backfilled with concrete. The existing finished surface of the highway, verge and agricultural land will be reinstated as per its original condition.

Turbine Delivery Route

The turbine delivery route extends north-westwards along the R494 from junction 27 of the M7 to Killaloe, south-westwards along the R463 and then north-westwards on the R466. The route will follow existing roads with no requirement for any modifications. The turbine route is, therefore, not considered further in terms of flood risk.

The proposed turbine delivery route is shown on Drawing No. Drawing No. P20-003 GIS Fig3-3 *'Turbine Delivery Route'.*

10.5.3 Methodology

National Planning Policy

The Planning System and Flood Risk Management Guidelines for Planning Authorities (PSFRM Guidelines) was published in 2009 by the Office for Public Works (OPW). These outline the core objectives for the management of flood risk, including those for new planning applications. Flood risk is defined as a combination of two components:

- The likelihood/probability of flooding; and
- The consequences of flooding.

The PSFRM Guidelines divide geographical areas into three flood zones based on the probability of flooding:

- Zone A (High Risk): a probability of greater than 1 in 100 (1% Annual Exceedance Probability) for river flooding or 1 in 200 (0.5% AEP) for coastal flooding;
- Zone B (Moderate Risk): a probability of between 1 in 1000 and 1 in 100 (0.1% - 1.0% AEP) for river flooding and 1 in 1000 and 1 in 200 (0.1% - 0.5% AEP) for coastal flooding; and
- Zone C (Low Risk): a probability of less than 1 in 1000 (0.1% AEP) for both river and coastal flooding.

The PSFRM Guidelines are based on a 'sequential' approach to ensure that new development is directed towards land at a low risk of flooding. If a proposed development lies within a higher risk area, appropriate justification is required and measures for mitigating the flood risk are to be identified via the Justification Test.

The consequences of flooding depend on the hazards caused by flooding (e.g. depth of water, speed of flow, rate of onset and water quality) and the vulnerability of the receptor. Table 3.1 of the Guidelines, reproduced as Table 10.8 below, outlines the three vulnerability classifications and examples of the types of development included.

Table 10-8: Vulnerability Class and Development Types

Vulnerability Class	Example Land Use and Types of Development
Highly Vulnerable Development (including Essential Infrastructure)	• Garda, ambulance and fire stations and command centres required to be operational during flooding; • Hospitals; • Dwellings, student halls of residence, hostels, residential institutions (care homes, children's homes and social services homes), dwellings designed/constructed/adapted for the elderly or people with impaired mobility; • Caravans and mobile home parks; Essential infrastructure including primary transport and utilities distribution, electricity generating power stations and sub-stations, water and sewage treatment, and potential significant sources of pollution in the event of flooding.
Less Vulnerable Development	• Buildings used for retail, leisure, warehousing, commercial, industrial and non-residential institutions

Vulnerability Class	Example Land Use and Types of Development
	• Land and buildings used for holiday or short-let caravans and camping (subject to specific warning and evacuation plans) • Land and buildings used for agriculture and forestry • Waste treatment (except landfill and hazardous waste) • Mineral working and processing Local transport infrastructure
Water-Compatible Development	• Flood control infrastructure • Docks, marinas and wharves • Water-based recreation and tourism Amenity open space, outdoor sports and recreation and essential facilities

Table 3.2 of the Guidelines, reproduced in Table 10-9 below, states what types of development would be appropriate within each Flood Zone and those that would be required to meet the criteria of the Justification Test.

Table 10-9: Appropriate Development within Flood Zones

Vulnerability	Flood Zone A	Flood Zone B	Flood Zone C
Highly Vulnerable development (Including Essential Infrastructure)	Justification Test	Justification Test	Appropriate
Less Vulnerable Development	Justification Test	Appropriate	Appropriate
Water-Compatible Development	Appropriate	Appropriate	Appropriate

The OPW published the Flood Risk Management Climate Change Sectoral Adoption Plan for Flood Risk Management in 2015 (updated in 2019) and provides information on the potential changes in flood hazard as a result of climate change. The Plan outlines two potential future scenarios:

- Mid-Range Future Scenario (MRFS) -typical or near to the general average of future climate projections; and
- High-End Future Scenario (HEFS) - a more extreme future based on the upper end of the range of projections of future climatic conditions.

Table 5-1 of the Plan (reproduced as Table 10.10 below) shows the changes to flood-related parameters under both scenarios.

Table 10-10: Allowances Flood Parameters for Mid-Range and High-End Future Scenarios

Vulnerability	Mid-Range Future Scenario	High-End Future Scenario
Extreme Rainfall Depths	+20%	+30%
Peak Flood Flows	+20%	+30%

Vulnerability	Mid-Range Future Scenario	High-End Future Scenario
Mean Sea Level Rise	+500mm	+1000

A series of flood maps were produced in 2015 as part of the National Catchment based Flood Risk Assessment and Management (CFRAM) program. The mapping shows the extent of fluvial and coastal flooding in the present-day scenario, and the Mid-Range and High-End future scenarios.

A further series of flood maps were produced in 2019 as part of the National Indicative Fluvial Mapping (NIFM) project. The mapping extends to areas not covered by the 2015 CFRAM program and includes the present-day scenario, and the Mid-Range and High-End future scenarios.

10.5.4 Local Planning Policy

The County Clare Strategic Flood Risk Assessment (SFRA) (JBA Consulting Engineers and Scientists, 2017) provides a broad assessment of all types of flood risk to inform strategic land-use planning decisions within County Clare. The SFRA contains flood mapping, a Flood Risk Management Plan, and advice on zoning and land use proposals within settlements.

10.5.5 Flood Risk Identification – Risk to the Development

10.5.5.1 Wind Farm

Online Catchment Flood Risk Assessment and Management (CFRAM) fluvial flood mapping shows that the site is not located in an area with a High, Medium or Low probability of fluvial flooding in the present day scenario (see Figure 10.4). The closest area of Low risk (i.e. Zone C) being areas of low-lying ground adjacent to the River Shannon, over 3km to the east of the site. The extent of the fluvial flood risk in the Mid-Range and High-End future scenarios generally follows the present-day flood extents, and the site is not affected.

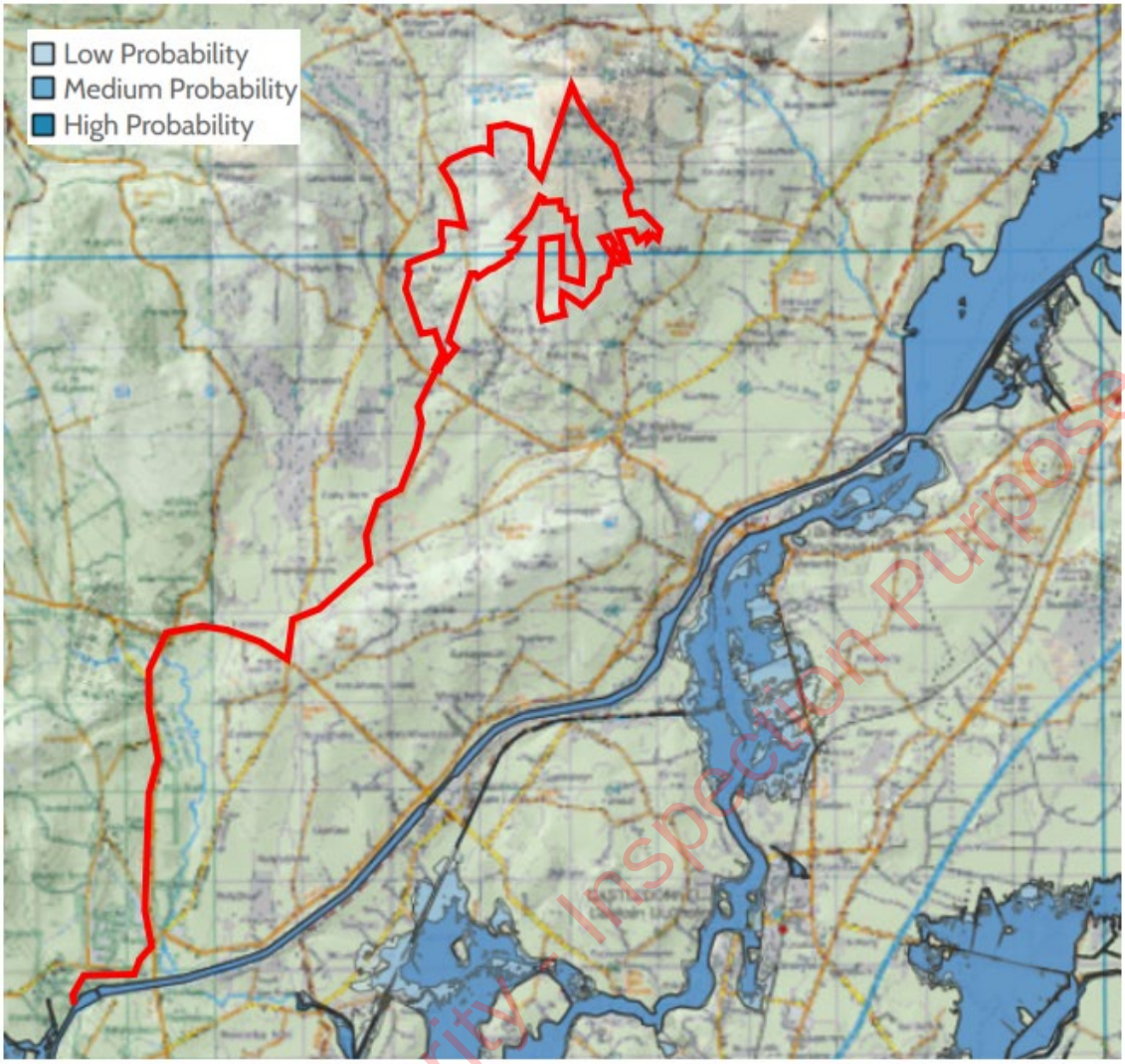

Figure 10-4: CFRAM River Flood Extents – Present Day[31]

The NIFM fluvial mapping also shows that the site is not at risk of fluvial flooding in the present day scenario (see Figure 10.5). The closest area of elevated risk is land located adjacent to the Bridgetown stream at the confluence with the Fahy stream, approximately 0.8km to the south-east of the site. This land is situated at a lower elevation than the site and this is not considered to pose a risk of flooding to the site. The extent of fluvial flooding in the NIFM future scenarios affect a similar area to the present-day flood extents.

[31] Source: Catchment Flood Risk Assessment and Management (CFRAM) fluvial flood mapping. Available online here: Flood Maps - Floodinfo.ie . Accessed September 2022.

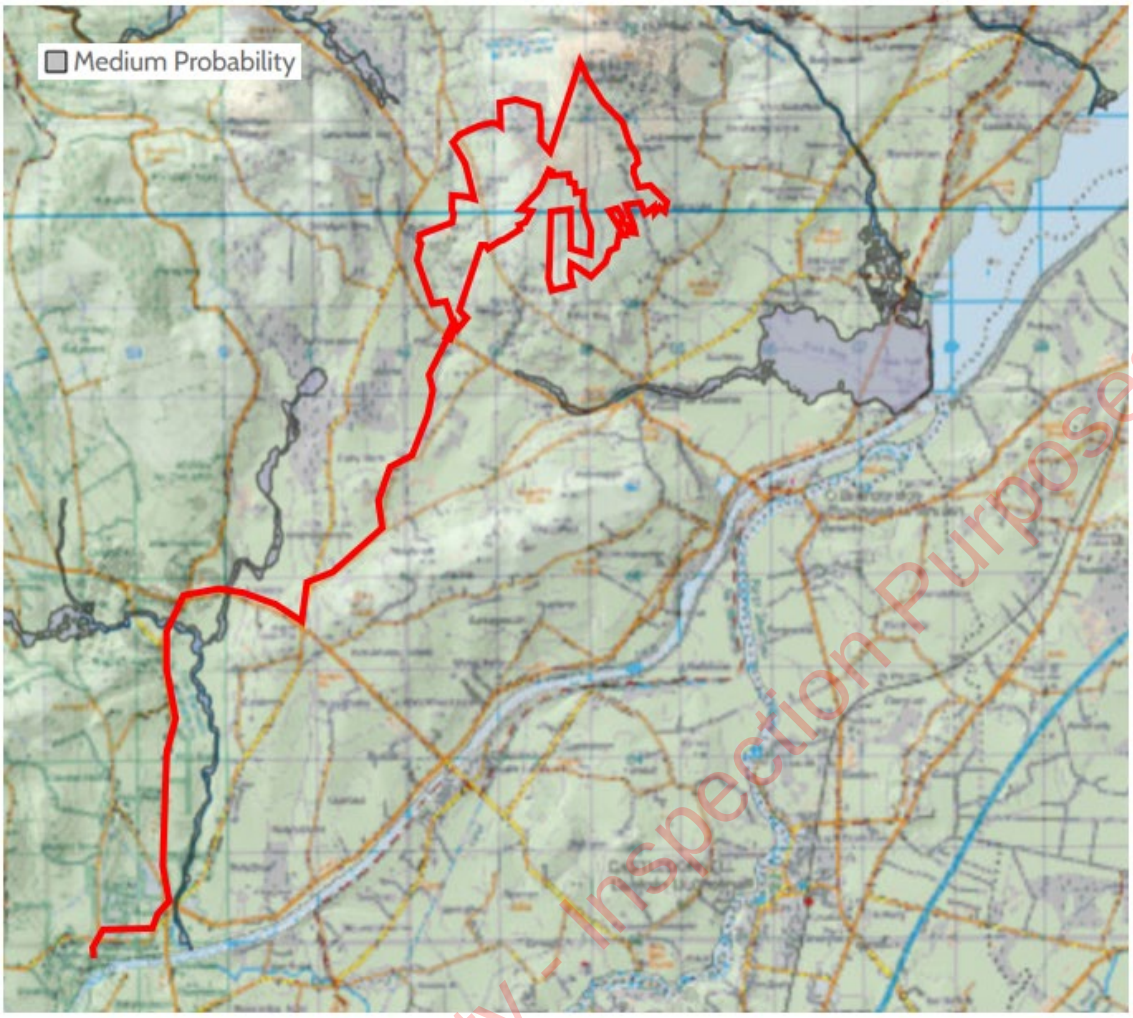

Figure 10-5: NIFM River Flood Extents – Present Day[32]

Whilst the NIFM project modelled smaller watercourses, which were not modelled as part of the CFRAM project, it is considered unlikely that the watercourses within the site were assessed. Due to the steep topography of the site, however, it is considered unlikely that there would be large areas of low-lying open ground where fluvial flooding could accumulate.

The Geological Survey Ireland (GSI) Groundwater Flooding Probability Maps show that the site and GCR are not located in an area with an increased level of groundwater flooding.

10.5.5.2 GCR

As shown in Figure BB and CC, the proposed GCR generally crosses land with no elevated risk of fluvial flooding. The route, however, extends through low-lying ground adjacent to the Glenomra Wood Stream and Blackwater stream. NIFM mapping shows that this area has a Medium probability of flooding (i.e. 1 in 1000 to 1 in 100 probability) which would be classified as Zone B. As the site is separated from the connection point by the Blackwater stream, there would be no viable route from the site to GCR without extending through areas of Zone B.

[32] Source: National Indicative Fluvial Mapping (NIFM) Flood River Extent mapping. Available online here: Flood Maps - Floodinfo.ie. Accessed September 2022.

Where the cable route is required to cross larger watercourses, this will be done using horizontal directional drilling (HDD) to extend the cable beneath the channel. There will, therefore, be no large open sections of trench during the construction phase which could be inundated during a fluvial flooding event. This risk will be further mitigated by only undertaking HDD during dry periods.

Where the cable route crosses smaller watercourses the cable will be installed within an excavated trench. This will be done during periods of dry weather with the watercourse dammed and water diverted over or around the works using a flume pipe or a temporary diversion channel. With the full implementation of the control measures set out in this section, the risk of flooding will be minimal.

10.5.6 Flood Risk Identification – Risk from the Development

10.5.6.1 Wind Farm Site

The site is not located within areas of Flood Zone A, B or C and it is considered that there will be no impact on flood plain storage or fluvial flood flow routes as a result of the proposed development.

The majority of site areas consist of agricultural land and woodland, with the only development being the series of access tracks extending through the site. The quarry area in the south-west of the site consists of areas of exposed mineral, access tracks and rough vegetation.

The proposed wind farm development will include eight wind turbines installed within areas of undeveloped agricultural land. The turbines will be constructed on concrete bases with adjacent areas of hardstanding. Approximately 7.2km of new internal access tracks, approximately 5m wide and be constructed from aggregate, will be constructed to provide access to the wind turbines. .

Approximately 1.4km of existing access roads will also be retained and widened by approximately 1m. The proposed substation and construction compounds will be situated within the quarry area and it is considered that the increase in impermeable area will be minimal in this location.

There will, therefore, be an increase in impermeable area as a result of the proposed development. The rate and volume of surface water runoff could, therefore, increase during storm events. However, when compared to the total area of the site it is considered that the increase in impermeable area and subsequent impact on surface water runoff will be minimal.

The proposed access tracks will cross watercourses in four locations, and existing drainage ditches would be realigned where access tracks are widened. Modification to existing drainage channels, and structures crossing the channels, could potentially impact on the existing drainage regime causing flooding if the capacity of channels is reduced or flows are impeded. Access tracks on sloped ground which are not constructed coincident with the topography also have the potential to block existing overland flow routes and divert surface water runoff to areas previously unaffected.

Climate change could also exacerbate the risk of flooding associated with the proposed development. Increases in rainfall intensity could increase the rate and volume of surface water runoff and flows within watercourses. As shown in Table DD, rainfall intensity could increase by between 20% and 30% in the mid-range and high-end future scenarios respectively.

Mitigation will, therefore, be required to ensure that the risk of fluvial flooding and surface water flooding to downstream areas is not increased as a result of the proposed development.

10.5.6.2 GCR

The majority of the cable route will be located away from areas of Flood Zone A, B and C and it is considered that there would be no impact on fluvial flooding in these locations as a result of the proposed development. Where the cable route crosses areas of Flood Zone B, it will be installed below ground level within a trench. Where the cable route crosses smaller watercourses, this will generally be done within an excavated trench. For larger watercourses, horizontal directional drilling (HDD) will be used to pass the cable beneath the channel.

With appropriate control measures in place during construction (as described in Section 10.7) there will, therefore, be no impact on flood plain storage or fluvial flood flow routes as a result of the proposed GCR.

Where the cable route crosses agricultural land the trench will be infilled and reinstated as per the existing condition. There will be no increase in impermeable area or changes in topography and it is considered that there will be no impact on surface water flooding as a result of the proposed GCR.

10.5.7 Summary of Flood Risk Identification and Assessment

It is considered that the wind farm site is at a very low risk of flooding from fluvial sources, surface water runoff or groundwater. Mitigation will be required to ensure that the proposed development does not increase the risk of flooding as a result of increased impermeable area, or impact on existing watercourses and overland flow routes resulting from the construction of access tracks

The risk of surface water and groundwater flooding is considered to be low during the installation of the underground GCR cable. Installation methods during the construction phase, utilising HDD or the damming and temporary diversion of watercourses, will mean that the underground cable route will also be at a very low risk of fluvial flooding during the construction phase. Trenches will be back-filled and restored to their existing pre-construction surface condition and ground level, meaning that there will be no impact on the rate of surface water runoff, flood plain storage or flood flow routes.

The risk of flooding from all sources is also considered to be very low along the turbine delivery route.

10.6 Proposed Drainage During the Construction and Operational Phases

10.6.1 Overview

The Surface Water Management Plan for the construction, operational and decommissioning stages of the proposed development is contained in Appendix 10.2. The proposed drainage regime at the site will mitigate for any increase in flood risk and potential impacts on water quality as a result of the proposed development.

Surface water drainage features will be installed as part of the construction phase and retained where required during the decommissioning phase, ensuring that there would be no increase in the risk of surface water flooding to off-site areas during any phase of the proposed development.

The drainage strategy within internal areas of the main wind farm will incorporate three main components of Sustainable Drainage Systems (SuDS):

- Interceptor drains;
- Swales; and
- Settlement Ponds

A conceptual plan of the proposed drainage regime is included as Figure 10-6 below.

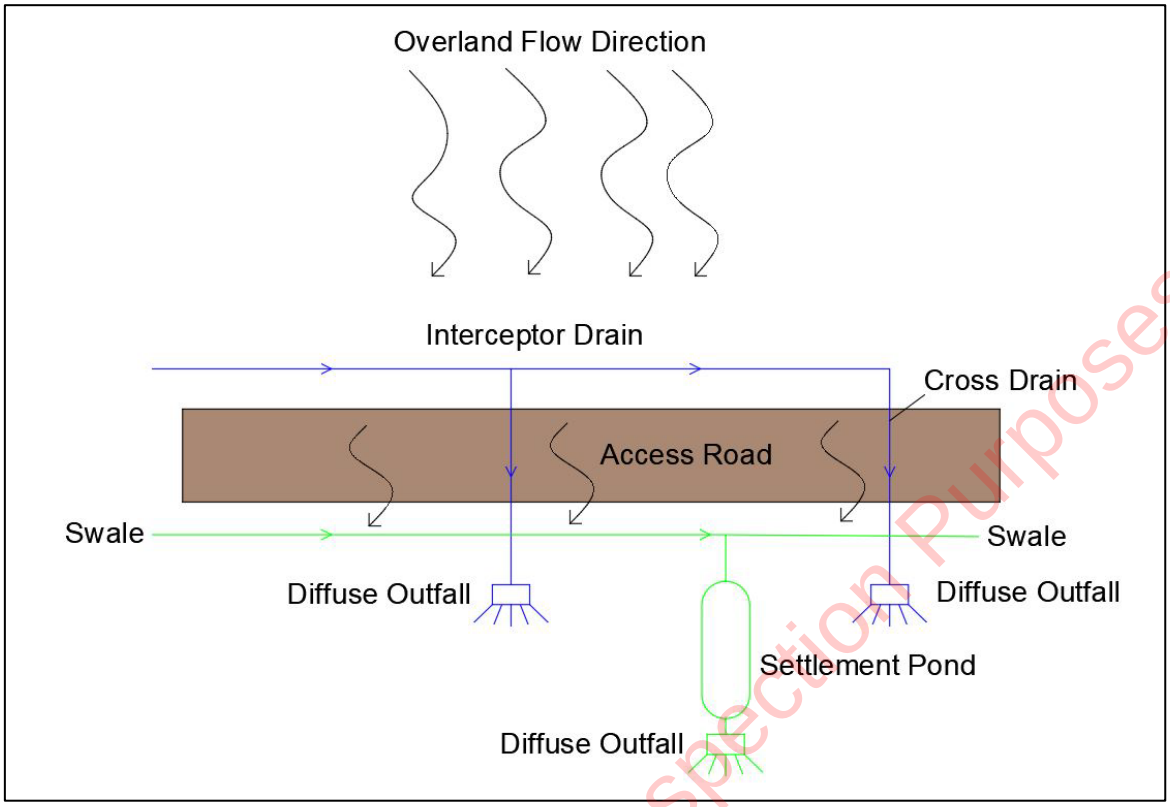

Figure 10-6: Drainage Design Principles

10.6.2 Existing Undeveloped Areas

Interceptor drains will be constructed upslope of areas of hardstanding and new sections of access tracks. These will intercept overland flows from areas of undeveloped land, preventing mixing with runoff from access tracks and hard surfaces. These channels will direct flows around areas of hardstanding and across access tracks via cross drains at regular intervals. Flows will then be discharged diffusely across vegetated areas to minimise erosion and encourage evapotranspiration and infiltration to groundwater as per the existing drainage regime at the site. Interceptor drains will be installed as part of the construction phase.

Where interceptor drains have a gradient of greater than 2%, crushed rock 'check dam' structures will be installed at regular intervals to reduce the velocity of the flows and prevent erosion.

10.6.3 Existing Tracks and Surfaced Access Roads

Existing access tracks are generally drained by adjacent drainage ditches and swales. These drainage features will be retained and upgraded where necessary to the same standard as the proposed drainage design. Where existing tracks are widened, existing drainage will be realigned or replaced. The replacement sections of drain shall have a similar gradient and width as existing channels to ensure the flow rate and capacity of the existing channel is retained and adequate for the contributing area.

All track widening will be undertaken using clean, uncrushable aggregate to allow for some dispersal of surface water runoff via infiltration and, therefore, reduce the rate of surface water runoff generated.

10.6.4 New Main Wind Farm Site Access Tracks and Hard Surfaces

The proposed internal access tracks will also generally be constructed using unbound aggregate materials which will allow a portion of surface water runoff to disperse via infiltration.

Vegetated swales will be installed adjacent to new access tracks and areas of hardstanding. These swales will be 0.3m in depth with 1 in 3 side slopes. Swales will be installed downslope of access tracks and hardstandings where coincident with the topography and will provide some attenuation for the surface water runoff during storm events.

Geotextile silt traps will be installed across the swales during the construction phase to prevent the ingress of silt into the watercourse and will remain in place until the vegetation has been established.

Where swales are constructed on slopes of greater than 2%, check dams will be installed at regular intervals to reduce flow velocities. By reducing flow rates, the check dams can also provide upstream storage within the swale allowing some dispersal via infiltration close to source rather than conveying all flows to a single larger downstream drainage feature, in accordance with the principals of SuDS.

Settlement ponds (Section 10.10.4) will be installed as construction progresses in order to provide mitigation during construction works, and will be designed in accordance with Ciria C648 (Control of water pollution from linear construction projects). Ponds will be less than 1.5m deep with 1 in 3 side slopes. Runoff from roads and infrastructure within the proposed swale networks will be discharged to these ponds and will be temporarily retained to allow for the settlement of sediment and suspended solids. During the construction phase, standing water from excavations will be pumped to settlement ponds and there will be no direct discharge to the existing drainage network prior to treatment.

Settlement ponds will not discharge directly to watercourses. Treated water will be discharged diffusely via an outfall to disperse via overland flow or into natural drainage features as per the existing regime. Discharge will be restricted to a rate at or below the existing greenfield runoff rate during storm events, and the ponds will be sized to accommodate flows for all storm events up to and including the 1 in 100 year event.

The settlement ponds will also contain surface water runoff in the event of a spill or leak, and the outflow can be closed off to retain any potential pollutants within the settlement ponds prior to any necessary treatment.

10.6.5 Drainage of Temporary Site Compounds

The proposed construction compounds will be drained in a similar manner as the wind farm site, with surface water runoff from undeveloped areas intercepted and dispersed naturally, and surface water runoff from areas of hardstanding intercepted by swales and conveyed to settlement ponds. Surface water runoff from the compound area will be directed through a Class 1 Full Retention Oil Interceptor before discharge to the surface water drainage network.

There will be no discharge of foul flows from welfare units, with water retained in holding tanks and removed from site by a contractor.

10.6.6 Drainage of Substation

The substation will be drained via an underground piped surface water drainage network. The network will also utilise linear drainage channels and filter drains.

The network will discharge overland via a Class 1 Full Retention Oil Separator at a restricted greenfield rate. Attenuation for flows exceeding this rate will be provided within an underground tank.

In accordance with SuDS best practice, it is proposed to include a rainwater harvesting tank. Rainwater will be filtered and stored within the underground tank for reuse.

There will also be no discharge of foul flows from welfare units within the substation, with water stored in tanks and removed from site by a contractor.

10.6.7 Proposed Watercourse Crossings

There will be ten watercourse crossings within the wind farm site, two of which will involve the crossing of an EPA mapped river waterbody (Black (O'Briensbridge) Stream). The remaining crossings shall comprise the crossing of 1 no. unmapped stream and 7 no. agricultural/forestry drains. It is proposed to install one single-span bridge and nine box culvert crossings. Crossings will be designed in accordance with National Roads Authority guidance 'Guidelines for the Crossing of Watercourses During the Construction of National Road Schemes', with clear span bridges being the preferable type of water crossing, with box culverts and piped culverts used where a bridge would not be feasible. Reference numbers and locations of the crossings are included in Table 10-11 below.

Table 10-11: Proposed Watercourse Crossings

Reference	Grid Ref X	Grid Ref Y	Type of Crossing
WCC-WF001 (Channel upstream of EPA-mapped stream (Broadford)	563088.0793	670422.6438	Box Culvert
WCC-WF005 (Black (O'Briensbridge) Stream Crossing)	564133.332	669570.2913	Bridge
WCC-WF006 (Agricultural drain)	563356.7725	670277.8517	Box Culvert
WCC-WF008 (Forestry drain)	564409.1668	670315.5322	Box Culvert
WCC-WF009 (Forestry drain)	564409.6952	670304.5098	Box Culvert
WCC-WF010 (Forestry drain)	564287.5751	670210.6102	Box Culvert
WCC-WF011 (Forestry drain)	564253.495	670131.03	Box Culvert
WCC-WF012 (Black (O'Briensbridge) Stream Crossing)	564095.0638	670481.0743	Box Culvert
WCC-WF013 (Forestry drain)	564325.6279	670560.9296	Box Culvert
WCC-WF014 (Unmapped stream)	564447.4545	670614.7786	Box Culvert

A cross section of a single-span bridge is included as Figure 10-7. The level of the bridge will provide sufficient freeboard to allow for the 1 in 100 year (+20%) fluvial flood level. The crossing shall also be sized to convey the flow from 1 in 100 year (+20%) flood event unobstructed.

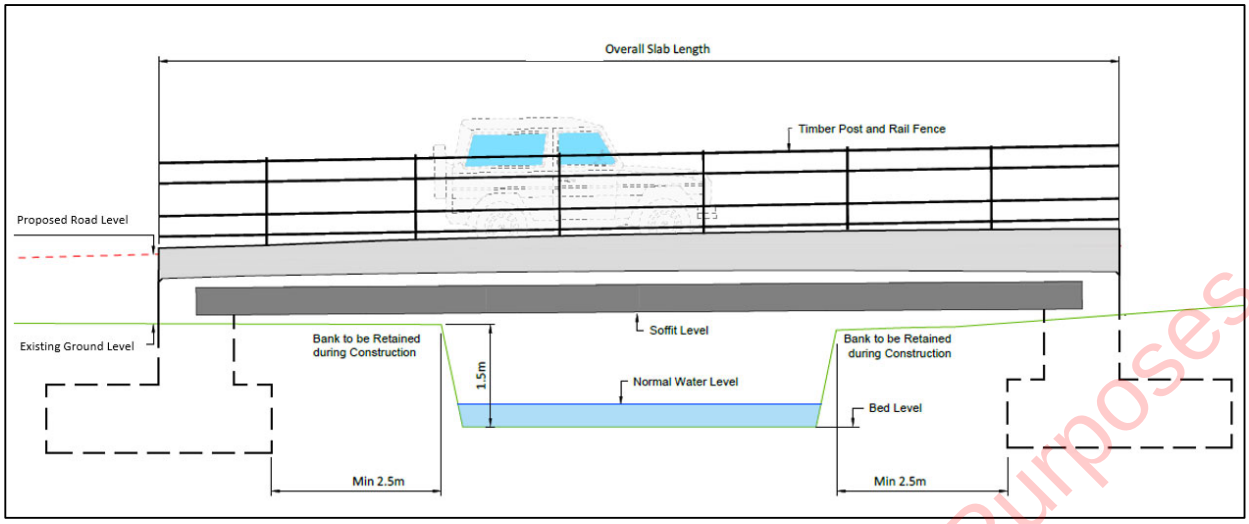

Figure 10-7: Single-Span Bridge Cross Section

Box culverts will be used at the remaining 9 no. crossings identified during site walkovers, where a piped culvert would not be sufficient. These will also be sized to accommodate the 1 in 100 year (+20%) flood flow. A cross section of a box culvert is shown in Figure 10-8 below. Box culverts will be installed a minimum of 500mm into the stream bed in accordance with the NRA guidelines.

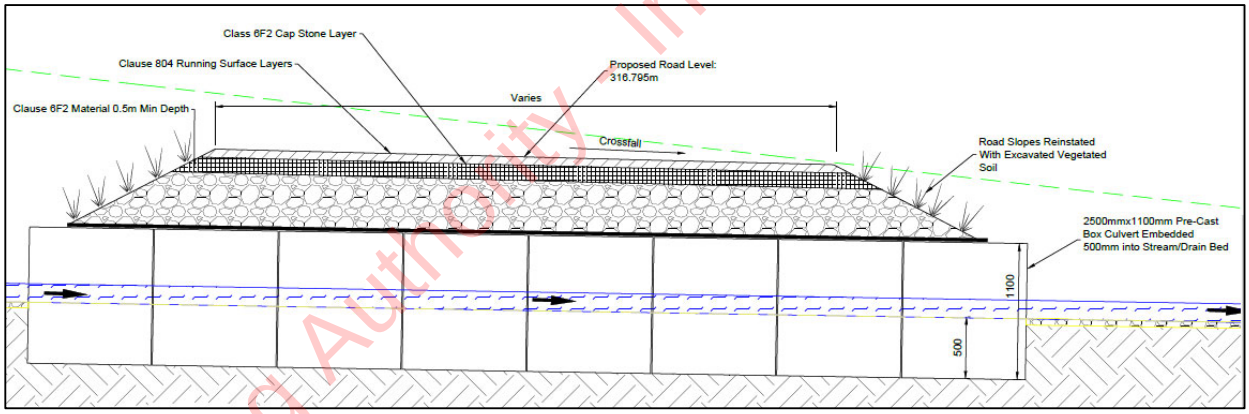

Figure 10-8: Box Culvert Cross Section

It is proposed that any additional minor drains within the site will be crossed using piped culverts. Piped culverts will only be used over very short stretches i.e. at track crossings. Pipe culverts will be sized to take the 1 in 100-year flood flow with a 20% allowance for Climate Change. Concrete or HDPE pipes may be used depending on the size of the watercourse to be crossed. Refer to the CEMP in Appendix 3.2 for further details.

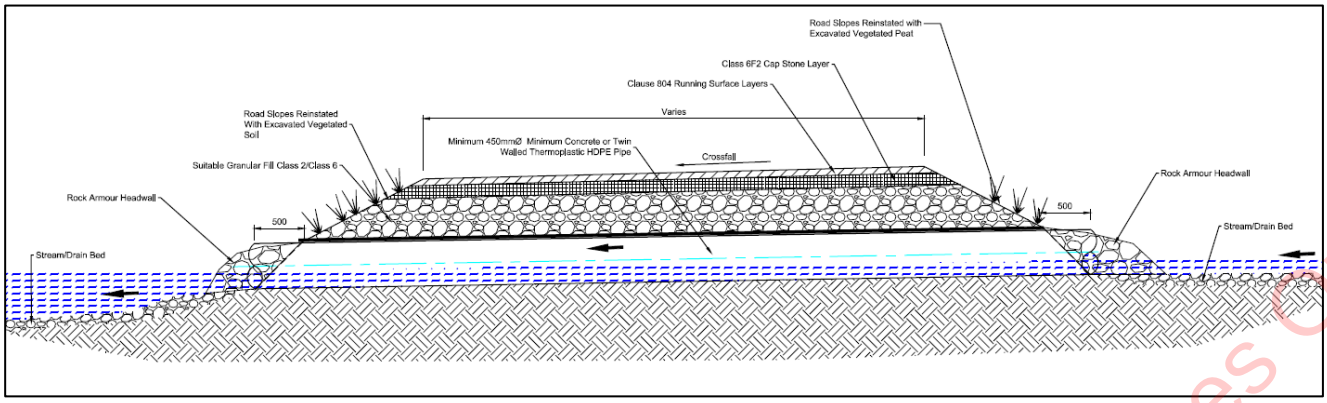

Figure 10-9: Piped Culvert Crossing Long Section

With suitably sized piped culvert and box culvert crossings, and a suitably-designed bridge, there will be no impact on flows within watercourses and the risk of flooding will not be increased as a result of the proposed development.

10.7 Proposed Mitigation Measures

10.7.1 Overview

The proposed surface water drainage strategy and construction techniques will also provide mitigation to ensure that there is no impact on water quality downstream of the site as a result of the proposed development.

The surface water management plan will include a Surface Water Quality Monitoring Programme. Monitoring will be undertaken at least 12 months prior to construction commencing to enable baseline conditions of surface water quality to be locally well established on the surface water receptors. This will be undertaken in co-ordination with aquatic ecology surveys to understand the baseline biodiversity.

Surface water sampling will be carried out to establish a baseline for water quality for the receiving waters of the proposed wind farm and GCR. Water sampling will be coordinated with the aquatic ecological assessment to ensure comparability. Regarding acceptable water quality, as guidance, European Communities Environmental Objectives (Surface Water) Regulations S.I. 272 of 2009, (EOSWR 272/09) thresholds are shown in Table 10-12.

The following parameters will be measured in order to provide a comprehensive baseline of the biological water quality:

- pH.
- Alkalinity (mg $CaCO_3$/l).
- Total Ammonia (mg N/l).
- Molybdate Reactive Phosphorus MRP (mg P/l).
- Total Oxidised Nitrogen TON (mg N/l).
- Dissolved Organic Carbon DOC (mg C/l).
- Biological Oxygen Demand BOD (mg O_2/l).
- Chemical Oxygen Demand COD (mg O_2/l).
- Suspended solids (mg/l).

Table 10-12: Acceptable Chemical Conditions (European Communities Environmental Objectives (Surface Water) Regulations S.I. 272 of 2009, (EOSWR 272/09))

Parameter	Threshold Values (mg/L)
BOD	High status ≤ 1.3 (mean)
	High status ≤ 2.2 (95%ile)
	Good status ≤ 1.5 (mean)
	Good status ≤ 2.6 (95%ile)
Total Ammonia	High status ≤ 0.040 (mean)
	High status ≤ 0.090 (95%ile)
	Good status ≤ 0.065 (mean)
	Good status ≤ 0.14 (95%ile)
Molybdate Reactive Phosphorus (mg/l P)	High Status < 0.025 (mean) or <0.045 (95%ile) Good Status <0.035 (mean) or < 0.075 (95%ile)

10.7.2 Proposed Mitigation Measures for the Construction Stage

Best practice construction methods will be used during the construction stage to minimise impacts on water quality. Further mitigation measures for key parts of the construction phase are identified below. These are outlined in more detail in the Construction Environmental Management Plan CEMP (Chapter 3 Appendix 3.1). Regarding good practice associated with mitigating the risk of hydrocarbon release during construction, as stated in the SWMP, construction vehicles will be refuelled off-site, wherever possible. This will primarily be the case for road vehicles such as vans and trucks. Refuelling of mobile plant during construction will be carried out at the temporary compound. Any additional fuel containers, other than the fuel bowser, used for smaller equipment (such as generators, lights etc.) will be stored within additional secondary containment e.g. bund for static tanks or drip trays for smaller mobile containers. Taps/nozzles for fuels and storage containers for oils will be fitted with locks to ensure their use is controlled. Only designated trained and competent operatives will be authorised to refuel plant on site.

All tank and drum storage areas shall, as a minimum, be bunded, either locally or remotely, to a volume not less than the greater of the following:

a. 110% of the capacity of the largest tank or drum within the bunded area; or
b. 25% of the total volume of substance which could be stored within the bunded area.

Despite the area of the site delineated by the boundary, the footprint of the infrastructure and associated buffer of land changed on site is significantly less. This means the vast majority of the site will remain as its current land use. For instance, regarding the foundations of each turbine, each foundation is circular, with relatively narrow (25 m) diameter and (3.5m) depth. This is an inherent mitigation in design.

10.7.2.1 Instream works

The following methodology shall be applied at all locations where instream works are required:

- Construction machinery operating in-stream should be mechanically sound to avoid leaks of oils, hydraulic fluid;
- All equipment or machinery to be used in the water will be sprayed and cleaned with disinfectant.

10.7.2.1.1 Temporary Stream Diversions

If temporary diversion channels are necessary, the channel will be non-eroding, of similar width to the natural channel. This will be designed in accordance with NRA guidelines and compliant with the following:

- A minimum 10 meter vegetative buffer zone will be maintained between disturbed areas and the water body. There will be no storage of material/equipment, excavated material or overnight parking of machinery inside the 10m buffer zone;
- Double silt fencing will be placed upslope of the buffer zone on each side of the water body;
- Bog mats will be used underneath excavators inside the 10 meter vegetative buffer zone to prevent soil erosion and potential water quality impacts from localised surface water runoff;
- There will be no batching of concrete within 100m of the watercourse;
- Once reinstated, the channel will be re-seeded as soon as possible and silt fencing will be left in place until the area has re-vegetated.

10.7.2.1.2 Watercourse Crossings

For minor watercourse and drain crossings within the site, the following methodology will be used:

- Work will not be undertaken during periods of high rainfall. This will minimise the risk of entrainment of suspended sediment in surface water runoff and transport via this pathway to surface water bodies
- Where there is a requirement to disturb either the bed or bank the watercourse will be dammed upstream and diverted prior to work commencing;
- A temporary berm will be placed along the edge of the track/road to prevent loose material being dislodged or washed into the water body;

10.7.2.2 Clear Span Bridges

The construction methodology for clear span bridges is detailed as follows:

- Excavation near riverbanks is required to install and secure pre-cast concrete abutments;
- Abutments will be set back 2.5m from 1 in 100-year event;
- Dry working conditions at these sites will be maintained by retaining the existing bank and using a short section of sandbags in a cofferdam style formation on the stream side of the working area. The sandbag screen will prevent any soil from excavations from falling into stream.

10.7.2.3 Horizontal Directional Drilling

HDD will be employed at 4 no. locations along the GCR in accordance with the following methodology:

- The depth of the bore should be at least 3m below the level of the public road and stream bed so as not to conflict with the road drainage and watercourse;
- Inert, biodegradable drilling fluid will be used;
- There will be no refuelling within 50m of the watercourse.

10.7.2.4 Proposed Mitigation Measures GCR Cable Installation

Good industry practice such as pollution prevention measures as detailed in Pollution Prevention Guidelines / Guidance for Pollution Prevention (PPG/GPP) PPG1, GPP21 and GPP22 will be implemented and will reduce the risk and the overall impact if a spill or leakage were to occur.

10.7.2.5 Proposed Mitigation Measures for Tree Felling

To ensure a tree clearance method that reduces the potential for sediment and nutrient runoff, the construction methodology will follow the specifications set out in the Forest Service Forestry and Water Quality Guidelines (2000) and Forest Harvesting and Environmental Guidelines (2000).

In this regard, before any felling works commence on site all personnel, particularly machine operators, will be made aware of the following and will have copies of relevant documentation, including:

- The felling plan, surface water management, construction management, emergency plans and any contingency plans;
- Environmental issues relating to the site;
- The outer perimeter of all buffer and exclusion zones;
- All health & safety issues relating to the site.

The proposed tree felling around proposed 'infrastructure' will be limited to:

- 20m wide corridors for new and upgraded access tracks;
    - Felling Corridors around higher value woodland has been reduced to 10 m to protect as much woodland as possible.
- Outer footprint of turbine hardstandings including an additional 10m offset from same;
- Outer footprint of temporary compound;
- Outer footprint of onsite substation compound including an additional 10m offset from same;
- 6m corridor for buried cables in private lands;
- 82.2 m radius around each turbine tower located in forestry for bat impact mitigation;
- 25m radius around the footprint of on-site meteorological mast

10.7.2.6 Proposed Mitigation Measures for Turbine Delivery

Good industry practice such as pollution prevention measures detailed in Pollution Prevention Guidelines / Guidance for Pollution Prevention PPG1 (Pollution prevention), GPP21 (Pollution incident response planning) and GPP22 (Dealing with Spills) will reduce the risk and the overall impact if a spill or leakage were to occur.

10.7.3 Proposed Mitigation Measures for Operation and Maintenance Stage

The proposed surface water management plan (SWMP, included in Appendix 10.2) will ensure that there is no impact on water quality as a result of the proposed development. The proposed drainage system will provide several stages of treatment to surface water runoff from constructed areas, which follows the concept of a multi-stage SuDS 'treatment train'.

Interceptor drains installed upslope of access tracks and areas of hardstanding will divert surface water runoff from undeveloped land around the constructed areas to disperse naturally within open ground without mixing with the construction drainage.

The proposed swales will intercept surface water runoff from access tracks and areas of hardstanding. The grass within the swales will provide some filtration to remove a portion of silt and suspended solids. Silt traps will be provided upstream of outfalls from roadside swales.

The settlement ponds will be designed to provide sufficient retention time and a low velocity environment to allow suspended solids of a very small particle size to fall out of suspension prior to discharge. Additional treatment will be provided upstream of the settlement pond with the use of drainage stone at the inlet to provide filtration. In an emergency, the outfall from a settlement pond will be blocked to provide a temporary holding area for accidental spillages on site.

As stated in the SWMP, to adhere to CIRIA C753, part of the maintenance routine that will mitigate issues relating to surface water will be the inspection of the following: drains, cross-drains and culverts for blockages; outfalls to existing field drains and watercourses, existing roadside swales for obstructions; progress of re-vegetation.

The water quality will also be tested at outfalls at a minimum frequency of monthly for 12 months to comprise the baseline monitoring regime pre-construction.

10.7.4 Proposed Mitigation Measure for Decommissioning Stage

The access tracks will remain in situ for land management purposes, after the end of the operational period. Additionally, the turbine foundations and hardstanding will remain in situ and be covered over with soil from the site to re-vegetate naturally. This inherently mitigates disturbance through decommissioning process. Silt protection procedures, similar to during construction will be re-instated for decommissioning. If there is perceived to be risk of erosion during inspection of the revegetated hardstandings then erosion control measures will be taken.

10.7.5 Proposed Mitigation Measures for Flooding

The proposed turbine bases, new access tracks, widened existing access tracks and new compound areas will all increase the impermeable area within the site potentially increasing the rate and volume of surface water runoff during storm events.

All access tracks will be constructed from aggregate which will allow a portion of rainfall to infiltrate and, therefore, reduce surface water runoff. Adjacent swales will also intercept and retain surface water runoff allowing this to disperse naturally via infiltration and evapotranspiration. Where swales are installed on sloped ground, check dam structures will be used within the channels to provide storage, allowing a portion of the flows to disperse naturally.

Swales and drainage channels will discharge runoff from access roads and areas of hardstanding to settlement ponds. These will be suitably sized to accommodate flows from storm events up to and including the 1 in 100-year storm event.

Settlement ponds will not discharge to a watercourse and flows from the ponds will disperse naturally within the catchment.

Watercourse crossings will be suitably sized to accommodate flows during the 1 in 100-year storm event, with no risk of impeding flows during extreme storm events and causing flooding upstream of the crossing.

The cable trenches will be excavated in dry weather where possible and infilled and revegetated if required to prevent soil erosion or generation of silt pollution of nearby surface water. There will, therefore, be no increase in the risk of flooding.

The surface water management system at the site will ensure that there will be no increase in the risk of fluvial or surface water flooding downstream as a result of the windfarm development.

10.8 Residual Impacts

10.8.1 Residual Impacts during Construction Stage

As discussed in Section 10.4, the potential pre-mitigation impacts associated with construction of the eight turbines and associated infrastructure at the wind farm site, GCR and TDR are as follows:

- Increased surface runoff from change in surface.
- Release of suspended solids into surface water bodies via runoff from disturbed ground and tree felling.
- Release of cement-based products into surface water bodies via runoff.
- Release of hydrocarbons, such as fuel into surface water bodies via runoff.
- Contamination from wastewater such as temporary sanitary storages.

The potential pre-mitigation impacts associated with laying of the cable for GCR are as follows:

- Release of suspended solids into surface water bodies via runoff.
- Release of hydrocarbons, such as fuel into surface water bodies via runoff.

The effect of the impacts on hydrology and water quality will be mitigated with measures outlined in Section 10.7. This will ensure that the residual impacts of the construction stage are **Not significant** and there will be no perceivable impact on the Lower Shannon River SAC or the Doon Lough NHA, which are highly sensitive receptors that are hydrologically connected to the wind farm site, GCR and TDR. Furthermore, the Proposed Development will not result in the deterioration of the status of any water body under the WFD or jeopardise the achievement of good status of any such water body.

10.8.2 Residual Impacts during Operation and Maintenance Stage

The unmitigated potential impact during the operational phase of the site was not significant. Visual monitoring and water quality monitoring at appropriate intervals should be undertaken as precautionary measures to inform any required contingency mitigation measures during operation. The main risk to surface water is the release of hydrocarbons, such as fuel into surface water bodies via runoff. The residual risk is **Not Significant.**

10.8.3 Residual Impacts during Decommissioning Stage

The unmitigated potential impact during decommissioning is similar, although less than during the construction including:

- Increased surface runoff from change in surfaces to hardstandings and other impermeable surfaces.
- Release of suspended solids from ground disturbance when covering hardstandings with soil.
- Release of hydrocarbons, such as fuel into surface water bodies via runoff.
- Contamination from wastewater such as temporary sanitary storages.

Mitigated with measures outlined in Section 10.7 will ensure that the residual impacts of the construction stage are **Not significant** and there will be no perceivable impact on the Lower Shannon River SAC or the Doon Lough NHA, which are highly sensitive receptors that are hydrologically connected to the wind farm site.

10.9 Conclusion

The existing risk of flooding to the windfarm site, GCR and turbine delivery route will be minimal. The windfarm site is not located within an area at risk of fluvial flooding. Where the cable route crosses larger watercourses, this will be done by horizontal directional drilling with no open sections of trench which could be inundated by a flooding event. Any surface water flooding occurring along the turbine delivery route would cause only minimal disruption. The site is not located in an area of groundwater flooding risk and the sloped topography means there would be few locations where large volumes of surface water runoff could accumulate.

Any increases in surface water runoff as a result of additional impermeable areas within the site will be managed at all stages of development by a surface water drainage network incorporating swales, drainage channels and settlement ponds. The network will be designed to retain high flows during storm events and allow these to disperse naturally, with no uncontrolled discharge to downstream areas.

The drainage features will also provide water quality benefits during all stages of works allowing for the filtration and settlement of suspended solids and a means of isolating runoff from pollution incidents.

The residual and cumulative impacts of the proposed development are overall **Not significant**. This will be achieved with the proposed mitigation measures detailed in Section 10.7.

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